CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY

(Autonomous)

Kokapet (Village), Gandipet, Hyderabad, Telangana – 500075

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1.1.3 Average percentage of courses having focus on employability/ entrepreneurship/ skill development offered by the institution during the last five years

1.1.3.1 Number of courses having focus on employability/ entrepreneurship/ skill development year-wise during the last five years.

Year	2021-22	2020-21	2019-20	2018-19	2017-18
Number	1166	1106	985	922	984

List of courses courses having focus on employability/ entrepreneurship/ skill development offered by the institution during 2017 - 18 from S. No. 4188 - 4560

S.No	Course Name	Code
4188	Engineering Mathematics - I	16MT C01
4189	Engineering Chemistry	16CY C01
4190	Applied Physics	16PY C02
4191	Programming and Problem Solving	16CS C01
4192	Elements of Mechanical Engineering	16ME C01
4193	Elements of Electronics and Communication Engineering	16EC C01
4194	Professional Ethics and Human Values	16CE C03
4195	Programming Laboratory	16CS C02
4196	Mechanical and IT Workshop	16ME C03
4197	Applied Physics Laboratory	16PY C04
4198	Engineering Chemistry Laboratory	16CY C03
4199	Engineering Mathematics - II	16MT C02
4200	Engineering Physics	16PY C01
4201	Applied Chemistry	16CY C02
4202	Elements of Electrical Engineering	16EE C01
4203	Engineering Mechanics	16CE C01
4204	Professional Communication in English	16EG C01
4205	Environmental Studies	16CE C02
4206	Engineering Graphics	16ME C02
4207	Engineering Physics Laboratory	16PY C03
4208	Applied Chemistry Laboratory	16CY C04
4209	Professional Communication Laboratory	16EG C02
4210	Engineering Mathematics-III	16MT C05
4211	Material Science and Metallurgy	16ME C04
4212	Mechanics of Materials	16ME C05
4213	Fluid Dynamics	16ME C06
4214	Machine Drawing	16ME C07
4215	Engineering Economics and Accountancy	16MB C01
4216	Material Science and Metallurgy Lab	16ME C08
4217	Mechanics of Materials Lab	16ME C09

4218	Computer Drafting Lab	16ME C10
4219	Kinematics of Machines	16ME C14
4220	Thermodynamics	16ME C15
4221	Hydraulic Machinery and Systems	16ME C16
4222	Manufacturing Processes	16ME C17
4223	Electrical Machines and Microcontroller Applications	16EE C14
4224	Hydraulic Machinery and Systems Lab	16ME C18
4225	Manufacturing Processes Lab	16ME C19
4226	Soft Skills and Employability Enhancement Lab	16EG C03
4227	Dynamics of Machines	ME 311
4228	AppliedThermodynamics	ME 312
4229	Manufacturing Processes	ME 313
4230	Heat Transfer	ME 314
4231	Design of Machine Elements	ME 315
4232	Human Values and Professional Ethics	CE 444
4233	Dynamics & Vibrations Lab	ME 316
4234	Thermodynamics Lab	ME 317
4235	Manufacturing Processes Lab	ME 318
4236	CAD and CAM	ME 321
4237	Metal Cutting & Machine Tool Engineering	ME 322
4238	Hydraulic Machinery & Systems	ME 323
4239	Refrigeration & Air Conditioning	ME 324
4240	Machine Design	ME 325
4241	Control Systems Theory	ME 351
4242	Additive Manufacturing	PE 324
4243	Human Rights & Legislative Procedure	ME 555
4244	Value Engineering	PE 353
4245	Surface Engineering	PE 354
4246	Mechanical Vibrations	ME 353
4247	CAD and CAM Lab	ME 326 -
4248	Metal Cutting & Machine Tool Engineering Lab	ME 327
4249	Hydraulic Machinery & Systems Lab	ME 328
4250	Industrial Visit	ME 329
4251	Thermal Turbo Machines	ME 411
4252	Metrology and Instrumentation	ME 412
4253	Finite Element Analysis	ME 413
4254	Operations Research	ME 414
4255	Renewable Energy Sources	ME 461
4256	Computational Fluid Dynamics	ME 462
4257	Automobile Engineering	ME 463
4258	Entrepreneurship	ME 464
4259	Robotics	PE 461
4260	Disaster Mitigation and Management	CE 461
4261	Thermal Engineering Lab	ME 415
4262	Metrology and Instrumentation Lab	ME 416
4263	Computer Aided Engineering Lab	ME 417
4264	Project Seminar	ME 418

4265	Industrial Administration and Financial Management	ME 419
4266	Production and Operations Management	ME 421
4267	Production Drawing	ME 422
4268	Power Plant Engineering	ME 471
4269	Intellectual Property Rights	ME 472
4270	Mechatronics	ME 473
4271	Mechanics of Composite Materials	ME 474
4272	Supply Chain Management	ME 475
4273	Manufacturing Systems and Simulation	PE 471
4274	Modern Machining and Forming Methods	PE 412
4275	Micro Manufacturing	PE 481
4276	Non - Destructive Testing and Evaluation	PE 482
4277	Product Design and Process Planning	PE 483
4278	Nano Materials and Technology	PE 484
4279	Information Security	CSE 481
4280	Seminar	ME 423
4281	Project	ME 901
4282	Engineering Mathematics - I	16MT C01
4283	Engineering Chemistry	16CY C01
4284	Applied Physics	16PY C02
4285	Programming and Problem Solving	16CS C01
4286	Elements of Mechanical Engineering	16ME C01
4287	Elements of Electronics and Communication Engineering	16EC C01
4288	Professional Ethics and Human Values	16CE C03
4289	Programming Laboratory	16CS C02
4290	Mechanical and IT Workshop	16ME C03
4291	Applied Physics Laboratory	16PY C04
4292	Engineering Chemistry Laboratory	16CY C03
4293	Engineering Mathematics - II	16MT C02
4294	Engineering Physics	16PY C01
4295	Applied Chemistry	16CY C02
4296	Elements of Electrical Engineering	16EE C01
4297	Engineering Mechanics	16CE C01
4298	Professional Communication in English	16EG C01
4299	Environmental Studies	16CE C02
4300	Engineering Graphics	16ME C02
4301	Engineering Physics Laboratory	16PY C03
4302	Applied Chemistry Laboratory	16CY C04
4303	Professional Communication Laboratory	16EG C02
4304	Engineering Mathematics-III	16MT C05
4305	Material Science and Metallurgy	16ME C04
4306	Mechanics of Materials	16ME C05
4307	Fluid Dynamics	16ME C06
4308	Machine Drawing	16ME C07
4309	Engineering Economics and Accountancy	16MB C01
4310	Material Science and Metallurgy Lab	16ME C08
4311	Mechanics of Materials Lab	16ME C09

4312	Computer Drafting Lab	16ME C10
4313	Kinematics of Machines	16ME C14
4314	Thermodynamics	16ME C15
4315	Metal Casting and Welding	16PE C01
4316	Metal Forming Technology	16PE C02
4317	Electrical Machines and Microcontroller Applications	16EE C14
4318	Metal Casting and Welding Lab	16PE C03
4319	Metal Forming Technology Lab	16PE C04
4320	Soft Skills and Employability Enhancement Lab	16EG C03
4321	Dynamics of Machines	ME 311
4322	Applied Thermodynamics &Heat Transfer	PE 313
4323	M/c Tool Engineering	ME 314
4324	Design of Machine Elements	ME 315
4325	Computer Aided Engineering	PE312
4326	Additive Manufacturing	PE 314
4327	Dynamics & Vibrations Lab	ME 316
4328	M.c Tool Engineering and CAM lab	PE 315
4329	Applied Thermodynamics &Heat Transfer lab	PE316
4330	Metal Forming Technology	PE 321
4331	CAD/FEM	PE 322
4332	Metal Casting & Welding	PE 323
4333	Machine Design	ME 325
4334	Turbo Machinery	PE 351
4335	Human Rights & Legislative Procedure	ME 352
4336	Value Engineering	PE 353
4337	Mechanical Vibrations	ME 353
4338	Refrigeration & Air Conditioning	ME 324
4339	Control Systems Theory	ME 351
4340	Metal Forming Technology Lab	PE 324
4341	CAD/FEM Lab	PE 325
4342	Metal Casting & Welding Lab	PE 326:
4343	Industrial Visit/Summer Internship	PE 327
4344	Production Drawing Practice	PE 411
4345	Metrology & Instrumentation	ME 412
4346	Operations Research	ME 414
4347	Modern Machining & Forming Methods	PE 412
4348	Robotics	PE 461
4349	Renewable Energy Sources	ME 461
4350	Computations Fluid Flows	ME 462
4351	Automobile Engineering	ME 463
4352	Entrepreneurship	ME 464
4353	Disaster Mitigation & Management	CE 461
4354	Computer Aided Production Drawing Lab	PE 413
4355	Metrology & Instrumentation Lab	ME 416
4356	Manufacturing Engg. Lab	PE 414
4357	Creative & Innovative Project	PE 415
4358	Production And Operations Management	ME 421

4359	Tool Design	PE 421
4360	Power Plant Engineering	ME 471
4361	Intellectual Property Rights	ME 472
4362	Mechatronics	ME 473
4363	Mechanics of Composite Materials	ME 474
4364	Supply chain Management	ME 475
4365	Manufacturing Systems & Simulation	PE 471
4366	Micro Manufacturing	PE 481
4367	Non Destructive Testing & Evaluation	PE 482
4368	Product Design & Process Planning	PE 483
4369	Nano Materials & Technology	PE 484
4370	Total Quality Management	PE 485
4371	Information Security	CSE 481
4372	Seminar	PE 422
4373	Project	PE 423
4374	Automation	16MEC101
4375	Computer Aided Modeling and Design	16MEC102
4376	Computer Integrated Manufacturing	16MEC103
4377	Failure Analysis and Design	16MEE101
4378	Engineering Research Methodology	16MEE107
4379	Theory of Elasticity and Plasticity	16MEE111
4380	Integrated Mechanical Design	16MEE102
4381	Robotic Engineering	16MEE103
4382	Programming Methodology and Data Structures	16MEE104
4383	Optimization Techniques	16MEE105
4384	Vibrations Analysis and Condition Monitoring	16MEE106
4385	Tribology In Design	16MEE108
4386	Advanced Mechanics of Materials	16MEE109
4387	CAD/CAM Lab (Lab –I)	16MEC106
4388	Seminar – I	16MEC108
4389	Soft Skills Lab	16EG C104
4390	Computer Aided Mechanical Design and Analysis	16MEC104
4391	Finite Element Techniques	16MEC105
4392	Computational Fluid Dynamics	16MEC205
4393	Mechanics of Composite Materials	16MEE110
4394	Product Design and Process Planning (PDPP) - (Elective)	16MEE 121
4395	Experimental Techniques and Data Analysis	16MEE112
4396	Design for Manufacture	16MEE113
4397	Data Base Management Systems	16MEE114
4398	Fracture Mechanics	16MEE115
4399	Design of Press Tools	16MEE116
4400	Design of Dies	16MEE117
4401	Rapid Prototyping Principles & Applications	16MEE118
4402	Flexible Manufacturing Systems	16MEE119
4403	Non-Traditional Machining & Forming	16MEE120
4404	Computation Lab (Lab –II)	16MEC107
4405	Seminar – II	16MEC109

4406	Mini Project	16MEC110
4407	Project Seminar	16MEC111
4408	Project work	16MEC112
4409	Advanced Thermodynamics	16MEC 202
4410	Advanced Heat & Mass Transfer	16MEC 203
4411	Advanced I.C. engines	16MEC 204
4412	Thermal & Nuclear Power Plants	16MEE 215
4413	Computer Aided Graphics and Design	16MEE201
4414	Engineering Research Methodology	16MEE107
4415	Design of Gas Turbines	16MEE 205
4416	Advanced Energy Systems	16MEE 206
4417	Fuels and Combustion	16MEE 207
4418	Power Plant Control and Instrumentation	16MEE 208
4419	Design of Pumps and Compressors	16MEE 209
4420	Numerical Methods	16MEE 210
4421	Thermal Systems Laboratory (Lab – I)	16MEC 206
4422	Seminar – I	16MEC 208
4423	Soft Skills Lab	16EG C104
4424	Finite Element Techniques	16MEC 105
4425	Fluid Flow and Gas Dynamics	16MEC 201
4426	Computational Fluid Dynamics	16MEC 205
4427	Optimization Techniques	16MEE 105
4428	Turbo Machines	16ME E 202
4429	Fuels and Combustion	16MEE 207
4430	Fluid Power Systems	16MEE203
4431	Environmental Engineering and Pollution	16MEE 211
4432	Refrigeration Machinery & Components	16MEE 212
4433	Energy Management	16MEE 213
4434	Convective Heat Transfer	16MEE 214
4435	CFD Lab (Lab – II)	16MEC 207
4436	Seminar-II	16MEC 209
4437	Mini Project	16MEC 210
4438	Project Seminar	16MEC 211
4439	Project work	16MEC 212
4440	Mathematics - I	16MT C02
4441	Basics of Biology - I	16BT C01
4442	Elements of Bio-Technology	16BT C02
4443	Professional Communication in English	16EG C01
4444	Professional Communication Laboratory	16EG C02
4445	Mathematics - II	16MT C04
4446	Basics of Biology - II	16BT C03
4447	Programming and Problem Solving	16CS C01
4448	Introduction to Anatomy and Physiology of Humans	16BT C04
4449	Programming Laboratory	16CS C02
4450	Mechanical and IT Workshop	16ME C03
4451	Mathematics-III	16MT C06
4452	Process Principles and Reaction Engineering	16BT C05

4453	Biochemistry	16BT C06
4454	Cell biology	16BT C07
4455	Microbiology	16BT C08
4456	Genetics	16BT C09
4457	Biochemistry Lab	16BT C10
4458	Microbiology Lab	16BT C11
4459	Soft Skills and Employability Enhancement Lab	16EG C03
4460	Chemical and Biochemical Thermodynamics	16BT C12
4461	Molecular Biology	16BT C13
4462	Immunology	16BT C14
4463	Instrumental Methods in Biotechnology	16BT C15
4464	Industrial Biotechnology	16BT C16
4465	Engineering Economics and Accountancy	16MB C01
4466	Immunology Lab	16BT C17
4467	Instrumental Methods in Biotechnology Lab	16BT C18
4468	Biostatistics	MT 311
4469	Fluid Mechanics and Heat Transfer	BT 311
4470	Protein Engineering and Enzyme Technology	BT 312
4471	Bioreaction Engineering	BT 313
4472	Genetic Engineering and rDNA Technology	BT 314
4473	Fluid Mechanics and Heat Transfer Lab	BT 315
4474	Enzyme Technology Lab	BT 316
4475	Genetic Engineering Lab	BT 317
4476	Soft Skills and Employability Enhancement	EG 221
4477	Fermentation Technology	BT 321
4478	IPR, Regulatory Affairs and Clinical Trials	BT 322
4479	Bioinformatics	BT 323
4480	Environmental Biotechnology	BT 324
4481	Mass Transfer Operations	BT 325
4482	Virology	BT 351
4483	Phyto Chemicals and Herbal Products	BT 352
4484	Spectroscopic Analysis of Biomolecules	BT 353
4485	Medical Biotechnology	BT 354
4486	Bioprocess Lab	BT 326
4487	Bioinformatics Lab	BT 327
4488	Mass Transfer Operations Lab	BT 328
4489	Downstream Processing	BT 411
4490	Bioprocess Dynamics and Control	BT 412
4491	Plant Biotechnology	BT 413
4492	Animal Biotechnology	BT 414
4493	Principles and Practice of Management	MB 216
4494	Developmental Biology	BT 461
4495	Cancer Biology	BT 462
4496	Genomics and Proteomics	BT 463
4497	Pharmaceutical Biotechnology	BT 464
4498	Downstream Processing Lab	BT 415
4499	Tissue culture Lab	BT 416

4500	Project Seminar	BT 417
4501	Computer Applications in Bioprocess Industries	BT 421
4502	Bioprocess Economics and Plant Design	BT 422
4503	Molecular Modeling and Drug Design	BT 471
4504	Immunodiagnostics	BT 472
4505	Tissue Engineering	BT 473
4506	Bioprocess Validations and Current good manufacturing Practices	BT 481
4507	Food Biotechnology	BT 482
4508	Nanobiotechnology	BT 483
4509	Entrepreneurship	ME 464
4510	Seminar	BT 423
4511	Project	BT 901
4512	Discrete Mathematics	16MCC101
4513	Computer Programming and Problem Solving	16MCC102
4514	Elements Of Information Technology	16MCC103
4515	Managerial Economics and Financial Analysis	16MBC128
4516	Professional Communication in English	16EGC101
4517	Computer Programming Lab Using C	16MCC104
4518	Elements of Information Technology Lab	16MCC105
4519	Professional Communication Lab	16EGC102
4520	Object Oriented Programming(OOP)	16MCC106
4521	Computer Organization	16MCC107
4522	Software Engineering	16MCC108
4523	Data Structures Using C++	16MCC109
4524	Operations Research	16MCC110
4525	Probability and Statistics	16MTC102
4526	Object Oriented Programming Lab Using Java	16MCC111
4527	Data Structures Lab Using C++	16MCC112
4528	Database Management Systems	16MCC113
4529	Web Technologies	16MCC114
4530	Design and Analysis of Algorithms	16MCC115
4531	Operating Systems	16MCC116
4532	Database Management Systems Lab	16MCC117
4533	Web Technologies Lab	16MCC118
4534	Operating Systems Lab	16MCC119
4535	Organizational Behavior	16MBC04
4536	Human Values and Professional Ethics	16CE C03
4537	Disaster Mitigation and Management	16CE E21
4538	Entrepreneurship	16MEE20
4539	Computer Networks	16MCC120
4540	Data warehousing and Data Mining	16MCC121
4541	Advanced Java Programming	16MCC122
4542	Computer Networks Lab	16MCC123
4543	Data warehousing and Data Mining Lab	16MCC124
4544	Mini Projects	16MCC125
4545	Software Testing	16MCE102
4546	Artificial Neural Networks	16MCE103

4547	Cloud Computing	16MCE106
4548	Software Project Management	16MCE107
4549	Information Security	MC 311
4550	Middleware Technologies	MC 312
4551	Object Oriented System Development	MC 313
4552	Software Testing	MC 361
4553	Mobile Computing	MC 362
4554	Software Project Management	MC 371
4555	Cloud Computing	MC 372
4556	Programming Lab-OOSD	MC 316
4557	Programming Lab- MWT	MC 317
4558	Seminars	MC 318
4559	Project Work	MC 901
4560	Seminar	MC 322

17-18

16MT C01

ENGINEERING MATHEMATICS – I

Instruction	3L + 1T Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	4

Course Objectives:

1. To solve Linear System of Equations using Matrix Methods
2. To Know the Partial Derivatives and use them to interpret the way a function of two variable behaves
3. To analyse the Shape of the Graph of a given Curve
4. To Evaluate Double and Triple integrals of various functions and their significance
5. Formulate and solve the Differential Equations of First Order
6. To know the methods to solve real life problems.

Course outcomes: On the successful completion of this course student shall be able to

1. Solve system of linear equations and identify the Eigen values and Eigen vector in engineering problems
2. Expand and find extreme values of functions of two variables
3. Trace and interpret curve behavior in physical systems
4. Find the areas, volumes and surface of solids revolution
5. Use-differential equations to model engineering phenomena such as circuit theory, networks
6. An ability to solve the problems and interpret it in geometrical approach

UNIT- I

Linear Algebra: Review of Rank & Consistency, Eigen values, Eigen vectors- properties (without proofs). Cayley- Hamilton Theorem (statement only) inverse and powers of a Matrix by Cayley-Hamilton Theorem. Reduction of Quadratic form to Canonical form by linear transformation, rank, positive, negative, definite, semi-definite, index and signature

UNIT- II

Functions of several variables: Partial differentiations, Homogenous function, Euler's theorem, Implicit functions, Jacobins, Taylor"s series in one and two variables, Maxima and Minima for function of two variables with and without constraints

UNIT- III

Differential Calculus: Curvature and Radius of curvature centre of curvature, circle of curvature. Evolutes, involutes and Envelopes, Curve tracing-Cartesian, polar and parametric curves

UNIT- IV

Multiple Integrals: Double Integrals, Triple Integrals, Change of order of Integration, Applications of integration, rectification, areas, volumes and surfaces of solids of revolution in Cartesian coordinates, Centre of Gravity, PAPPUS theorem.

UNIT- V

First order differential equations and its application: Exact differential equations, Orthogonal trajectory's, Electrical circuits, Newtons law of cooling

Text Books:

1. Ervin Kreyszig "Advanced Engineering " 10 Edition, john wiley & sons -publishers
2. A R.K.Jain&S.R.K.Iyenger "Advanced Engineering Mathematics" , 3rd edition, Narosa Publications
3. AlenJaffery "Mathematics for Engineers and Scientists", 6th edition : CRC press, Taylor & Francis Group.(Elsevier),2013

Suggested Reading:

1. Kanti.B.Datta "Mathematical Methods of science and engineering", Aided with MATLAB, .Cengage Learning India Pvt. Ltd, Pratapgang ,New Delhi
2. B.S.Grewal "Higher Engineering Mathematics" , Khanna Publishers
3. William E.Boyce /Richard C.Dip "Elementary differential equations" , 9th Edition

Reddy

PROFESSOR & HEAD
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ENGINEERING CHEMISTRY

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives

The syllabus has sought to fulfill the objective of making the student of engineering and technology realize that chemistry is the real base of his profession and that therefore he must have a good understanding of chemistry before he can use it in his profession.

" the study of chemistry is profitable not only in as much as it promotes the material interest of mankind ,but also because it furnishes us with insight into the wonders of creation , which immediately surround us and with which our existence, life and development, are most closely connected." ----- Justus Von Leibig (German Chemist)

The various units of the syllabus is so designed to fulfill the following objectives.

1. This syllabus helps at providing the necessary introduction of the chemical principles involved and devices in a comprehensive manner understandable to the students aspiring to become practicing engineers.
2. The aim of framing the syllabus is to impart intensive and extensive knowledge of the subject so that students can understand the role of chemistry in the field of engineering.
3. Thermodynamics and Electrochemistry units give conceptual knowledge about spontaneous processes and how can they be harnessed for producing electrical energy and efficiency of systems.
4. Fuels have been taught with a view to give awareness as to materials which can be used as sources of energy
5. To understand importance of analytical instrumentation for different chemical analysis.

Course Outcome

1. This syllabus gives necessary theoretical aspects required for understanding intricacies of the subject and also gives sufficient exposure to the chemistry aspects in different disciplines of engineering
2. The above knowledge also helps students to carry out inter disciplinary research such that the findings benefit the common man.
3. This syllabus imparts a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

UNIT – I

Chemical Thermodynamics : Introduction and definition of the terms, the concept of reversible and irreversible processes, Work done in isothermal and adiabatic processes, Success and limitations of First law of thermodynamics, need for second law of thermodynamics, statements of second law of thermodynamics, Carnot cycle, heat engine and its efficiency, Carnot theorem, concept of Entropy - Entropy changes in reversible and irreversible processes, physical significance of entropy criteria of spontancity in terms of entropy and Gibb's free energy function , Gibb's-Helmholtz equation and applications, Numericals.

UNIT – II

Phase rule & Chemical Equilibria

Phase rule : Statement , definition of the terms - phases, components , degrees of freedom with examples, Phase diagram - one component system (water system), two component system (siver-lead system) , desilverisation of lead.

Chemical Equilibria - Homogenous and Heterogenous Equilibria - applications

UNIT – III

Fuels: Classification, requirements of a good fuel, calorific value, types of calorific value, calculation of CV using Dulong's formula, Combustion - calculation of air quantities by weight and volume, Numericals.

Solid fuels: coal - analysis of coal – proximate and ultimate analysis - importance.

Liquid fuels - crude oil - fractional distillation, cracking - Fixed bed catalytic cracking, knocking, antiknocking agents (TEL, MTBE), octane number, cetane number, unleaded petrol.

Gaseous fuels - LPG, CNG - composition and uses

UNIT – IV

Electrochemistry Introduction, construction of electrochemical cell, sign convention, cell notation, cell emf, SOP and SRP, electrochemical series and its applications, Nernst equation and applications, Types of Electrodes - Standard Hydrogen Electrode, Saturated Calomel Electrode, Quinhydrone electrode and Ion selective electrode (Glass electrode), construction, Numericals

UNIT –V

Instrumental Techniques in Chemical Analysis: Principle, method and applications of Conductometry (acid-base titration), Potentiometry (acid-base, redox titration), pH- metry (acid – base titration), Colorimetry (Beer Lambert's law)

Green Chemistry - outlines and Principles

Text Books:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Pub, Co., New Delhi (2002)
2. Puri & Sharma, "Principles of Physical Chemistry
3. S.S.Dara & S.S.Umare, "Engineering Chemistry", S.Chand company
4. J.C. Kuriacose & J. Rajaram, "Chemistry in engineering and Technology", Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
5. B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
6. P.R.Vijayasarathi, "Engineering Chemistry" PHI Learning Private Limited, New Delhi (2011)

Suggested Reading:

1. Physical chemistry by P.W.Atkin (ELBS OXFORD PRESS)
2. Physical chemistry by W.J.Moore (Orient Longman)
3. Physical Chemistry by Glasstone
4. Physical Chemistry by T.Engel & Philip Reid, Pearson Publication.
5. B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd.,Meerut (2001).

16PY C02

APPLIED PHYSICS

Instruction	2L Periods per week
Duration of End Examination	2 Hours
End Examination	50 Marks
Sessional	20 Marks
Credits	2

Course Objectives: The objectives of the course is to make the student
1. Learn the concepts of modern physics
2. Gain knowledge of wave mechanics and statistical mechanics
3. Know the different kinds of materials and their characterization techniques

Course Outcomes: At the end of the course, the student will be able to
1. Understand the advances in laser physics, holography, optical fibers and apply them in engineering & technology
2. Explain the importance of wave mechanics and band theory of solids
3. Analyze and apply distributions of statistical mechanics for problem solving
4. Identify the materials with semiconducting and superconducting properties for engineering applications
5. Understand the role of novel materials and their characterization techniques in engineering and technology

UNIT – I

Lasers &Holography: Characteristics of lasers – Spontaneous & stimulated emission of radiation – Einstein's coefficients – Population inversion – Lasing action – He-Ne laser – Semiconductor laser – Applications. Basic principle of Holography – Recording & Reconstruction of hologram – Applications

Optical Fibers: Principle and Construction – Propagation of light through an optical fibre – Acceptance angle – Numerical aperture – Pulse dispersion – Classification of optical fibers: Single mode & Multi mode and Step-index & Graded-index optical fibers – Double crucible method – Applications.

UNIT – II

Wave Mechanics: Schrödinger time independent and time dependent wave equations – Physical significance of wave function – Infinite square well potential (particle in a box) – Potential barrier – Tunneling effect .

Band Theory of Solids: Origin of energy band formation – Electron in periodic potential – Kronig-Penny model (qualitative) – Classification of solids

UNIT – III

Elements of Statistical Mechanics: Maxwell-Boltzmann statistics – Bose-Einstein statistics – Fermi-Dirac statistics – Photon gas – Planck's' law of black body radiation – Wien's law and Rayleigh-Jean's law from Planck's law – Concept of electron gas (qualitative) – Fermi energy level.

UNIT – IV

Semiconductors: Intrinsic and extrinsic semiconductors – Carrier concentration in intrinsic semiconductors – Energy gap – Hall Effect – Construction & working of solar cell.

Superconductors: General properties of superconductors – Meissner's effect – Type I and Type II superconductors – BCS theory (qualitative) – Applications.

UNIT – V

Nanomaterials: Properties of materials at reduced size – Surface to volume ratio – Quantum confinement –Preparation of nanomaterials: Bottom-up approach (Sol-gel method) & Top-down approach (Ball milling method) – Elementary ideas of carbon nanotubes – Applications of nanomaterials.

Techniques for Characterization of Materials: X-ray fluorescence – Auger (OJ) process – Scanning electron microscope (SEM) – Tunneling electron microscope (TEM) – Atomic force microscope (AFM).

Text Books:

1. B.K. Pandey and S. Chaturvedi, "Engineering Physics", Cengage Publications, 2012.
2. M.N. Avadhanulu and P.G. Kshirsagar, "A Text Book Engineering Physics", S. Chand Publications, 2014.
3. Satya Prakash, "Statistical Mechanics", Kedar Nath Ram Nath Publications, 2008.
4. S.L. Gupta and Sanjeev Gupta, "Modern Engineering Physics", Dhanpat Rai Publications, 2011.

Suggested Reading:

1. R. Murugeshan and Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publications S. Chand Publications, 2014.
2. M. Arumugam, "Materials Science", Anuradha Publications, 2015.
3. P.K. Palanisamy, "Engineering Physics", Scitech Publications, 2012.
4. Hitendra K Malik and A.K. Singh, "Engineering Physics", Tata McGraw Hill Education Publications, 2011

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16CS C01

PROGRAMMING AND PROBLEM SOLVING

Instruction	3L + 1T Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	4

Course Objective:

1. To acquire problem solving Skills.
2. To be able to write Algorithms.
3. To understand structured programming Approach.
4. To understand Memory structure.
5. To implement I/O Programming.
6. To be able to write program in C Language.

Course Outcomes: Student will be able to:

1. Develop algorithms for scientific problems.
2. Explore algorithmic approaches to problem solving.
3. Understand the components of computing systems.
4. Choose data types and structure to solve mathematical problem.
5. Develop modular programs using control structure, arrays and structures.
6. Write programs to solve real world problems using structured features.

UNIT – I

Introduction to Computers: Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts.

Introduction to C Language: Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.

UNIT – II

Control Statements: Bitwise Operators, Relational and Logical Operators, If, If-Else, Switch-Statement and Examples. Loop Control Statements: For, While, Do-While and Examples. Continue, Break and goto statements.

Functions: Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Parameter Passing-Call-by-value, call-by-reference, Recursion.

UNIT – III

Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers.

Arrays: Concepts, Using Arrays in C, Array Applications, Two- Dimensional Arrays, Multidimensional Arrays.

Searching and Sorting: Linear and Binary Search, Selection Sort and Bubble Sort.

UNIT – IV

Pointers: Introduction, Pointers to Pointers, Compatibility, Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocation Functions, Array of Pointers, Programming Applications, Pointers to void, Pointers to Functions, Command-line Arguments.

Strings: Concepts, String Input /Output Functions, Arrays of Strings, String Manipulation Functions.

UNIT – V

Structures: Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Unions, Type Definition (typedef), Enumerated Types.

Input and Output: Introduction to Files, Modes of Files, Streams, Standard Library Input/output Functions, Character Input/output Functions

Preprocessors: Preprocessor Commands.

Text Books:

1. Pradip Dey and Manas Ghosh "Programming in C 2/e" Oxford University Press , 2nd Edition 2011.
2. B. W. Kernighan and D.M. Ritchie, "The 'C' Programming Language" Prentice Hall India, 2nd Edition. 1990.
3. B.A.Forouzan and R.F. Gilberg A Structured Programming Approach in C, Cengage Learning,2007.

Suggested Reading:

1. Rajaraman V. "The Fundamentals of Computers" 4th Edition, Prentice Hall of India, 2006.
2. R S Bichker "programming in c" University Press ,2012.

16ME C01

ELEMENTS OF MECHANICAL ENGINEERING

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. Student will understand different types of engineering materials and their applications.
2. Student will come to know working principles of Petrol & Diesel engines with basic knowledge of thermodynamics.
3. Student will understand various making processes.
4. Student will come to know various power transmission devices.
5. Student will understand the importance of principles of management in industry.
6. Student will come to know aspects of various quality control techniques.

Course Outcomes: At the end of the course, students will be able to

1. Select the material depending upon requirement.
2. Evaluate performance of Petrol & Diesel engines.
3. Demonstrate his/her knowledge in preparing process chart for various machining operations.
4. Estimate the power required for various power transmitting devices like belt and gear trains.
5. Become a successful entrepreneur after studying principles of management.
6. Apply various quality control techniques after studying principles of industrial engineering.

UNIT – I

Engineering Materials: Metals and their alloys, Ductile and brittle materials, Ceramics, Polymers, Composite materials

Simple Stresses & Strains: Stress-strain diagram (for ductile and brittle materials), Poisson's ratio, Young's Modulus, Rigidity modulus, Bulk modulus, Failure theories, factor of safety.

UNIT – II

Thermodynamics: Zeroth, First, Second and Third laws of thermodynamics and corollaries

I.C. Engines: Working principle of Two stroke and Four stroke SI and CI engines, Calculations of efficiencies.

Heat Transfer: Fourier law of conduction in single coordinates, Newton's law of conduction, Stephens & Boltzmann law of radiation

UNIT – III

Basic Manufacturing Processes: Introduction to Welding, Brazing & Soldering, Principles of gas welding & arc welding processes, Casting, Principles of sand casting and die casting, Principles of Turning, Drilling, Milling, Grinding, Knurling, Tapping and Honing operations

UNIT – IV

Kinematics: Definitions of kinematic link, pair, mechanism and machine

Gear Trains: Simple, Compound, Inverted and Epicyclic gear trains

Belt Drives: Open and crossed belt drives, length of belts, ratio of belt tensions for flat belt, condition for maximum power transmission for flat belt

Fluid Mechanics: Definition and basic properties of fluids, types of fluids and fluid flows, stream lines, streak lines, stream function and velocity potential

UNIT – V

Industrial Engineering & Management: Introduction to scientific management, basics and importance of work study, steps in conducting work study, time study, standard time, organization and types of organization, Quality definition and its importance, introduction to quality control, types of inspection

Text Books:

1. Jonathan Wickert and Kemper E. Lewis, An Introduction to Mechanical Engineering, 3rd Ed, Cengage learning, USA, 2013
2. Yunus A. Cengel, Heat Transfer: A Practical Approach, Mcgraw-Hill, 2nd edition, 2002
3. Mahesh M Rathore, Thermal Engineering, Tata Mc Grw Hill Edution Pvt. Ltd., 2010

Suggested Reading:

1. R K Rajput, Thermal Engineering, Laxmi Publications, 2010
2. Michael Geoffrey Stevenson, Industrial Engineering, University of N.S.W., Division of Postgraduate Extension Studies, 1972
3. PN Rao, Manufacturing Technology, Volume-I, 3rd Edition, Tata McGraw-Hill, Education, 2009
4. Thomas Bevan, Theory of Machines, 3rd Edition, Pearson Education India, 1986
5. P. N. Modi, S. M. Seth, Hydraulics and Fluid Mechanics: Including Hydraulic Machines, Standard Book House, 2011

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16EC C01

ELEMENTS OF ELECTRONICS AND COMMUNICATION ENGINEERING

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. To understand the elementary concepts of electronic devices.
2. To study basics of Boolean algebra and working of digital circuits.
3. To understand basic operations of AM, FM, filters and multiplexing .
4. To enable the students to understand the working of commonly used communication systems.
5. To give an exposure to the selected applications.

Course Outcomes: The students will be able to

1. Familiar with the basic electronic devices and simple circuits
2. Work with Boolean algebra principles, build the simple combinational and sequential circuits
3. Appreciate the need for modulation, filtering and multiplexing
4. Understand the working principles of a few communication systems
5. Familiar to the selected applications

UNIT – I

Basics of Passive and Active devices

Classification of passive and active devices and their symbols; current flow in a semiconductor; Operating principle of a diode, its application as a rectifier; Operating principle of a transistor (BJT and JFET), Principle and use of Zener diode, Photo diode and LED.

UNIT-II

Introduction to Digital Electronics

Number systems, Binary addition and subtraction, ASCII code, Boolean algebra (Theorems and properties), Logic gates, Combinational circuits such as Half adder, Full adder and Half subtractor, Introduction to sequential logic, Basic Flip flop, Evolution of ICs, block diagram description of Microprocessor and Microcontroller.

UNIT – III

Principles of Communication Engineering (Elementary treatment only)

Basic Communication system components; Concept of Modulation, Introduction to AM, FM and comparisons; Introduction to wired and wireless communication; Concepts of filtering, LPF, HPF, BPF and BSF; concept of multiplexing, TDM and FDM.

UNIT-IV

Overview of Communication systems

Radio spectrum and applications, Modes of propagation;
Basic cellular network and concepts of a cell, frequency reuse, hand-off and cross-talk;
Basic Radar block diagram and applications; Introduction to communication satellite, Geostationary satellites and subsystems, Applications of satellites, GPS, DTH, Remote Sensing;

UNIT –V

Basic operating principles of selected applications:

Block diagram of CRO and application; Software Defined Radio (SDR)-Definition and it's block diagram; Smart phone-features; Introduction to Wireless sensor networks (Bluetooth and ZigBee), RFID-and its types, basic functions; Introduction to Modem.

Text Books:

1. "Electronic Principles" by Albert Malvino and David J Bates, 7th Edition, 2006
2. "Digital Priniciples and Applications", by Donald P Leach, Albert Paul Malvino, Gautham saha, Tata McGraw Hill,6th Edition,2009
3. "Electronic Communication Systems", by Kennedy and Davis, Tata Megra Hill Publications, 4th Edition, 2008

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16CE C03

PROFESSIONAL ETHICS AND HUMAN VALUES

Instruction	1L Periods per week
Duration of End Examination	2 Hours
End Examination	50 Marks
Sessional	---
Credits	1

Course Objectives:

1. To develop the critical ability among students to distinguish between what is of value and what is superficial in life
2. To enable the students, understand the values, the need for value adoption and prepare them meet the challenges
3. To enable the students, develop the potential to adopt values, develop a good character and personality and lead a happy life
4. To motivate the students, practice the values in life and contribute for the society around them and for the development of the institutions /organisation around they are in.
5. To make the students understand the professional ethics and their applications to engineering profession

Course Outcomes:

1. Students develop the capability of shaping themselves into outstanding personalities, through a value based life.
2. Students turn themselves into champions of their lives.
3. Students take things positively, convert everything into happiness and contribute for the happiness of others.
4. Students become potential sources for contributing to the development of the society around them and institutions/ organisations they work in.
5. Students shape themselves into valuable professionals, follow professional ethics and are able to solve their ethical dilemmas.

UNIT-I Concepts and Classification of Values –Need and challenges for value Adoption -Definition of Values – Concept of Values – Classification of Values – Hierarchy of Values – Types of Values – Interdependence of Values
Need for value education – Lack of education in values – Benefits of value education- Challenges for Value adoption – Cultural, Social, Religious, Intellectual and Personal challenges

UNIT – II: Personal Development and Values in Life
Personal Development: – Accountability and responsibility – Desires and weaknesses – Character development – Good relationships, self-restraint, Spirituality and Purity - Integrating values in everyday life

UNIT – III: Practicing Values for the development of Society
Resentment Management and Self-analysis – Positive Thinking and Emotional Maturity – The importance of Women , Children and Taking care of them – Helping the poor and needy – Fighting against addictions and atrocities – Working for the Sustainable development of the society
Principles of Integrity-Institutional Development - Vision for better India.

UNIT – IV: Basic Concepts of Professional Ethics
Ethics, Morals and Human life , Types of Ethics, Personal Ethics, Professional Ethics, Ethical dilemmas, Science – Religion - Ethics, Case Studies on Professional Ethics, Exemplary life sketches of prominent Indian personalities like Sri.M.Visweshwarayya, Dr.APJ Abdul Kalam and JRD Tata

UNIT-V: Ethics in Engineering Profession
Engineering Profession-Technology and Society- Ethical obligations of Engineering Professionals-Role and responsibility of Engineers - A few Case Studies on Risk management safety and Risk Management
Plagiarism-Self plagiarism- -Ethics Standards and Bench Marking

Text Books:

1. Subramanian R, " Professional Ethics " , Oxford University Press , 2013
2. Nagarajan R S, " A Text Book on Human Values and Professional Ethics " New Age Publications , 2007
3. Dinesh Babu S, " Professional Ethics and Human Values " , Laxmi Publications , 2007

Suggested Reading:

1. SantoshAjmera and Nanda Kishore Reddy , "Ethics , Integrity and Aptitude",McGrawhill Education Private Limited, 2014
2. Govinda Rajan M, Natarajan S, Senthil Kumar V S,"Professional Ethics and Human Values", Prentice Hall India, Private Limited,2012
3. Course Material for Post Graduate Diploma In "Value Education & Spirituality" Prepared by Annamalai University in Collaboration with Brahma Kumaris, 2010

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PROGRAMMING LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

1. Demonstration of control structures.
2. Demonstration of switch case (menu driven).
3. Demonstration of Parameter passing Methods.
4. Demonstration of Functions using Recursion.
5. Demonstration of arrays Operations on Matrix.
6. Implementation of bubble sort.
7. Implementation of selection sort.
8. Implementation of Linear and Binary Search.
9. Implementation of string manipulation operations with and without library function.
10. Demonstration using Pointers.
11. Demonstration of Array of Structures.
12. Sequential file operations.

Text Books:

1. Pradip Dey and Manas Ghosh "Programming in C 2/e" Oxford University Press , 2nd Edition 2011.
2. B. W. Kernighan and D.M. Ritchie, "The 'C' Programming Language" Prentice Hall India, 2nd Edition. 1990.

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16ME C03

MECHANICAL AND IT WORKSHOP

Instruction	3P Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessional	25 Marks
Credits	2

Trades for Practice **1. Fitting** **2. Tin Smithy** **3. Carpentry** **4. House Wiring Exercises in Fitting**

1. To make a perfect rectangular MS flat
2. To do parallel cuts using Hack saw
3. To drill a hole and tap it
4. To make male and female fitting using MS flats-Assembly1
5. To make male and female fitting using MS flats-Assembly2

Exercises in Tin smithy

1. To make a square tray from the given sheet metal.
2. To make a rectangular box from the given sheet metal with base and top open. Solder the corners.
3. To make a scoop.
4. To make a dust pan from the given sheet metal.
5. To make a pamphlet box.

Exercises in Carpentry

1. To plane the given wooden piece to required size
2. To make a cross lap joint on the given wooden piece according to the given dimensions.
3. To make a Tee lap joint on the given wooden piece according to the given dimensions.
4. To make a dove tail-joint on the given wooden piece according to the given dimensions.
5. To make a bridle joint on the given wooden piece according to the given dimensions.

Exercises in House Wiring

1. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch, and wiring of one buzzer controlled by a bell push.
2. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs.
3. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
4. Stair case wiring-wiring of one light point controlled from two different places independently using two 2-way switches.
5. Go-down wiring.

Demonstration of plumbing and welding trades .

Note: ***A minimum of 12 exercises from the above need to be done***

References:

1. Workshop Technology – Hazra chowdary

IT Workshop

List of Tasks:

Task 1: MS Word: Formatting text, inserting images, tables, equations and hyperlinks
Document Management: Page layout techniques and printing
Task 2: MS Excel: Functions and formulas and graph plotting
Task 3: MS Power point presentation: Guidelines for effective presentation, inserting objects, charts, hyperlinks and navigation between slides
Task 4: Essentials Search Engines & Net etiquette, Plagiarism, Open source tools and other utility tools

Suggested Reading:

1. Scott Mueller's Upgrading and Repairing PCs, 18/e, Scott. Mueller, QUE, Pearson, 2008.
2. The Complete Computer upgrade and repair book, 3/e, Cheryl A Schmidt, Dreamtech

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16PY C04

APPLIED PHYSICS LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives: The objectives of the course is to make the student

1. Acquire knowledge in experiments of modern physics
2. Understand the characteristics of various semiconductor devises
3. Work with lasers and optical fibers

Course Outcomes: At the end of the course, the student will be able to

1. Understand the various applications of semiconductor devices and their suitability in engineering
2. Demonstrate the working of lasers and optical fibers and their applications in the field of communication
3. Analyze the electrical properties of a given solid based on its energy band gap
4. Verify the resistance and thermoelectric power properties with temperature variation
5. Demonstrate the concept of electron and its charge experimentally

List of Experiments:

1. Planck's Constant – Determination of Planck's Constant using photo cell
2. Solar Cell – Study of I-V characteristics of given solar cell and calculation of fill factor, efficiency and series resistance
3. Hall Effect– Determination of Hall coefficient, carrier concentration & mobility of charge carriers of given semiconductor specimen
4. P-N Junction Diode – Study of V-I characteristics and calculation of resistance of given diode in forward and reverse bias
5. Laser – Determination of wavelength of given semiconductor red laser
6. Fibre Optics – Determination of NA and power losses of given optical fibre
7. Energy Gap – Determination of energy gap of given semiconductor
8. Thermistor – Determination of temperature coefficient of resistance of given thermistor
9. *e/m* of Electron by Thomson's Method
10. Thermoelectric Power – Determination of thermoelectric power of given sample

Note: A student must perform a minimum of eight experiments.

Suggested Reading:

1. "Applied Physics"- Manual by Department of Physics, CBIT, 2016
2. S.K. Gupta, "Engineering Physics Practical", Krishna's Educational Publishers, 2014
3. O.P. Singh, V. Kumar and R.P. Singh, "Engineering Physics Practical Manual", Ram Prasad & Sons Publications, 2009

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16CY C03

ENGINEERING CHEMISTRY LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory
2. For practical understanding of theoretical concept of chemistry

Course Outcomes:

1. This syllabus helps the student to understand importance of analytical instrumentation for different chemical analysis.
2. The above knowledge also helps students to carry out inter disciplinary research such that the findings benefit the common man.

List of Experiments:

1. Introduction to chemical analysis.
2. Preparation of standard solution of oxalic acid and Standardization of NaOH
3. Estimation of amount of Fe^{+2} in the given solution using Mohr's salt and $KMnO_4$
4. Estimation of amount of Fe^{+2} in the given solution using Mohr's salt and $K_2Cr_2O_7$
5. Estimation of amount of copper in the given solution using hypo solution.
6. Estimation of amount of HCl pH metrically using NaOH solution
7. Estimation of amount of CH_3COOH pH metrically using NaOH solution
8. Determination of concentration of given KMnO4 solution Colorimetrically
9. Determination of concentration of given $K_2Cr_2O_7$ solution Colorimetrically
10. Distribution of acetic acid between n-butanol and water.
11. Distribution of benzoic acid between benzene and water
12. Preparation of urea – formaldehyde / phenol- formaldehyde resin.

Suggested Reading:

1. Vogel' S text book of quantitative chemical analysis by J. Mendham and Thomas,Person education Pvt.Ltd New Delhi ,6th ed. 2002
2. Laboratory Manual on Engineering Chemistry by Dr. Subdharani (Dhanpat Rai Publishing)
3. A Textbook on experiment and calculation in engineering chemistry by S.S. Dara S.Chand
4. Instrumental methods of Chemical Analysis, MERITT & WILLARD East-West Press).

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16 MT C02

ENGINEERING MATHEMATICS – II

Instruction	3L Periods per week + 1 (extra hour)
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. To know the relevant methods to solve higher order differential equations.
2. To learn the Laplace and Inverse Laplace transforms for solving engineering problems.
3. To know improper integrals such as Beta, Gamma functions.
4. To learn Vector Differential Operator and its physical interpretations.
5. To evaluate vector line, surface & volume integrals.
6. Learn to apply all the above mathematical methods/techniques to interpret the results in physical and technical terms.

Course outcomes:

1. Solve the solutions of Differential Equations which arise in electrical circuits, vibrations and other linear systems.
2. Able to solve solutions of differential equations with initial and boundary value problems.
3. Evaluating definite integrals using Beta, Gamma functions.
4. Understating the significance of gradient, divergent and Curl.
5. Use Greens, Gauss and Stoke's theorems to find the surface and volume integrals.
6. Able to solve and analyse the Engineering problems.

UNIT-I Ordinary differential Equations: Linear Differential equations of higher order with constant coefficients, complementary function and particular integrals when RHS is of the forms $e^{ax}, \sin ax, \cos ax, x^m, e^{ax}(v), x^m(v)$,where v-is a function of x, Cauchy's equation, electrical circuits of second order

UNIT-II Laplace Transforms: Laplace transforms of standard functions, Laplace transforms of piecewise continuous functions, first shifting theorem, multiplication by 't', division by 't'. Laplace transforms of derivatives and integrals of functions-Unit step function-Periodic functions (without proofs). Inverse Laplace transforms-by partial fractions (Heaviside method), Convolution Theorem, Solving Ordinary differential equations by Laplace Transforms

UNIT-III Beta and Gamma Functions: Definitions of Beta and Gamma functions-elementary Properties of both Beta and Gamma functions, Relation between Beta and gamma functions, differentiation under the integral sign.

UNIT-IV Vector Differentiation: Scalar and vector fields- directional derivative- Gradient of a scalar-Divergence and Curl of a vector point function. Properties of divergence, curl, Solenoidal and Irrotational vectors

UNIT-V Vector Integration: Evaluation of Vector Line integrals, surface integrals and volume integrals, Greens, Gauss divergence and Stokes theorems (without proofs) and its applications

Text Books:

1. Erwin Kreyszig "Advanced Engineering Mathematics,"10th edition, John Wiley & Sons -Publishers.
2. R.K.Jain & S.R.K.Iyenger "Advanced Engineering Mathematics" , 3rd edition, Narosa Publications
3. Alen Jaffery "Mathematics for Engineers & Scientists" , 6thed 2013 CRC press, Taylor & Francis Group. (Elsevier)
4. Dr.B.S.Grewal "Higher Engineering Mathematics", 43rd edition, Khanna Publishers.

Suggested Reading: (for further reading and examples on applications)

1. A.Craft and Robert Davison "Mathematics for Engineers-a modern interactive approach" -Willey
2. Loius Pipes "Applied Mathematics and physicists" Mc Graw Hill publishers.
3. Kanti.B.Datta "Mathematical Methods of Science & Engg," Aided with MATLAB,. Cengage Learning India Pvt.Ltd.
4. AR Collar and A. Simpson "Matrices for Engineering Dynamics" -John Willey & sons.

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16PY C01

ENGINEERING PHYSICS

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives: The objective of the course is to make the student

1. Understand the general concepts of physics
2. Acquire knowledge of different kinds of waves and their behavior
3. Familiar with crystal physics and materials
4. To introduce the general concepts of physics

Course Outcomes: At the end of the course, the student will be able to

1. Describe the types of oscillations and analyze them
2. Demonstrate the wave nature of the light
3. Develop the concepts related to electromagnetic behavior
4. Identify the various crystal systems and defects
5. Explain the origin of magnetism and dielectric polarization and applications of these materials in the field of engineering & technology

UNIT – I Waves and Oscillations: Review of free oscillations - Superposition of two mutually perpendicular linear SHMs of same frequency and 1:2 ratio frequency – Lissajous figures – Damped vibrations – Differential equation and its solution – Logarithmic decrement - Relaxation time – Quality factor – Forced vibrations – Differential equation and its solution – Amplitude resonance-Torsional pendulum.
Ultrasonics: Production of ultrasonics by piezoelectric and magnetostriction methods – Detection of ultrasonics – Determination of ultrasonic velocity in liquids – Applications.

UNIT – II Interference: Division of amplitude – Interference in thin films (reflected light) – Newton's rings – & division of wavefront – Fresnel's biprism.
Diffraction: Distinction between Fresnel and Fraunhoffer diffraction – Diffraction at single slit – Diffraction grating (N Slits) – Resolving power of grating.

UNIT – III Polarization: Malus's law – Double refraction – Nicol's prism – Quarter & Half wave plates – Optical activity – Laurent's half shade polarimeter.
Electromagnetic Theory: Review of steady and varying fields – Conduction and displacement current – Maxwell's equations in differential and integral forms – Electromagnetic wave propagation in free space, dielectric and conducting media – Poynting theorem.

UNIT – IV Crystallography: Space lattice - Crystal systems and Bravais lattices – Crystal planes and directions (Miller indices) – Interplanar spacing – Bragg's law – Lattice constant of cubic crystals by powder diffraction method.
Crystal Imperfections: Classification of defects – Point defects – Concentration of Schottky and Frenkel defects – Line defects – Edge dislocation – Screw dislocation – Burger's vector.

UNIT – V Magnetic Materials: Classification of magnetic materials – Langevin theory of paramagnetism – Weiss molecular field theory – Domain theory – Hysteresis curve – Structure of ferrites (spinel & Inverse spinel) – Soft and hard magnetic materials.
Dielectric Materials: Dielectric polarization – Types of dielectric polarization: electronic, ionic, orientation and space-charge polarization (Qualitative) – Frequency and temperature dependence of dielectric polarization – Determination of dielectric constant (Schering bridge method) – Ferroelectricity – Barium titanate – Applications of ferroelectrics.

Text Books:

1. B.K. Pandey and S. Chaturvedi, "Engineering Physics", Cengage Publications, 2012
2. M.N. Avadhanulu and P.G. Kshirsagar, "A Text Book Engineering Physics", S. Chand Publications, 2014.
3. M. Arumugam, "Materials Science", Anuradha Publications, 2015.
4. S.L. Gupta and Sanjeev Gupta, Modern Engineering Physics, Dhanpat Rai Publications, 2011.

Suggested Reading:

1. R. Murugeshan and Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publications S. Chand Publications, 2014
2. V. Rajendran, "Engineering Physics", McGahill Education Publications, 2013
3. P.K. Palanisamy, Engineering Physics", Scitech Publications, 2012
4. V. Raghavan, "Materials Science and Engineering", Prentice Hall India Learning Private Ltd., 6th Revised edition, 2015

16CY C02

APPLIED CHEMISTRY

Instruction	2L Periods per week
Duration of End Examination	2 Hours
End Examination	50 Marks
Sessional	20 Marks
Credits	2

Course Objectives:

Applied chemistry is a fascinating area with the profound implications for engineers as well as biologists. Materials fabricated and used in our daily life are derived from chemicals, both natural and synthetic and their range of utility are growing day by day. It is imperative that engineers of different disciplines acquire sufficient knowledge of the materials and their characteristics for making proper selection of their end -use application.

The various units of the syllabus is so designed to fulfill the following objectives.

1. To impart technological aspects of modern chemistry and to lay foundation for the application of chemistry in engineering and technology disciplines
2. The student should be conversant with the
   i. Principles of water characterization and treatment of water for potable and industrial purposes.
   ii. Principles of polymer chemistry and engineering applications of polymers in domestic and engineering areas
3. Knowledge to prevent corrosion of machinery and metallic materials and water chemistry which require serious attention in view of increasing pollution, has been included in the syllabus.
4. Study of polymers is insisted as it gives better insight to industrial personnel by being exposed to wider aspects of polymer science.
5. Study of fuel cells is given importance as fuel cells are the alternate energy sources for generating electrical energy on spot and portable applications.
6. Newer materials lead to discovering of technologies in strategic areas like defense and space research. Recently modern materials synthesized find applications in industry and technology and in order to emphasize them, topics like composite materials, polymers, conducting polymers and nano materials have been incorporated in the curriculum.
7. To enable students to apply the knowledge acquired in improving the properties of engineering materials.
8. To give an insight into nano materials and composite materials aspect of modern chemistry.

Course Outcomes:

1. At the end of the course, the students will be familiar with the fundamentals of water technology; corrosion and its control; applications of polymers in domestic and engineering areas; nano materials and their applications.
2. The engineer who has the above background can effectively manage the materials in his designing applications and for discovering & improving the systems for various uses in industry, agriculture, health care, technology, telecommunications and electronics.
3. The above knowledge also helps students to carry out inter disciplinary research such that the findings benefit the common man.
4. Study of nano related materials helps to update the knowledge necessary to launch into the demands of the world.

UNIT –I

Water Chemistry: Hardness of water – Types, units of hardness, Disadvantages of hard water - Boiler troubles - scales & sludge formation - causes and effects, softening of water by ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water, disinfection of water by chlorination, Ozonization, UV radiation.

UNIT -II

Corrosion Science : Introduction, chemical corrosion – oxidation corrosion , electro chemical corrosion and its mechanism , Galvanic corrosion and types of differential aeration corrosion (waterline corrosion) , Factors affecting corrosion (position of the metals in galvanic series, relative areas of anode and cathode, nature of corrosion product – solubility and volatility of corrosion product, nature of corroding environment – temperature, humidity and P^H. Corrosion control methods – cathodic protection, sacrificial anodic protection

UNIT – III

High Polymers: Definition of polymer, degree of polymerization. Thermo plastics and thermo sets. Preparation, properties and uses of plastics (Polyvinyl chloride, Bakelite), fibers (Kevlar, polyurethane), Rubbers – natural rubber and its chemical structure, vulcanization and its significance. Preparation, properties and uses of silicone rubber, conducting polymers – definition, classification and applications

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UNIT – IV

Battery Technology: Types of batteries - Primary batteries - Dry cell, Lithium battery; Secondary batteries - lead acid storage cell ; Lithium ion battery ; Fuel cell - H_2-O_2 fuel cell, methanol-oxygen fuel cell – its advantages and applications.
Solar cells – photo voltaic cells

UNIT–V

Engineering Materials: Nano materials – Introduction to nano materials and general applications, basic chemical methods of preparation – Sol-gel method. Carbon nanotubes and their applications

Composite materials – definition, types of composites, fibre reinforced, glass fibre reinforced and carbon fibre reinforced composites and applications.

Text Books;

1. P.C.Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Pub, Co., New Delhi (2002)
2. Applied Chemistry "A text for Engineering & Technology" Springer (2005).
3. ShasiChawla, "Text Book of Engineering Chemistry", Dhanpat Rai Publishing Company, NewDelhi (2008).
4. S.S. Dara "A text book of engineering chemistry" S.Chand & Co.Ltd., New Delhi (2006).
5. B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd. New Delhi (2008).
6. Applied Chemistry by N. Krishnamurthy:P. Vallinavagam. And K. Jeysubramanian TMH
7. Chemistry of Engineering Materials by CV Agarwal,C.P Murthy, A.Naidu, BS Publications.
8. Chemistry of Engineering Meterials by R.P Mani and K.N.Mishra, CENGAGE learning

Suggested Reading:

1. B.K.Sharma, "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001)
2. Water Treatment : F. I. Bilane, Mir publisher
3. Fundamentals of Corrosion: Michael Henthorne, Chemical Engineering.
4. A textbook of Polymer Science: Fred, Billmeyer Jr., Wiley India Third edition.
5. Chemistry of Advanced Materials: CNR Rao, Rsc Publication.
6. Materials Science and Engineering an Introduction, William D. Callister, (Jr. Wiley publisher).
7. Introduction to nano materials by T.Pradeep.

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16EE C01

ELEMENTS OF ELECTRICAL ENGINEERING

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. To understand the basic concepts of electrical circuits.
2. To understand the principles of electromagnetic induction.
3. To know about different types of batteries, charging and discharging of batteries and types of fuel cells etc.
4. To know about different types of electrical wires and cables, domestic and industrial wiring.
5. To understand safety rules and methods of earthing.

Course Outcomes: After completion of the course, the student will be able to:

1. Acquire the knowledge of basic concepts of electrical circuits such as Ohm's law, Kirchhorff's laws etc.
2. Acquire the knowledge of basic Faraday's laws of electromagnetic induction.
3. Acquire the knowledge to solve the problem of AC circuits.
4. Acquire the knowledge of specifications of batteries, types of cells and sources of renewable energy.
5. Acquire the knowledge of electrical wiring and cables and their types and electrical equipment and their specification.
6. Acquire the knowledge of safety precautions in handling electrical appliances, importance of grounding and methods of earthing.

UNIT-I DC Circuits

Current, voltage, power and energy, sources of electrical energy, independent and dependent sources, source conversion, circuit elements, Resistor, Inductor, Capacitor Ohm's law, Kirchhoff's laws, analysis of series, parallel and series-parallel circuits, star-delta conversion, Node and Mesh analysis (with independent sources only).

UNIT-II : Electromagnetism & AC Circuits Electric charge, electric field, lines of force, electric field intensity, electric flux and flux density, Faraday's laws of electromagnetic induction, static and dynamically induced EMF.

A.C. Circuits: Generation of alternating voltage and current, equation of alternating voltage and current, average and rms values of sinusoidal quantities, form and peak factors, phasor representation of sinusoidal quantities, AC through pure resistance pure Inductance, pure capacitance, RL,RC,RLC circuits.

UNIT-III: Batteries and Fuel Cell

Introduction to batteries, simple cell, EMF and internal resistance of a cell, primary and secondary cells, cell capacity, types and specifications of batteries, charging and discharging of battery, safe disposal of batteries; fuel cell, principle and types of fuel cell, different sources of renewable energy.

UNIT-IV: Electrical Wiring

Types of wires and cables, types of connectors and switches, system of wiring, domestic and industrial wiring, simple control circuit in domestic installation, electrical equipment and their specifications

UNIT-V: Safety & Protection

Safety precautions in handling electrical appliances, electric shock, first aid for electric shock, other electrics hazards, safety rules, importance of grounding and earthing of electrical equipment, methods of earthing, circuit protection devices: Fuses, MCB, ELCB and Relays.

Text Books:

1. Edward Hughes, "Electrical and Electronics Technology", 10th Edition, Peasson Publishers 2010.
2. V.K. Mehta & Rohit Mehta, "Principles of Electrical Engineering", S.Chand Company Limited 2008
3. B.L. Theraja & A.K. Theraja, "Electrical Technology", Vol.I, S.Chand Company Limited 2008.

Suggested Reading:

1. P.V.Prasad & S. Siva Nagraju, "Electrical Engineering: Concepts & Applications", Cengage Learning, 2012.
2. S. Rao, "Electrical Safety, fire safety engineering & Safety Management", Khanna publications, 1998.
3. Surjit singh & Ravi Deep Singh, "Electrical Estimating and Costing", Dhanapath Rai & Co., 1997.

16CE C01

ENGINEERING MECHANICS

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives: During this course, students should develop the ability to:

1. Work comfortably with basic engineering mechanics concepts required for analyzing static structures
2. Identify an appropriate structural system to study a given problem and isolate it from its environment.
3. Analyze and model the problem using free-body diagrams and equilibrium equations
4. Apply pertinent principles to the system to solve and analyze the problems subjected to frictional forces.
5. Understand the meaning of centroid/ centers of gravity and moments of Inertia using integration methods.
6. Communicate the solution to all problems in an organized and coherent manner and elucidate the meaning of the solution in the context of the problem.

Course Outcomes: At the end of the course the student will be able to:

1. Solve problems dealing with forces in planar force systems
2. Draw free body diagrams to analyze the forces in the given structure
3. Understand the concept of moments and couples in plane systems.
4. Understand the mechanism of friction and can solve friction problems
5. Determine the centroid of plane areas and centers of gravity of bodies using integration methods
6. Determine moments of inertia, product of inertia for all areas and mass moments of inertia for bodies,

UNIT – I

Force Systems: Resolution of coplanar and non-coplanar force systems (both concurrent and non-concurrent), Determining the resultant of planar force systems. Moment of force and its applications and couples

UNIT – II

Equilibrium of force system: Free body diagrams, equations of equilibrium of planar force systems and its applications. Problems on general case of force systems

UNIT – III

Theory of friction: Introduction, types of friction, laws of friction, application of friction to a single body & connecting systems. Wedge and belt friction

UNIT– IV

Centroid: Significance of centroid, moment of area, centroid of line elements, plane areas, composite areas, theorems of Pappus & its applications. Center of gravity for elementary and composite bodies

UNIT – V

Moment of Inertia: Definition of MI, Polar Moment of Inertia, radius of gyration, transfer theorem, moment of Inertia of elementary & composite areas, product of inertia. Mass moments of inertia for elementary and composite bodies

Text Books:

1. K. Vijay Kumar Reddy and J. Suresh Kumar, Singer's Engineering Mechanics, BS Publications, Hyderabad, 2011.
2. Ferdinand L Singer, Engineering Mechanics, Harper and Collins, Singapore, 1904.

Suggested Reading:

1. A. Nelson, Engineering Mechanics, Tata McGraw Hill, New Delhi, 2010.
2. S. Rajashekaran & G. Sankarasubramanyam, Engineering Mechanics, Vikas publications, Hyderabad, 2002.
3. S.B. Junarkar and H.J Shah, Applied Mechanics, Charotar publishers, New Delhi, 2001.
4. Basudeb Bhattacharyya, Engineering Mechanics, Oxford University Press, New Delhi, 2008.
5. A K Tayal, Engineering Mechanics, Umesh Publications, New Delhi, 2010

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16EG C01

PROFESSIONAL COMMUNICATION IN ENGLISH

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. To enable the students to understand the role and importance of communication and to develop their basic communication skills in English.
2. To strengthen the students' usage of grammar and to develop their vocabulary.
3. To improve the students' listening skills and introduce them to different reading strategies.
4. To equip the students with appropriate writing skills.
5. To enhance imaginative and critical thinking through literary texts and book review.

Course Outcomes: The students will

1. Understand the nature, process and types of communication and will communicate effectively without barriers.
2. Understand the nuances of listening and will learn to make notes
3. Read different texts, comprehend and draw inferences and conclusions.
4. Write effective paragraphs, letters and reports
5. Critically analyze texts and write book reviews

UNIT- I Understanding Communication in English: Introduction, nature and importance of communication. Process of communication. Basic types of communication - verbal and non verbal. One way vs. Two way communication. Barriers to communication. Intrapersonal and interpersonal communication. Johari Window.
Grammar & Vocabulary: Parts of speech, figures of speech – Euphemism, Hyperbole, Irony, Metaphor, Onomatopoeia, Oxymoron, Paradox, Personification, Pun & Simile.

UNIT- II Developing Listening Skills: Exposure to recorded and structured talks, class room lectures- problems in comprehension and retention. Types of listening, barriers to listening, effective listening strategies. Note –taking.
Grammar & Vocabulary: Articles, Prepositions, Phrasal verbs, Idioms.

UNIT- III Developing Writing Skills: Sentence structure. Brevity and clarity in writing. Cohesion and coherence. Paragraph writing. Letter writing - form and structure, style and tone. Kinds of Letters –Apology and request letters. Email etiquette. Report writing.
Grammar & Vocabulary: Tense, Conditionals, homonyms, homophones.

UNIT - IV Developing Reading Skills: The reading process, purpose, different kinds of texts. Reading comprehension. Techniques of comprehension – skimming, scanning, drawing inferences and conclusions. Note-making
Grammar &Vocabulary: Concord, Connectives, Active and Passive voice, Words often confused.

UNIT- V: Reading for Enrichment

1. The Road Not Taken — Robert Frost
2. Goodbye Party For Miss Pushpa T. S — Nissim Ezekiel
3. The Open Window — Saki
4. The Romance Of A Busy Broker — O. Henry

Book reviews -Oral and written review of a chosen / novel/ play - a brief written analysis including summary and appreciation. Oral presentation of the novel/play
Grammar & Vocabulary: Indianisms, Common errors, Parallelisms.

Text Books:

1. Vibrant English, Orient Blackswan Ltd,

Suggested Reading:

1. M .Ashraf Rizvi, Effective Technical Communication, Tata Mc Graw- Hill, New Delhi
2. Meenakshi Raman and Sangeetha Sharma, Technical Communication - Principles and Practice, Oxford Univ. Press, New Delhi.
3. Sunil Solomon, English for Success, Oxford University Press, 2015
4. Krishna Mohan, Meera Banerji, Developing Communication Skills, McMillan India Ltd.
5. Michael McCarthy, English Vocabulary in Use.
6. Brikram K Das, Kalyani Samantray, An Introduction to Professional English and Soft Skills Cambridge Univ. Press, New Delhi.

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16CE C02

ENVIRONMENTAL STUDIES

Instruction	1L Periods per week
Duration of End Examination	2 Hours
End Examination	50 Marks
Sessional	- - -
Credits	1

Course Objectives:
1. To equip the students with inputs on the environment, natural resources and their conservation.
2. To study the interrelationship between the living organisms and the natural environment and also to enable the students to understand the structure and functioning of the ecosystems.
3. To understand the importance of biodiversity and create awareness on its threats and conservation strategies.
4. To enable the students become aware of pollution of various environmental segments including their causes, effects and control measures.
5. To create awareness about environmental legislations in the context of national conventions.

Course Outcomes: At the end of the course, the student should have learnt
1. To understand the scope and importance of environmental studies, identify the natural resources and ecosystems and contribute for their conservation.
2. To understand the ecological services of biodiversity and contribute for their conservation.
3. To develop skills to solve the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
4. To relate the social issues and the environment and contribute for the sustainable development.
5. To understand the essence of the ethical values of the environment for conserving depletable resources and pollution control.

UNIT – I

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Water resources- hydrological cycle, use and over utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Food resources- Changes caused by modern agriculture, fertilizers-pesticide problems, water logging and salinity. Forest resources- use and over exploitation, deforestation. Mineral resources- Use and exploitation, effects of mining. Energy resources- Growing energy needs, various renewable and non-renewable energy sources. Land resources- land as a resource, land degradation- causes and effects, Role of individuals in conservation of natural resources.

UNIT – II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, concept of food chains, food webs, ecological pyramids.

UNIT – III

Biodiversity: Types/classification of biodiversity, India as a mega diversity nation, values of biodiversity, threats to biodiversity, Conservation of biodiversity.

UNIT – IV

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, Soil pollution, Noise pollution and Thermal pollution.

Environmental Legislations: Environment protection act, Air, Water, Forest & Wild life acts.

UNIT – V

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development, Population explosion and Climate change: Global warming, Acid rain, Ozone layer depletion.

Text Books:

1. P. D.Sharma, "Ecology & Environment", Ashish publications, 1994
2. Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004

Suggested Reading:

1. Dr. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria & Sons, 2009
2. C. S. Rao, "Environmental Pollution Control Engineering", Wiley, 1991
3. S. S. Dara, "A Text Book of Enviromental Chemistry & Polution Control", S. Chand Limited, 2006

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16ME C02

ENGINEERING GRAPHICS

Instruction	1L + 3D Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:
1. To provide an exposure in understanding the drawings during a multidisciplinary approach towards a problem
2. To train up in perception and imagination of a three dimensional scenario.

Course Outcomes:
1. To understand theory of projections
2. Ability to improve visualization skills
3. Ability to sketch Engineering Objects

UNIT – I

Introduction to Engineering Drawing: Drawing Instruments and their uses, types of lines, use of pencils, Lettering, Rules of dimensioning

Conic Sections: Ellipse, Parabola, Hyperbola including the Rectangular Hyperbola (General method only)

Cycloidal curves: Construction of cycloid, epi-cycloid, hypo-cycloid & involutes

UNIT – II

Orthographic Projections: Principles of Orthographic Projections – Conventions , Projection of Points, Projection of Lines - inclined to both planes.

UNIT – III

Projections of Planes: Projections of regular Planes – Perpendicular planes and Oblique planes.

UNIT – IV

Projections of Solids: Projections of Regular Solids – Regular Polyhedra, solids of revolution, (Simple position only)

Sections of Solids: Types of cutting planes – their representation – sections of solids in simple position.

UNIT – V

Introduction to Graphic packages: Getting started, Basic drawing and editing commands, creating lines, planes and solids.

Note: Syllabus for external examination will be from unit 1 to unit 4 only & unit-5 is exempted from external examination. Unit 5 is for internal examination only.

Text Books:

1. N.D.Bhatt," Elementary Engineering Drawing", Charotar Publishers, 2012
2. Basanth Agrawal and C M Agrawal "Engineering Drawing 2e ", McGraw-Hill Education(India) Pvt. Ltd.

Suggested Reading:

1. K.L.Narayana and P.K.Kannaiah, "Text Book of Engineering Drawing", Scitech Publications, 2011
2. P.S.Gill' "Engineering Graphics", Kataria Publications, 2011
3. K.Veenugopal, "Engineering Drawing and Graphics + Autocad", New Age International Pvt. Ltd, 2011
4. Shaw M.B and Rana B.C., "Engineering drawing", Pearson, 2nd edition, 2009
5. P I Varghees, " Engineering Graphics ",Tata McGraw-Hill publications, 2013
6. Bhattacharya. B, "Engineering Graphics", I. K. International Pvt. Ltd, 2009
7. Dhawan R.K., "Principles of Engineering Graphics and Drawing", S. Chand, 2011

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16PY C03

ENGINEERING PHYSICS LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives: The objectives of the course is to make the student

1. Apply theoretical physics knowledge in doing experiments
2. Understand the behavior of the light experimentally
3. Analyze the behavior of magnetic and dielectric materials

Course Outcomes: At the end of the course, the student will be able to

1. Understand the concept of errors and find the ways to minimize the errors
2. Demonstrate interference and diffraction phenomena experimentally
3. Distinguish between polarized and unpolarized light
4. Determine the loss of energy of a ferromagnetic material and its uses in electrical engineering
5. Understand the suitability of dielectric materials in engineering applications

List of Experiments:

1. Error Analysis – Estimation of errors in the determination of time period of a torsional pendulum
2. Newton's Rings – Determination of wavelength of given monochromatic source
3. Single Slit Diffraction – Determination of wavelength of given monochromatic source
4. Diffraction Grating – Determination of wavelengths of two yellow lines of mercury light
5. Malus's Law – Verification of Malus's law
6. Double Refraction – Determination of refractive indices of O-ray and E-ray of given calcite crystal
7. Polarimeter – Determination of specific rotation of glucose
8. B-H Curve – Determination of hysteresis loss of given specimen
9. Dielectric Constant – Determination of dielectric constant of given PZT sample
10. Ultrasonic Interferometer – Determination of velocity of ultrasonics in given liquid

Note: A student must perform a minimum of eight experiments.

Suggested Reading:

1. "Engineering Physics" - Manual by Department of Physics, CBIT, 2016
2. S.K. Gupta, "Engineering Physics Practical", Krishna's Educational Publishers, 2014
3. O.P. Singh, V. Kumar and R.P. Singh, "Engineering Physics Practical Manual", Ram Prasad & Sons Publications, 2009

16CY C04

APPLIED CHEMISTRY LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives:

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory
2. For practical understanding of theoretical concept of chemistry.
3. The student should be conversant with the principles water characterization and treatment of potable and industrial purposes.

Course Outcomes:

1. This syllabus helps the student to understand importance of analytical instrumentation for different chemical analysis.
2. The above knowledge also helps students to carry out inter disciplinary research such that the findings benefit the common man.

LIST OF EXPERIMENTS

1. Introduction to chemical analysis
2. Preparation of standard solution of oxalic acid and Standardization of NaOH
3. Estimation of amount of oxalic acid in the given solution using Mohr's salt and $KMnO_4$
4. Estimation of total hardness of water using EDTA solution
5. Estimation of temporary hardness and permanent hardness of water using EDTA solution
6. Estimation of amount of carbonate in the given solution using HCl link solution
7. Estimation of amount of carbonate and bicarbonate in the given solution using HCl link solution
8. Estimation of amount of HCl conductometerically using NaOH solution
9. Estimation of amount of CH_3COOH conductometerically using NaOH solution
10. Estimation of amount of HCl and CH_3COOH present in the mixture of acids conductometerically using NaOH solution
11. Estimation of amount of HCl potentiometrically using NaOH solution
12. Estimation of amount of Fe^{+2} potentiometrically using $KMnO_4$ solution

Suggested Reading:

1. Applied Chemistry: Theory and Practice (Latest ed.), By O.P. Vermani & A.K. Narula
2. Vogel's Textbook of Quantitative Chemical Analysis (Latest ed.), Revised by G.H. Jeffery, J. Bassett, J. Mendham & R.C. Denney
3. Instrumental methods of Chemical Analysis, MERITT & WILLARD East-West Press

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16EG C02

PROFESSIONAL COMMUNICATION LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives:
1. To introduce students to phonetics and the different sounds in English.
2. To familiarize the students with the software and give them sufficient practice in correct pronunciation.
3. To enable students to speak English correctly with focus on stress and intonation.
4. To help students overcome their inhibitions while speaking in English and to build their confidence. The focus shall be on fluency rather than accuracy.
5. To understand team work, role behavior and to develop the ability to analyze, evaluate, construct and refute arguments.

Course Outcomes:
1. The students will understand the speech sounds in English and the nuances of pronunciation.
2. The students will understand tone, intonation and rhythm and apply stress correctly.
3. The students will be able to participate in group discussions with clarity and confidence.
4. The students will speak confidently on stage with appropriate body language.
5. The students will debate on various issues and learn to work in teams.

Exercises
1. **Introduction to English Phonetics**: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English**: Phonetic sounds and phonemic sounds, introduction to International Phonetic Alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters.
3. **Aspects of connected speech**: Strong forms, weak forms, contracted forms, elision.
4. **Word stress:** Primary stress, secondary stress, functional stress, rules of word stress.
5. **Rhythm & Intonation**: Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
6. **Listening skills** – practice with IELTS and TOEFL material
7. **Situational dialogues and role play**
8. **Public speaking** is to be shown by incorporating narrative examples and extracts from speeches.
9. **Group Discussions**– videos to be shown and practice sessions
10. **Poster making** – preparation and presentation
11. **Debate** - Differences between a debate and a group discussion. Essentials of a debate, conducting a debate.

Suggested Reading:

1. E Suresh kumar et al, . English for Success (with CD), Cambridge University Press India Pvt Ltd. 2010.
2. Aruna Koneru, Professional Speaking Skills, Oxford University Press, 2016
3. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
4. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
5. Edgar Thorpe. Winning at Interviews, Pearson Education, 2006
6. Priyadarshi Patnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd 2011

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16MT C05

ENGINEERING MATHEMATICS-III

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives:

1. To study the expansion of functions in various intervals.
2. To form P.D.E and to find its solution.
3. To solve Wave, Heat & Laplace equations.
4. To learn Differentiation and Integration of complex valued functions.
5. To evaluate Complex Integration.
6. To evaluate Real definite integrals.

Course outcomes: On successful completion of this course the student will be able to

1. Expand functions in the given intervals.
2. Solve linear and non linear PDEs.
3. Solve one-dimension, two-dimension, Heat steady state equations and also one-dimension wave equation.
4. Solve problems on Analytic functions, Cauchy's theorem and Cauchy's integral formula.
5. Expand functions by using Taylor's and Laurent's series.
6. Solve Real and Complex integrals by using Cauchy Theorems.

UNIT – I

Fourier series: Definition of Periodic, Single valued, finite maxima and minima of functions. Euler's Formulae, Dirichlets Conditions for Fourier expansion, Functions having points of discontinuity, Change of interval, Expansion of odd and even functions, Half-range sine series and cosine series.

UNIT-II:

Partial differential equations: Formation of partial differential equations by eliminating the arbitrary constants or arbitrary functions, solutions of linear partial differential equation of first order by using Lagrange's Method, solution of Non-linear partial differential equations of first order by using standard types, Charpit's Method.

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UNIT - III

Applications of Partial differential equations: Solution of partial differential equations by using method of separation of variables, solution of vibration of a stretched string (1D-Wave equation), one dimensional heat equation, Two dimensional heat equation under steady state conditions.

UNIT - IV

Theory of Complex variables: Analytic functions, Cauchy Riemann equations (Cartesian and polar forms), construction of Analytic functions by using Milne-Thomson's method. Harmonic function. Complex line integrals, Cauchy's theorem, Cauchy's Integral formula and its derivatives and problems related to the above theorems.

UNIT - V

Expansion of functions, Singularities & Residues: Taylor's and Laurent's series Expansions (Only statements). Zeros, types of singularities, Residues and Cauchy's Residue theorem, Evaluation of real integrals by Cauchy's residue theorem. Evaluation of improper real integrals of the type: $\int_{-\infty}^{\infty} f(x)dx$ Where f(x) has no poles on real axis and $\int_0^{2\pi} f(\sin\theta, \cos\theta)d\theta$.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, 2015.
2. M.D. Raisinghania, Advanced Differential equations, 7th edition, S Chand publishers, 2013.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition, McGraw Hill publishers, 2003.

Suggested Reading:

1. N P Bali and Manish Goyal, A Text Book of Engineering Mathematics, 9th Edition, Laxmi publishers, 2016.
2. Alan Jeffrey, Mathematics for Engineers and Scientists, 6th Edition, Chapman & Hall/CRC publishers, 2013.
3. A R Vasistha and R K Gupta, Integral transforms, Krishna prakashan publishers, 2004.
4. R.K.Jain & S.R.K.Iyenger, Advanced Engineering Mathematics, 3rd Edition, Narosa Publications, 2007.

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16ME C04

MATERIAL SCIENCE AND METALLURGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: Student will

1. Enable to understand structure property relations, analyze the failures of metals and their prevention.
2. To broad understanding of phase diagrams.
3. Acquire basic knowledge in various heat treatment operations, their purpose and applications.
4. Expose to various methods of extractive metallurgy techniques.
5. Understand various modes of failure and suggest mechanisms for preventions of failures.
6. Understand applications of conventional metals and alloys.

Course Outcomes: On successful completion of this course the student will be able to

1. Know the fundamental science and engineering principles relevant to material.
2. Suggest appropriate physical metallurgical methods (phase diagrams).
3. The type of heat treatment operation to be given to any metal in order to improve desired Mechanical properties.
4. Basic ability to plan an extraction process for given ore.
5. Suggest the appropriate methods for prevention of failures.
6. Analyze the applications of conventional metals and alloys.

UNIT–I

Imperfections in crystals, dislocation in crystals, types of dislocations, effect of slip and twinning on the plastic deformation, cold and hot working, strain hardening and Bauchinger effect, recovery, recrystallization, grain growth and its effect.

on mechanical properties of metals.

Fracture: Types of fracture in metals, modes of fracture, Griffith theory of brittle fracture, crack propagation, ductile fracture, fracture under combined stress.

UNIT–II

Fatigue: S–N curve, Structure of fatigue fracture specimen. Fatigue crack propagation, effect of metallurgical variables on fatigue of metal, low cycle fatigue, experimental determination of fatigue strength (RR–Moore Test).

PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana

Creep: Creep strength, creep curve, creep deformation mechanisms, creep test.

Diffusion: Fick's law of diffusion, application of diffusion theory in mechanical engineering.

UNIT–III

Structure of Alloys: study of eutectic, eutectoid, peritectic and peritectoid reactions, Iron–Iron Carbide equilibrium diagram, construction and interpretation.

Types of plain carbon steels, cast irons and their properties and characteristics.

UNIT–IV

Heat Treatment: Annealing, normalising, hardening, tempering, Construction and interpretation of T–T–T diagram, austempering and martempering, case hardening, carburizing, nitriding, carbo–nitriding, flame hardening, induction hardening.

UNIT–V

Introduction to Extractive Metallurgy: Method of production of pig iron by blast furnace, cast iron by cupola furnace, Method of production of steel by Bessemer convertor, L.D process and electric arc process.

Alloy Steels: Effects of alloying elements like nickel, chromium, manganese, silicon tungsten, and titanium, Study about stainless steels, HSS, brass, bronze; their composition and properties.

Text Books:

1. V. Raghavan, Materials Science and Engineering, Prentice Hall of India Ltd., 4th Edn. ,2005.
2. S.H. Avner, Introduction to Physical Metallurgy, Tata McGraw Hill Publishers, 2nd Edn., 2005.

Suggested Reading:

1. S.P. Nayak, Engineering Metallurgy and Material Science, Charoter Publishing House, 6th Edn., 2005.
2. E. Dieter, Mechanical Metallurgy, Metric Edition, Tata McGraw Hill, 3rd Edn, 2005.
3. K.L. Kakani, Material Science, New Age Publications (P) Ltd., 2008.

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Gandipet, Hyderabad-500 075, Telangana

16ME C05

MECHANICS OF MATERIALS

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Pre-Requisites: Engineering Mathematics, Engineering Mechanics.

Course Objectives:

1. Student is exposed to the concept of different types of loads, stresses, strains and analysis of members for axial loads.
2. Student will acquire knowledge in drawing bending and shear force diagrams of beams for various loads.
3. Student becomes familiar with methods of evaluation of deflection of beams of various configurations and stresses that arise due to simple bending.
4. Student is exposed to the concept of principal stresses and phenomenon of torsion.
5. Student will acquire knowledge in estimating stresses for thin and thick cylindrical shells.
6. Student will acquire knowledge in estimating crippling load in buckling for various columns and struts.

Course Outcomes:

Students who successfully complete this course will have demonstrated ability to:

1. Classify the materials, stresses, strains and understand engineering constants, poisons ratio along with relation between them. Also analyze axially loaded members.
2. Draw shear force, bending moment diagrams for different types of beams and calculate stresses and strains due to simple bending.
3. Determine slope and deflection for various configurations of beams using different methods and stress, strain and deflection due to torsion of circular members.
4. Analyze shear stress distribution in different sections of beams.
5. Understand compound stresses, calculation of principal stresses analytically and graphically using Mohr's circle.

6. Estimate stresses in thin and thick cylinders. Also estimate critical load in buckling for various columns and struts.

UNIT–I

Stresses and Strains: Definitions, types of stresses and strains, elasticity and plasticity. Hooke's law, stress-strain diagrams for engineering materials, modulus of elasticity. Poisson's ratio, relationship between elastic constants, linear and volumetric strains, bars of uniform strength, temperature stresses, compound bars.

UNIT–II

Beams: Definition of bending moment and shear force; relationship between intensity of loading, shear force and bending moment; bending moment and shear force diagrams for cantilever, simply supported and overhanging beams; simple theory of bending, moment of resistance, modulus of section.

UNIT–III

Slopes and Deflections: Slope and deflection measurements of cantilever, simply supported beams with Macaulay's and double integration methods subjected to point loads and uniformly distributed loads.

Torsion: Derivation of torsion formula for circular sections, torsional stresses, angle of twist, power transmission, effect of combined bending and torsion.

UNIT–IV

Shear Stresses in beams: Distribution of shear stresses in rectangular, I-section and T-section for solid and hollow sections.

Compound stresses, principal stresses and strains. Mohr's circle of stress.

UNIT–V

Cylinders: Stresses in thin and thick cylinders with internal and external pressures. Hoop and longitudinal stresses in cylinders, stresses in compound cylinders.

Columns and struts: Euler's and Rankine's formulae for axial load applications. Secant and Perry formulae for eccentrically loaded columns.

Text Books:

1. S.S.Rattan, "Strength of materials", Tata Mc-Graw Hill, 3rd Edition, 2016.
2. S. Ramamrutham, "Strength of Materials", Dhanpatrai and Sons, 1993.
3. G.H.Ryder, "Strength of materials", 3rd Edition in SI Units, Macmillan India Limited, Delhi 2002.

Suggested Reading:

1. S.S. Bhavakatti, Strength of Materials, Vikas Publication, 2003.
2. B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Pub., 1992.
3. G.H. Ryder, Strength of Materials, Third Edition in SI units, Macmillan India Limited, Delhi, 2002

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16ME C06

FLUID DYNAMICS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: Student will understand

1. The fluid properties and different fluids.
2. The centre of pressure and stability conditions.
3. The importance of stream function and velocity potential function.
4. The equations related to Fluid dynamics.
5. Different types of fluid flows.
6. Major and minor losses of fluid flows.

Course Outcome: On successful completion of this course the student will be able to

1. Differentiate different types of fluids.
2. Calculate centre of buoyancy and metacentric height.
3. Differentiate rotational and irrotational flows.
4. Determine forces exerted on fluid body.
5. Differentiate laminar over turbulent flows.
6. Determine various losses incurred in fluid flows.

UNIT–I

Properties of fluids: Definition of fluid and concept of continuum. Difference between ideal and real fluids. Classification of fluids. Fluid properties: Pressure, Density, Specific weight, Specific volume, Dynamic and Kinematic viscosity, Compressibility and Bulk modulus, Surface tension and Capillarity.

Pressure measurement: Fluid pressure at a point, pascal's law, Hydrostatic law, Measurement of pressure by different manometers.

UNIT–II

Fluid Statics: Total pressure, centre of pressure, total pressure and centre of pressure on plane surfaces like horizontal plate, vertical plate, inclined plate and curved surfaces.

Buoyancy and Floatation: Buoyancy, buoyant force, centre of buoyancy, Meta centre, stability for submerged and floating bodies.

UNIT-III

Fluid Kinematics: Classification of fluid flow: steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational.

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Gandipet, Hyderabad-500 075. Telangana

one, two and three dimensional flows, General concepts of path line, stream line and stream tube. Definition and properties of stream function, velocity potential function and use of flow nets.

UNIT–IV

Fluid Dynamics: Energy of fluid body, potential energy and potential head, pressure energy and pressure head, kinetic energy and kinetic head, derivation of Euler's and Bernoulli's equations and their applications like venturi meter, orifice meter, pitot tube, impulse momentum equation and applications. Discharge equations for weirs and notches.

UNIT–V

Laminar and Turbulent flow in pipes: Distinction between laminar and turbulent flows, Reynold's number and its significance, upper and lower critical values of Reynold's number for flow in pipes, development of laminar and turbulent flow in circular pipes. Hagen–Poiseuille equation, frictional losses in pipes, Darcy equation, estimation of Darcy's friction factor, empirical formulae and Moody's chart.

Flow through pipes: Loss of energy in pipes, Major losses, Minor losses, Hydraulic gradient and total energy lines.

Text Books:

1. P.N.Modi and S.M.Seth, Hydraulic and Fluid Mechanics, Standard Book House, 2010.
2. R.K.Rajput, Fluid Mechanics and Hydraulic Machines, S. Chand and Company, 2010.

Suggested Reading:

1. K.L.Kumar, Engineering Fluid Mechanics, Eurasia Publishing House, 2005.
2. V.L.Streeter, Fluid Mechanics, Mc.Graw Hill Co. Ltd., 2005.
3. D.S.Kumar, Fluid Mechanics, S.K. Kataria and Sons, 2010.

16ME C07

MACHINE DRAWING

Instruction	1L+2D Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	2

Pre-Requisites: The student is required to have an idea about Engineering Drawing

Course Objectives: Student will

1. Understand drawing and develop capacity to represent any object with the help of sketch.
2. Study the conventions and rules to be followed by engineers for making accurate drawings.
3. Understand the basic dimensioning practices that have to be followed in the preparation of Drawings.

Course Outcomes:

On successful completion of this course the students will be able to:

1. Draw conventional representation of different materials and mechanical components.
2. Read the working drawings in the machine shop.
3. Draw the orthographic projections and sectional views of machine parts.
4. Draw missing views as well as to analyze and interpret drawings of machine components.
5. Understand the shape and structure of different types of screws, keys, couplings, and rivets.
6. Draw assembly drawings of certain Machine Tools, Engine parts and Valves etc.

1. INTRODUCTION:

Format of drawing sheet, title block, conventions of drawing lines and dimensions, First and third angles projections, conversion of Pictorial view to orthographic views, convention for sectional views. Orthographic projections including sectional views of simple machine elements.

2. DRAWING OF FASTENERS, JOINTS AND COUPLINGS:

Practices of sketching work: Free hand sketches of typical machine elements for simple cases for riveted and screwed fastening, joints, couplings (To indicate proportions).

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Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075, Telangana

3. ASSEMBLY DRAWING:

Preparation of assembly drawings from given details, Ability to supply additional views. The exercises will be drawings of typical machine parts like:

1. Bearings-Plummer block(Pedestal bearing),
2. Petrol Engine Connecting rod,
3. Eccentric,
4. Cross head,
5. Stuffing box,
6. Pipe vice,
7. Screw jack,
8. Lathe Tail-stock
9. Single Tool Post,
10. Revolving centre.

Note: The test is for the ability of the student to read and interpret drawings. The drawing should include part list in standard format.

Text Books:

1. N. Siddeshwar, Machine Drawing, Tata McGraw Hill Publishing Co., Ltd., 5th Edition, 2004.
2. N.D. Bhatt, V.M. Panchel, Machine Drawing, Cherotar Publishing house, Anand, New Delhi, 49th Edition, 2014.

Suggested Reading:

1. K.L. Narayan, P. Kanniah, K. Venkat Reddy, Machine Drawing, New Age International (P) Ltd., 2nd Edition, 2009.
2. K.C. John, Text book of Machine Drawing, PHI Learning, 2010.
3. Ajeet Singh, Machine Drawing, Galgotia Publications, 2010.

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Gandipet, Hyderabad-500 075. Telangana

16MB C01

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: Students will

1. introduce managerial economics and demonstrate its importance in managerial decision making.
2. develop an understanding of demand and relevance of its forecasting in the business.
3. provide the basics of market structure and the concept of equilibrium in different market structures.
4. examine the economic analysis of production process, types of inputs and to explain different costs and their relationship with the output.
5. understand the importance of project evaluation in achieving a firm's objective.
6. explain the concept of Accountancy and provided knowledge on preparation and analysis of Final accounts.

Course Outcomes: After completion of the course, student will be able to:

1. apply fundamental knowledge of Managerial economics concepts and tools.
2. understand various aspects of demand analysis and forecasting.
3. understand price determination for different markets.
4. study production theory and analyze various costs and benefits involved in it so as to make best use of resources available.
5. analyze different opportunities and come out with best feasible capital investment decisions.
6. apply accountancy concepts and conventions, Final accounts and financial analysis.

UNIT-I:

Introduction to Managerial Economics: Introduction to Economics and its evolution - Managerial Economics - its scope, importance, Its usefulness to engineers - Basic concepts of Managerial economics.

UNIT-II:

Demand Analysis: Demand Analysis - Concept of demand, determinants, Law of demand, its assumptions, Elasticity of demand, price, income and

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cross elasticity, Demand Forecasting – Types of Market structures. (Simple numerical problems).

UNIT-III:

Production and Cost Analysis: Theory of Production - Firm and Industry - Production function - input-out relations - laws of returns - internal and external economies of scale. Cost Analysis: Cost concepts - fixed and variable costs - explicit and implicit costs - out of pocket costs and imputed costs - Opportunity cost - Cost output relationship - Break-even analysis. (Theory and problems).

UNIT-IV:

Accountancy: Book-keeping, principles and significance of double entry book keeping, Journal, Subsidiary books, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments.

UNIT-V:

Capital Budgeting: Introduction to capital budgeting, Methods: traditional and discounted cash flow methods. Introduction to Working capital management. (Numerical problems).

Text Books:

1. Mehta P.L., Managerial Economics – Analysis, Problems and Cases, Sultan Chand and Son's Educational publishers, 2013.
2. Maheswari S.N., Introduction to Accountancy, Vikas Publishing House, 2013.
3. Panday I.M., Financial Management, Vikas Publishing House, 11th edition, 2015.

Suggested Reading:

1. Varshney and KL Maheswari, Managerial Economics, Sultan Chand, 2014.
2. M.Kasi Reddy and S.Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007.
3. A.R.Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2013.

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Gandipet, Hyderabad-500 075. Telangana

16ME C08

MATERIAL SCIENCE AND METALLURGY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	3

Course Objectives: Students will

1. Acquire basic knowledge by understanding iron-carbide diagram and its application in engineering.
2. Expose to Metallographic study and analysis of various metals.
3. Acquire knowledge in determining the hardness of metals before and after various Heattreatment operations.
4. Understand differences between different heat treatment methods.
5. Expose to T-T-T curve and its application in engineering metallurgy.
6. Understand the relation between micro structure and properties.

Course Outcomes: On successful completion of this course the students will be able to

1. Identify crystal structure of various metals.
2. Measure hardness and can correlate with microstructure.
3. Perform a suitable heat treatment operation based on desired properties.
4. Underlines the importance of grain size in evaluating the desired mechanical properties.
5. Understand the process of heating and cooling for various heat treatment methods.
6. Correlate the heat treatment methods and the mechanical properties obtained.

List of the Experiments

1. Study of: Metallurgical Microscope, Allotropes of Iron, Iron-Iron carbide diagram, Procedure for specimen preparation.
2. Observations for the following specimens - i) Low carbon steels, ii) Medium carbon steels, iii) Eutectoid steels, iv) High Carbon steels, v)Stainless steels, vi) Case carburized, vii)HSS, viii) White cast iron, ix) Gray cast iron, x) alleable iron, xi)Spheroidal iron, xii) Al–Si alloy and determination of grain size using Image Analyzer.
3. Preparations of the following specimens : i) $\alpha-\beta$ Brass, ii)Normalised steel iii)Medium carbon steel iv)Nodular cast iron v) Grey cast iron.

PROFESSOR & HEAD
Department of Mechanical Engineering
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4. Heat Treatment Processes
   i) Annealing
   ii) Normalizing
   iii) Hardening.

Text Books:

1. V. Raghavan, Materials Science and Engineering, Prentice Hall of India Ltd., 4th Edition. ,2005.
2. S.H. Avner, Introduction to Physical Metallurgy, Tata McGraw Hill Publishers, 2nd Edition., 2005.

Suggested Reading:

1. S.P. Nayak, Engineering Metallurgy and Material Science, Charoter Publishing House, 6th Edition., 2005.
2. E. Dieter, Mechanical Metallurgy, Metric Edition, Tata McGraw Hill, 3rd Edition, 2005.
3. K.L. Kakani, Material Science, New Age Publications (P) Ltd.,2008.

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Gandipet, Hyderabad-500 075. Telangana

16ME C09

MECHANICS OF MATERIALS LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	3

Course Objectives:

1. To apply mechanics of materials theory on real specimens and learn the practical testing procedures and concepts.
2. Demonstrate an understanding of tension, and the relationship between stress, strain and application of Hooke's law.
3. Demonstrate an understanding of types of beams, deflections and measurement of material property through deflections.
4. Demonstrate an understanding of torsion and deformations resulting from torsion.
5. To demonstrate the understanding of hardness and its measurement using different scales like Brinnel and Rockwell.
6. To demonstrate an understanding of measurement of shear modulus and young's modulus for machine members like helical and leaf springs through loading respectively.

Course Outcomes: Students who successfully complete this course will have demonstrated ability to:

1. Draw stress-strain curve for an isotropic material and understand the salient features of it.
2. Demonstrate in determining the Young's modulus of various beam materials by conducting load-deflection test.
3. Evaluate rigidity modulus of a given shaft specimen by torsion test.
4. Able to find out Young's modulus and shear modulus for mechanical components like leaf spring and closely coiled helical spring through load-deflection test respectively.
5. Evaluate hardness of different materials using different scales and also estimate the impact resistance of a material by conducting impact tests.

6. Find the compressive and crushing strengths of concrete cubes and bricks.

List of Experiments

1. Uni-axial tension test using UTM.
2. Brinnel's and Rockwell's hardness tests.
3. Deflection test on propped cantilever.
4. Deflection test on a helical spring to determine the rigidity modulus.
5. Torsion of shaft to determine the rigidity modulus of shaft material.
6. Defection test on a cantilever beam to determine the Young's modulus.
7. Deflection test on a simply supported beam to determine the Young's modulus.
8. Deflection test on continuous beam to determine the Young's modulus.
9. Load-deflection test on a leaf spring to find out the young's modulus of leaf material.
10. Crushing and compression test on bricks and concrete cubes.

Text Books:

1. S.S.Rattan, Strength of materials, Tata Mc-Graw Hill, 3rd Edition, 2016.
2. S. Ramamrutham, Strength of Materials, Dhanpatrai and Sons, 1993.
3. G.H.Ryder, Strength of Materials, 3rd Edition in SI Units, Macmillan India Limited, Delhi 2002.

Suggested Reading:

1. S.S. Bhavakatti, Strength of Materials, Vikas Publication, 2003.
2. B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Pub., 1992.
3. G.H. Ryder, Strength of Materials, Third Edition in SI units, Macmillan India Limited, Delhi, 2002.

PROFESSOR & HEAD
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Gandipet, Hyderabad-500 075. Telangana

16ME C10

COMPUTER DRAFTING LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: Students will

1. Acquire knowledge in 2D drafting tools.
2. Acquire knowledge in graphic communication.
3. Expose to design methodologies.
4. Acquire knowledge in concept of layers.

Course Outcomes: On successful completion of this course the students will be able to

1. Demonstrates Graphics and design competencies.
2. Apply CAD techniques for 2D modeling.
3. Develops an ability to think 3D and interpret data from blue prints and sketches, layers concepts.
4. Apply and draw orthographic projections with the knowledge of correct graphics communication (drawings).
5. Draw 2D drawings and sectional views of part models.
6. Draw 2D drawings and sectional views of assembly models.

Application Software Tool: **Auto CAD / Solid Works**

1. **INTRODUCTION TO SOLIDWORKS DRG EDITOR/ AUTOCAD** :
   XY Coordinate system, Angular measurement, Setting of Units, Limits, Absolute, Relative and Polar Coordinates, zoom, Text, Multiline Text, Creating Title Block – Title, Drawing Number, Drawn, Checked, Approved, Angle of Projection, Scale, Basic Toolbars and commands - Format, View, Draw, Dimension, Modify Tool bars, Draw tool bar options - line, Circle, Rectangle, Ellipse, Spline and Arc , Modify tool bar options- Trim, Extend, Offset, Fillet, Chamfer, Mirror, Break, Array, Polar, Rectangular, Move, Copy, Stretch, Rotate ESNAP, SNAP, Grid, Ortho, Dimension Tool bar –aligned, angular, linear and annotations, leader line. Setting Dimension Style. View Tool bar - Orbit, Render, 3D Views (SW, SE, NE, NW Isometric Views).

2. **EXERCISES FOR PRACTICE:**
Square headed spanner, circular, rectangular components, concentric squares, circle inscribed in a square and rectangle. Fork, Depth Stop, Pump Housing, Geneva Wheel. Importance of Layer - Layer and object properties; construction line, object line, hidden line, centre line, hatching, dimensioning, leader, Options like - Region, Extrude.

3. **EXERCISES FOR PRACTICE:**
2D drawings and sectional views - Shaft support, Sliding Block, Bearing Bracket, Shaft bracket, Anchor bracket, Piston of Petrol Engine, Petrol Engine Connecting Rod.

4. **EXERCISES FOR PRACTICE**:
2D drawings of Components of Screw Jack, Components of Plummer Block.

Text Books:

1. Machine Drawing, K L Narayana, Kannaiah & Venkat Reddy.
2. Solidworks Drawing and Training Manual.
3. Autocad Command Reference manual.

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Gandipet, Hyderabad-500 075, Telangana

16ME C14

KINEMATICS OF MACHINES

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives: Student will acquire knowledge in

1. Analysis of mechanisms.
2. Drawing displacement diagrams for followers with various types of motions.
3. Cam profile drawing for various followers.
4. Estimation of transmission of power by belts and application of various gears and gear trains.

Course Outcomes: Student will demonstrate knowledge in

1. Understanding basic elements of machinery and their motion characteristics.
2. Designing a suitable mechanism depending on application.
3. Drawing displacement diagrams and cam profile diagram for followers executing different types of motions and various configurations of followers.
4. Drawing velocity and acceleration diagrams for different mechanisms.
5. Selecting gear and gear train depending on application.
6. Selection of suitable clutch, brake.

UNIT–I

Introduction: Definition of link, element, pair, kinematic chain, mechanism and machine, Grubler's criterion, single and double slider chains, inversions of quadratic chain, inversions of single and double slider crank chains. Mechanism with lower pairs and straight line motion mechanism, Pantograph and Geneva mechanisms. Ackerman and Davis steering gear mechanisms and Hooke's Joint. Peaucellier, Hart, Scott-Russel, Watt and Tchebicheff mechanisms.

UNIT–II

Analysis of mechanisms: Graphical methods to find velocities of mechanisms, instantaneous centre, body centre and space centre, Kennedy's theorem, graphical determination of acceleration of different mechanisms including Coriolis component of acceleration, analytical method to find the velocity and acceleration, analysis of four bar mechanism with turning pairs, Freudenstein's method for synthesis of four bar linkage.

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Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology
Gandipet, Hyderabad-500 075. Telangana

UNIT–III

Laws of Friction: Friction in screw threads, pivots, collars, Clutches - Single and Multi plate, Cone and centrifugal clutches. Friction circle and friction axis of a link.

Brakes and Dynamometers: Block or shoe, band and block, internal expanding shoe brake, Prony, rope brake, belt transmission, torsion dynamometers.

UNIT–IV

Cams: Types of cams and followers, displacement diagrams for followers, uniform motion, parabolic motion, simple harmonic motion, cycloidal motion, drawing cam profile with knife edge follower, translating roller follower and translating flat follower. Cams of specified contours, tangent cam with roller follower, circular arc (convex) cam with roller follower.

UNIT–V

Gears: Classification of gears, spur gears, nomenclature, law of gear tooth action, involute as gear tooth profile, interference of involute gears, minimum number of teeth to avoid interference, contact ratio, cycloidal tooth profile, comparison of involute and cycliodal tooth profile.

Helical Gears: Helical gear tooth relations, contact of helical gear teeth,

Gear trains: Gear trains–simple and compound, reverted and epicyclic gear trains. Differential of an Automobile.

Text Books:

1. Thomas Bevan, Theory of Machines, CBS Publishers, 2009.
2. S.S. Rattan, Theory of Machines, Tata McGraw Hill Publishers, 4th Edition, 2013.
3. J.E.Shigley, Theory of Machines, Tata Mc.Graw Hill Publishers, New Delhi, 3rd Edition, 2005.

Suggested Reading:

1. C.S. Sharma and Kamlesh Purohit, Theory of Mechanisms and Machines PHI Learning Pvt. Limited, 2006.
2. Amitabh Ghosh and A.K.Mallik, Theory of Machines, East West Publications, 3rd Edition, 2009.

16ME C15

THERMODYNAMICS

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives: Student will understand

1. Basic definitions of thermodynamics and significance of Zeroth law of thermodynamics.
2. The importance and application of first law of thermodynamics.
3. The various laws associated with second law of thermodynamics.
4. Properties of pure substances and use of Molier diagram.
5. Various air standard cycles, their importance and their comparison.
6. Calculation procedures of the air-fuel ratio.

Course Outcomes: On successful completion of this course the students will be able to

1. Estimate the temperature of different scales of thermometers.
2. Apply the first law of thermodynamics process to various thermodynamics processes.
3. Understand the meaning of perpetual motion of machine of second kind and its significance.
4. Read data from the chart of Mollier diagram and its applications.
5. Distinguish working principles of various IC engines like diesel engine, petrol engine.
6. Calculate theoretical air–fuel ratios required for combustion of fuels and also convert from gravimetric analysis to volumetric analysis and vice versa.

UNIT–I

Introduction: Thermodynamics, Macroscopic and Microscopic approaches, thermodynamic systems, properties, processes and cycles, thermodynamic equilibrium, quasi – static process, measurement of pressure, Zeroth law of thermodynamics and its significance, measurement of temperature, reference points, ideal gas equation.

UNIT–II

First Law of Thermodynamics: Concept of heat and work, first law of thermodynamics for closed system, energy- a property of the system, application of first law to various thermodynamic processes like isobaric, isochoric, isothermal, adiabatic and polytropic, definition of enthalpy, PMM1, first law applied to flow processes, application of SFEE to nozzle and diffuser, throttling device, turbine and compressor.

UNIT–III

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Kelvin–Planck and Clausius statements of second law of thermodynamics, PMM2, equivalence of Kelvin-Planck and Clausius statement, reversible and irreversible processes, Carnot theorem, Clausius inequality, calculation of entropy change during various thermodynamic processes, principle of entropy increase, T–S diagrams, application of entropy principle for mixing of two fluids. Helmholtz and Gibb's functions.

UNIT–IV

Thermodynamic Properties of Fluids: Properties of pure substances, p–v diagram, p–T diagram, p–v–T surface, T–s diagram, h–s diagram, dryness fraction, use of steam tables, Maxwell relations.

UNIT–V

Air Standard Cycles: Air standard cycles - Otto, Diesel, Dual Combustion Cycles, working principle, derivation of expression for air standard efficiency, comparison of otto, diesel and dual cycles-for the same compression ratio, for the same maximum pressure and temperature.

Vapour Power Cycles: Vapour power cycles - Carnot cycle, Simple Rankine cycle.

Fuels and Combustion: Characteristics of an ideal fuel, classification of fuels, Stoichiometric air-fuel ratio, equivalence ratio, relation between volumetric and gravimetric analysis.

Text Books:

1. P.K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publishers, 5th edition, 2013.
2. D.S. Kumar, Thermal science and Engineering, S.K.Kataria and Sons, 4th edition, 2013.
3. D.P.Mishra, Engineering Thermodynamics, Cengage Learning, 2012.
4. Y.A. Cengel and M.A. Boles, Thermodynamics: An Engineering Approach, Tata McGraw Hill Publishers, 7th edition, 2014.

Suggested Reading:

1. R.K. Rajput, Thermal Engineering, Laxmi Publications (P) Ltd, 8th edition, 2011.
2. Mahesh M Rathor, Thermal Engineering, Tata McGraw Hill Publishers, 2013.

16ME C16

HYDRAULIC MACHINERY AND SYSTEMS

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Objectives: Students will

1. Learn laws related to Fluid Machinery.
2. Demonstrate his/her knowledge of principles and problems associated with reciprocating pumps.
3. Understand various principles related to rotary pumps.
4. Come to know the working principles of Hydraulic turbines.
5. Learn the performance characters and selection of turbines.
6. Understand the fundamental principles of hydraulic systems.

Outcomes: On successful completion of this course the students will be able to

1. Apply the various fluid laws to different hydraulic machines.
2. Understand the methodology of selection of reciprocating pumps.
3. Acquire the knowledge the functionality of rotary pumps.
4. Understand the selection procedure and estimate the power developed by various hydraulic turbines.
5. Compare the performance of hydraulic turbines and pumps based on characteristics curves.
6. Acquire knowledge the functionality of various hydraulic systems.

UNIT-I

Hydraulic Machines: Classification- Impulse-momentum equation- Lay-out of hydraulic power plant- working principle- Impact of jet on vanes- Force exerted by a jet striking (i) a fixed flat vertical vane held normal to the jet flow (ii) at the centre of a fixed symmetrical curved vane (iii) at one end of fixed symmetrical and unsymmetrical curved vanes (iv) flat vertical vane moving in the direction of jet (v) a series of flat vertical moving vanes (vi) at the centre of symmetrical moving curved vanes (vii) symmetrical curved vanes moving in the same direction as that of jet at inlet (viii) at one end of a series of un-symmetrical moving curved vanes.

UNIT-II

Reciprocating Pumps: Classification- working principle- single and double acting pumps- discharge, work done and power required to drive the pumps- slip, % slip and negative slip- Variation of pressure head in the suction and delivery pipes due to acceleration of piston- Variation of pressure head due to friction in the suction and delivery pipes- Indicator diagrams- Ideal and actual diagrams- Effect of piston acceleration and pipe friction on indicator diagram- Maximum speed at which the pump must run to avoid separation during suction and delivery strokes- Air vessels- Function of air vessels- Work saved by fitting air vessels to single and double acting pumps- Discharge of liquid into and out of air vessels- Performance characteristic curves.

UNIT-III

Centrifugal pumps: Classification- Working principle- Comparison over reciprocating pumps-Velocity triangles- Manometric head- work done per second- Head equivalent of work done- Manometric, mechanical and overall efficiencies- Pressure rise in the impeller- Minimum starting speed- Specific speed- Physical significance of specific speed- Model testing- Conditions of similarity of CF pumps- Priming- Performance characteristic curves.

UNIT-IV

Hydraulic Turbines: Classification- Impulse and reaction turbines- Construction and working of Pelton wheel, Francis turbine and Kaplan turbine- Velocity triangles- Work done (power developed)- Hydraulic, Mechanical and Overall efficiencies- Maximum efficiency- Comparison between Impulse and reaction turbines- Comparison between Francis and Kaplan turbines- Specific speed- Physical significance of specific speed- Unit testing -Unit quantities- Model testing of turbines- Conditions for similarity of turbines- Performance characteristic curves.

UNIT-V

Hydraulic Systems (appliances): Working of hydraulic press- accumulator- intensifier- Ram- jack- lift- direct acting hydraulic lift- Suspended hydraulic lift- crane- air lift pump- gear wheel pump.

Text Books:

1. Bansal, R.K., A Text Book of Fluid Mechanics and Hydraulic Machines, Laxmi Publication (P) Ltd., New Delhi, 2004.
2. Modi, P.N. and Seth. S.M., Hydraulics and Fluid Machines, Standard Book House, New Delhi, 2004.

Suggested Reading:

1. Ramamrutham S., Hydraulics, Fluid Mechanics and Fluid Machines, Dhanpat Rai and Sons, New Delhi, 2004.
2. Kumar K.L., Engineering Fluid Mechanics, Eurasia Publishing House (P) Ltd., New Delhi, 2004.
3. White, Frank. M., Fluid Mechanics, 5th Edition., McGraw Hill 2003.
4. Madan Mohan Das., Fluid Mechanics and Turbomachines, PHI Learning Private Limited, New Delhi, 2009.

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16ME C17

MANUFACTURING PROCESSES

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives: to enable the students to

1. Aelect the suitable manufacturing process for a given component.
2. Design pattern, gating system and rises for a simple casting.
3. Identify defect and suggest the remedy for the same.
4. Select suitable welding process for a given requirement.
5. Decide minimum capacity of the machine for a given forming operation.
6. Select suitable forming process for a simple component.

Course Outcomes: Students are able to

1. Select the suitable manufacturing process for a given component.
2. Design pattern, gating system and rises for a simple casting.
3. Identify defect and suggest the remedy for the same.
4. Select suitable welding process for a given requirement.
5. Decide minimum capacity of the machine for a given forming operation.
6. Select suitable forming process for a simple component.

UNIT- I

Pattern design and Methoding: Introduction to casting, classification of casting processes, pattern design: Types of patterns, pattern materials, pattern allowances; Gating system: purpose, elements, requirements, types of gates, choke, gating ratio, types of gating systems, gating system design; Risering: purpose, requirements, chvorinov's rule, optimum shape and dimensions of riser, riser design by Caine's method, Modulus method and NRL method.

UNIT- II

Moulding, Melting, and special casting processes : Moulding sand: ingredients, required properties of moulding sand; Core : purpose, core prints, Melting furnaces: cupola, induction and arc furnace; casting defects and remedies; Special casting processes: Pressure die casting, Centrifugal casting, shell moulding, investment casting, CO2 moulding.

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UNIT- III:

Arc and Resistance Welding Processes: Introduction, Classification of welding processes, Physics of arc, DCSP, DCRP, AC, shielded Metal Arc Welding, Submerged arc welding, Gas Tungsten arc welding, Plasma arc welding, Atomic Hydrogen welding, Resistance welding: spot, projection, seam, butt and percussion welding.

UNIT-IV:

Other Welding processes: Oxy-Acetylene welding, Thermit welding, laser beam welding, Electron beam welding. solid state welding: forge welding, friction welding, ultrasonic welding and explosive welding Soldering and brazing, weld defects and Weldability.

Fundamentals of metal Forming: True stress and true strain, strain hardening, volume constancy applied to disc and slab. Yield criteria. Hot working and Cold working.

UNIT-V:

Metal Forming processes: forging: open die ,closed die and isothermal forging processes, forging equipment, defects; Rolling: process, nomenclature, geometric relationships, rolling mills, defects; Extrusion: types, load calculation assuming ideal deformation, defects; Wire Drawing: Process, analysis considering ideal deformation, defects; shearing: shearing load, energy required, types of shearing processes; Cup Drawing : process, calculation of blank diameter for a given cup, drawing load; sheet bending: process, bend allowance.

Text Books

1. P.N.Rao, Manufacturing Technology, Vol.1, Tata McGraw Hill Publ., 3rd Edition, 2011.
2. Amitabh Ghosh and Mallick, Manufacturing Science, Assoc. East West Press Pvt. Ltd., 4th Edition, 2011.

Suggested Reading

1. Schey, Introduction To Manufacturing Processes, 2nd Edition, Mcgraw -hill Education
2. Roy A.Lindberg, Materials and Process of Manufacturing, Prentice Hall of India 5th Edition, 1992.
3. Serope Kalpakjian, Manufacturing Engineering and Technology, Addision, Wesley Publishing Company, 2006.
4. Mikell P.Grover, Fundamentals of Modern Manufacturing Materials, Processes And Systems, 3rd Edition, Willey A.

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16EE C14

ELECTRICAL MACHINES AND MICROCONTROLLER APPLICATIONS

(Common to BE - Mech and Prod)

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives:

1. To understand the concepts of transformers.
2. To comprehend the need of DC and AC machines and their control aspects.
3. To know the features of 3-phase induction motors.
4. To understand the concepts of 8051 microcontrollers.
5. To understand the basics of interfacing with 8051 microcontrollers.

Course Outcomes: The student will be able to

1. Identify the compatibility of DC machines for a given application.
2. Identify the applications of 3-phase induction motor.
3. Know the calculation of Efficiency and regulation of transformer.
4. Program using 8051 microcontrollers.
5. Use 8051 microcontrollers for basic applications.

UNIT- I

D.C. Generators: Constructional details, Principle of operation, EMF equation, Classification of generators, Armature reaction, Characteristics of shunt, series and compound generators.

DC Motors: Working Principle, back EMF, Classification of motors, Torque developed in motors, Characteristics of shunt, series and compound motors, Three point starter, Speed control of DC motors.

UNIT- II

Transformers: Construction, Working principle, EMF equation, Ideal transformer, Practical transformer on no load and load conditions, Equivalent circuit of transformer, Efficiency and regulation of transformer, OC and SC tests.

UNIT-III

Three Phase Induction Motors: Production of rotating magnetic field, construction and principle of operation, Torque Calculation, speed-torque characteristics, Speed control of 3-phase induction motors.

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UNIT-IV

8051 Microcontrollers: Introduction to microprocessor, microcontroller classification, Internal architecture of 8051 and its pin configuration, Memory organization and expansion. **SFR's:** Counter and timers, serial data I/O, Interrupts.

8051 Instruction set: Addressing modes and Instruction set. Assembly Language Programming with 8051.

UNIT-V

8051 Interfacing: Expansion of I/O ports, A/D converter, D/A converter, Stepper motor interfacing with 8051, DC motor interfacing with 8051.

Text Books:

1. D.P. Kothari and Nagrath, Basic Electrical Engineering, Tata McGraw Hill Publications, 2nd edition, 2007.
2. V.K.Mehta, Principles of Electrical Engineering, S.Chand and Co, 1st edition, 2003.
3. Muhammad Ali Mazidi, Jainice Gilispie Mazidi and Rolin D. MCkinlay, The Microcontroller and Embedded Systems using Assembly and 'C', 2/e Pearson Education, 2007.
4. Ayala K.J., The 8051 Micro Controller Architecture, Programming and Application, Penram International, 2007.

Suggested Reading:

1. B. L.Theraja and A.K. Theraja, A Text book of Electrical Technology, S.Chand and Co., 24th revised Edition, 2007.
2. P. V. Prasad, S. Sivanagaraju, Electrical Engineering: Concepts and Applications, Cengage Learning, 1st Edition, 2012.

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16ME C18

HYDRAULIC MACHINERY AND SYSTEMS LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: Students will

1. Determine discharge of fluid flow.
2. Understand how to determine various types of flow using Reynolds apparatus.
3. Verify fluid laws like Bernoulli's equation.
4. Determine losses through pipes.
5. Demonstrate knowledge in evaluating performance characteristics of pumps.
6. Vvaluate the performance characteristics of turbines.

Course Outcomes: On completion of the course, the students will be able to

1. Measure the discharge in pipes.
2. Carry out discharge measurements in open channel.
3. Determine the energy loss in conduits.
4. Calculate forces and work done by a jet on fixed or moving, flat and curved blades.
5. Evaluate the performance characteristics of pumps.
6. Demonstrate the characteristics curves of turbines.

List of experiments:

1. Verification of Bernoulli's equation.
2. Determination of Darcy's friction factor and nature of water flow through pipes.
3. Determination of Cd for V- notch.
4. Determination of Cd for rectangular notch.
5. Determination of Cd for venturimeter.
6. Determination of Cd for Orifice meter.
7. Determination of impact force of jet on fixed flat and fixed curved vanes.
8. Performance and characteristic curves of reciprocating pump.
9. Performance and characteristic curves of centrifugal pump.
10. Performance and characteristic curves of self-priming pump.
11. Performance and characteristic curves of gear pump.
12. Performance and characteristic curves of Pelton wheel.

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13. Performance and characteristic curves of Francis Turbine under constant speed and variable speed conditions.
14. Performance and characteristic curves of Kaplan turbine under constant speed and variable speed conditions.

Note: Any 12 experiments need to be conducted.

Text Books:

1. Bansal R.K., A Text Book of Fluid Mechanics and Hydraulic Machines, Laxmi Publication (P). Ltd., New Delhi, 2004.
2. Modi P.N. and Seth S.M., Hydraulics and Fluid Machines, Standard Book House, New Delhi, 2004.

Suggested Reading:

1. Ramamrutham S., Hydraulics, Fluid Mechanics and Fluid Machines, Dhanpat Rai and Sons, New Delhi, 2004.
2. Kumar K.L., Engineering Fluid Mechanics, Eurasia Publishing House (P). Ltd., New Delhi, 2004.

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16ME C19

MANUFACTURING PROCESSES LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: to enable the students to

1. prepare the mould for a single piece and split patterns.
2. test the moulding sand and anlalyse the same.
3. test the bead geometry and correlate the results to the input parameters.
4. use TIG, MIG and Spot welding machines and experiment with them.
5. test the formability characteristics of a given sheet metal.
6. demonstrate the of understanding the parts of simple, compound, progressive and combination dies and use them for production of parts.

Course Out comes: Students are able to

1. prepare the mould for a single piece and split patterns.
2. test the moulding sand and anlalyse the same.
3. test the bead geometry and correlate the results to the input parameters.
4. use TIG, MIG and Spot welding machines and experiment with them.
5. test the formability characteristics of a given sheet metal.
6. demonstrate the understanding of the parts of simple, compound, progressive and combination dies and use them for production of parts.

Experiments:

Casting

1. Design and manufacturing of a simple pattern with various allowances.
2. Green sand moulding practice for a single piece pattern.
3. Green sand moulding practice for a split pattern with a horizontal core.
4. Moulding sand testing: GCS, GSS, DCS and DSS Permeability and shatter index.
5. Finding out the GFN, Moisture content and clay content for a given sand sample.
6. Melting and Pouring of Aluminum.
7. Dimensional inspection and visual inspection of the casting and analysis of dimensional variation and defects.

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Welding

8. Study of gas welding equipment and process. Identification of flames, making Butt joint with gas welding.
9. Study of Arc welding process, comparison of the bead geometry with DCSP, DCRP and A.C.
10. Study of resistance welding process and plot the variation of spot area with time and current variation.
11. Study of TIG welding process and plotting cooling curve in TIG welding process.
12. Study of SAW Welding process and finding out deposition efficiency of the process.
13. Study of MIG welding process and testing of weld bead formed by MIG welding.

Metal Forming

14. Evaluation of Formability of a given sheet material using Erichsen cupping test.
15. Study of Simple Die design for Blanking/Piercing operations in sheet metal forming and.
16. Manufacturing of circular blanks using a mechanical press (capacity 30 Tons) and measurement of forces and comparing with theoretical loads.
17. Study of Progressive die design and manufacturing of washer components using the same on a fly press (capacity 6 Tons) and estimation of forces.
18. Study of Compound die design and manufacturing of washer components using the same on double body fly press (capacity 8 Tons) and estimation of forces.
19. Study of Combination die design and manufacturing of cylindrical cups using the same on a Hydraulic power press (capacity 50 Tons) and estimation of drawing force.
20. Study of deep drawing die design and measuring forces with/ without blank holder for cylindrical/square cups using 10T load cell on a Hydraulic power Press and comparing them with the theoretical values.
21. Measurement of cutting force for Blanking operation using 10T load cell on Mechanical power Press for different materials and comparing theoretical and practical values.
22. Study of extrusion dies and demonstration of extruding lead material

Note: Minimum 12 Experiments need to be conducted by choosing any 4 from each section.

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16EGCO3

SOFT SKILLS AND EMPLOYABILITY ENHANCEMENT LAB

Instruction	2 hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
CIE	15 Marks
Credits	1

Course Objectives: To help the students

1. Participate in group discussions and case studies with confidence and to make effective presentations. Also to learn the art of communication.
2. With- resume packaging, preparing and facing interviews.
3. Build an impressive personality through effective time management & goal setting, self confidence and assertiveness.
4. Understand what constitutes proper grooming and etiquette in a professional environment. Also to understand academic ethics and value systems.
5. To understand the elements of research and hone their soft skills through a live, mini project.

Course Outcomes: The students will be able to

1. Be effective communicators and participate in group discussions and case studies with confidence. Also be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals. Also learn to mange time effectively and deal with stress.
4. Make the transition smoothly from Campus to Corporate. Also use media with etiquette and know what academic ethics are.
5. To do a live, mini project by collecting and analyzing data and making oral and written presentation of the same.

Exercise 1

Group Discussion and Case studies: Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.

Elements of effective presentation, Structure of presentation, Presentation tools, Body language, Creating an effective PPT.

Exercise 2

Interview Skills: Resume writing, structure and presentation, planning, defining the career objective, projecting ones strengths and skill-sets.

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Interview Skills: concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews.

Exercise 3

Personality Development: Effective Time Management, setting realistic goals, self confidence and assertiveness, stress management, moral values.

Exercise 4

Corporate Culture: Grooming and etiquette, communication media etiquette, Academic ethics and integrity.

Exercise 5

Mini Project: General/Technical Research, developing a questionnaire, data collection, analysis, written report and project seminar.

Suggested Reading:

1. Dr. Shalini Verma, Body Language- Your Success Mantra, S Chand, 2006.
2. Ramesh, Gopalswamy, and Mahadevan Ramesh, The ACE of Soft Skills, New Delhi: Pearson, 2010.
3. Covey and Stephen R, The Habits of Highly Effective People, New York: Free Press, 1989.

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ME 311 **DYNAMICS OF MACHINES**

Instruction	4 Periods + 1 Tutorial per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To find static and dynamic forces on planar mechanisms.
2. To know the causes and effects of unbalanced forces in machine members.
3. To determine natural frequencies of undamped, damped and forced vibrating systems of one, two and multi degree freedom systems.

Outcomes:

1. Graduates are expected to demonstrate the ability of the analysis of forces in mechanism which provide them the required inputs to design the systems which withstand operating conditions
2. Graduates will have the ability to identify the unbalance in rotors and engines and will get the knowledge of balancing.
3. Graduates are expected to understand the turning moment diagram, cyclic fluctuation in speed, fluctuation in energy and get the ability of designing flywheel.
4. Graduates will understand concepts of vibration thereby they are able to design the systems free from ill effects of vibration.

UNIT-I

Static and Dynamic Force analysis: Force analysis of Four bar and slider crank mechanisms: Study of dynamically equivalent system, Inertia forces on connecting rod.

Gyroscope: Gyroscopic couple, gyroscopic effects in vehicles.

UNIT-II

Governors: Classification of governors, Watt, Porter, Hartnell and Hartung governors, Controlling Force, Stability, Isochronism, Sensitivity, Power and Effort of governors.

Flywheels: Functions, Differences between flywheel and governor. Turning moment diagrams, flywheels analysis for I.C. Engines and Presses.

UNIT-III

Balancing: Forces on bearings due to rotating shaft carrying several masses in several planes. Determination of balance masses from the forces on the bearings, Shaking forces in single cylinder engine, Partial balancing of reciprocating engine. Balancing of two cylinder locomotive engine. Balancing of multi cylinder in-line engines. Balancing of radial engines by direct and reverse cranks method.

UNIT-IV

Vibrations: Vibrations of Single degree freedom system, (axial, transverse and torsional). Equivalent system of combination of springs, stepped shaft, whirling speed of shafts.

Damped vibrations: Types of damping, Vibrations with viscous damping.

Forced vibrations: Vibrations with harmonically applied force with viscous damping. Dynamic magnifier, Resonance, Vibration is isolation and Transmissibility.

UNIT-V

Torsional Vibrations: Torsional Vibrations of Two rotor, Three rotor and Geared systems.
Natural frequencies of two degree freedom systems. Modes of vibration.

Approximate methods: Dunkerley's method and Rayleigh's method.

Holzer's method: for multi rotor system.

Text Books:

1.S.S. Rathan, *Theory of Machines*, Tata-Mc Graw Hill, 1995.

2.John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, *Theory of Machines & Mechanisms*, Oxford University Press, 2003.

Suggested Reading

3. A. Ghosh and Mallick, *Theory of mechanisms and machines*, Affiliated to E-W Press, 1988.
4. Ashok G Ambedkar, Mechanism and Machine Theory, PHI, 2013.
5. Benson H. Tangue, Principles of Vibration, 2nd Edn., Oxford University Press, 2007
6. Robert L. Norton, *Design of Machinery*, Tata Mc Graw Hill, 2005.
7. Charles E Wilson, J. Peter Sadler *Kinematics and Dynamics of Machinery* Pearson Education, 2008.
8. Banal, R.K. Brar, J.S, 'Theory of Machines', Laxmi Publications, 3rd Edition., 2004.
9. J.S. Rao and Gupta, 'Theory and Practice of Mechanical Vibrations, PHI, 1984

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APPLIED THERMODYNAMICS

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To demonstrate basic knowledge by understanding the basic working principles of reciprocating air compressor and its applications in engineering.
2. Students will come to know the working principle of diesel and petrol engines, their combustion phenomena and problems pertaining to abnormal combustion
3. Students will understand working principle of various fire tube and water tube boilers along with functions of their mountings.
4. To demonstrate basic knowledge by understanding various thermodynamic cycles used power steam power plants along with steam nozzles.

Outcomes:

1. Students will be able to estimate power required for reciprocating air compressor, used for many engineering applications.
2. Students will be able to evaluate the performance of diesel and petrol engines and suggest some suitable methods for remedy of abnormal combustion.
3. Students will be able to select the boiler depending on application and specify the mountings
4. Students will be able to estimate thermodynamic efficiency of steam power cycles and design steam nozzles.

UNIT-I

Reciprocating Air Compressors: Uses of compressed air, Classification of compressors-single stage and multistage compressors, Derivation of work done with and without clearance volume, Workdone of multistage compressors- effect of clearance volume on work done -Inter-cooling and After-cooling

UNIT-II

Internal Combustion Engines- Classification, working principle, Deviation of actual cycles from air standard cycles, Index of compression and expansion for variable specific heats, Battery and Magneto ignition systems, Multipoint fuel injection system, Lubrication systems, Cooling systems, Carburetors-Simple and Zenith carburetors-Valve and Port-timing diagrams- Performance of I.C. engines- Determination of Indicated power, brake power, frictional power, brake thermal efficiency, mechanical efficiency, indicated thermal efficiency, relative efficiency, volumetric efficiency, specific fuel consumption based on brake power and indicated power, air intake- Heat balance sheet.

UNIT-III

Combustion in I.C. engines Combustion phenomena in spark ignition engines and compression ignition engines-Premixed and diffusion flames, Mechanics of propagation, Self ignition process, Limits of self ignition. Fuel requirements and fuel rating- Anti-knock additives, Effect of engine variables- Stages of combustion- Delay period, Period of uncontrolled combustion, Period of controlled combustion, After burning. Types of combustion chambers in spark ignition and compression ignition engines-Air pollution from IC engines- Effects and control of exhaust from engines.

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UNIT-IV

Steam Boilers : Classification of boilers-Fire tube boilers- Cochran boiler, Locomotive boiler and Lancashire boiler, Water tube boilers- Babcock and Wilcox boiler Boiler mountings and accessories. Boiler performance and boiler draught-Chimney design, Types of condensers- Jet and Surface condensers, Cooling towers.

UNIT-V

Steam power plant: Working Carnot and Rankine cycles, cycle analysis, Modified Rankin cycle, Cycle efficiency improvement methods, Reheating, Regeneration and Cogeneration

Steam nozzles: Types of nozzles, Nozzle efficiency, Velocity of steam flowing through the nozzle, Mass of steam discharged from the nozzle, Condition for maximum discharge, Critical pressure ratio, Diameters of nozzle throat and exit for maximum discharge

Text Books

1. Ganeshan, V., " *Internal Combustion Engines*", TMG, New Delhi, 2004
2. Rajput, R. K.,"*Thermal Engineering*", Laxmi Publishers, New Delhi, 2004
3. Mahesh M. Rathore, "Thermal Engineering," TMH, New Delhi, 2010

Suggested Readings:

4. Heywood, J.B. *"Internal Combustion Engine Fundamentals"*, TMH, New York, 2004
5. Ballaney, P.L., "*Thermal Engineering*", Khanna Publishers, New Delhi, 2010
6. Soman, Thermal Engineering, PHI, 2011.
7. Kulshrestha S.K., 'Thermal Engineering', Vikas Publishing, 2nd Edition, 2011

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MANUFACTURING PROCESSESS

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To provide the basic understanding of casting, welding and forming processes along with their relative merits, limitations and their applications.
2. To make the students familiar with design aspects and design calculations for pattern, gating system and riser.
3. To make the students to understand the defects, their causes and remedies in castings and weldments
4. To impart the ability to students to carry out load calculations for forming of simple shapes.

Outcomes:

1. Students are able to select the suitable manufacturing process for a given component.
2. Students are able to design pattern, gating system and rises for a simple casting.
3. Students are capable of indentifying defect and suggest the remedy for the same
4. Students can suggest minimum capacity of the machine for a given forming operation

UNIT-I

Casting: Introduction, classification, pattern design: Types of patterns, pattern materials, pattern allowances; gating system: purpose, elements, requirements, types of gates, choke, gating ratio, types of gating systems, gating system design, risering: purpose, requirements, chvorinov's rule, optimum shape and dimensions of riser, riser design by Caine's method, Modules method and NRL method.

UNIT-II

Casting : Moulding sand: ingredients, required properties; melting furnaces: cupola, induction & arc furnace; casting defects and remedies, inspection & testing of castings, Special casting processes: die casting, shell moulding, investment casting and CO_2 moulding.

UNIT-III

Welding : Introduction, Classification, Arc Welding: Physics of arc, DCSP, DCRP, AC, arc initiation, arc stability , parts of arc, arc-length characteristics, static V-I characteristics of power source; arc welding processes such as SMAW, SAW, GTAW, GMAW, PAW; Resistance welding: spot, projection, seam, butt and percussion welding processes; oxy-acetylene welding , Thermit welding, laser beam welding, Electron beam welding.

UNIT-IV

Welding: Soldering & brazing, weld defects, solid state welding: forge welding, friction welding, ultrasonic welding and explosive welding.

Fundamentals of Metal Forming: True stress & True strain, volume constancy, flow curve, condition for instability, yield criteria: Von-Mises & Tresca criteria, cold working hot working

UNIT-V

Bulk Metal Forming Processes: Forging: open die, closed die and isothermal forging processes; Rolling: Nomenclature, Roll strip contact length, condition for maximum draft, types of rolling mills; Extrusion: forward & backward extrusion hydrostatic extrusion, Impact extrusion, extrusion load calculations by uniform deformation energy method. Wire drawing: Wire drawing die, load calculations by uniform deformation energy method.

Sheet metal forming processes: Shearing: Various shearing operations, load and energy required for shearing, Methods of load reduction. Bending: bend allowance. Cup drawing :types, LDR, drawing force, calculation of blank diameter for circular cups

Text Books:

1. P.N.Rao "Manufacturing Technology", Vol.1, Tata McGraw Hill Publ., 3rd Edn., 2011.
2. Amitabh Ghosh & Mallick. "Manufacturing Science", Assoc. East West Press Pvt. Ltd., 4th Edn., 2011.

Suggested Reading:

3. Schey, " Introduction To Manufacturing Processes" 2nd Edn, Mcgraw-hill Education,.
4. Serope Kalpakjian, "Manufacturing Engineering and Technology", Addision, Wesley Publishing Company, 2006.
5. George E.Dieter, "Mechanical Metallurgy", SI Metric Edition McGraw-Hill
6. Mikell P.Grover "Fundamentals Of Modern Manufacturing : Materials, Processes And Systems" 3rd Edition, Willey Asia.

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ME 314

HEAT TRANSFER

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Note : During examination necessary charts and tables will be supplied.

Objectives:

1. To demonstrate basic knowledge by understanding different modes of heat transfer
2. Students will acquire the basic knowledge in estimating the effectiveness of extended surfaces
3. Students will acquire knowledge in estimating the relationship between various dimensionless numbers for free convection and forced convection
4. Students will acquire the basic knowledge in understanding the principles of radiation and also the application of heat exchangers

Outcomes:

1. Students will be able to understand the differences between conduction, convection and radiation heat transfer
2. Students will be able to estimate the necessity of providing fins for different situations and importance of unsteady state heat transfer in engineering applications
3. Students will be able to differentiate free convection from forced convection and deduce various equations pertaining to convection heat transfer
4. Students will be able to estimate the importance of black body in radiation heat transfer and design heat exchanger by various methods.

UNIT-I

Modes of heat transfer, Laws of heat transfer - Fourier, Newton, Stefan-Boltzmann General conduction equation in cartesian, cylindrical and spherical coordinates, One dimensional steady state conduction through slabs, hollow cylinders and spheres with and without heat generation, Effects of variable thermal conductivity in heat transfer of one dimensional steady state conduction of plates, cylinders and spheres, Steady state heat transfer through composite slabs, cylinders and spheres, Critical radius of insulation,

UNIT-II

Fins: Heat transfer analysis of fins with heat dissipation environment - rectangular straight and pin fins, Application of fin to temperature measurement, Unsteady state conduction, Lumped parameter analysis of a body with negligible internal temperature gradients, Transient heat transfer analysis of finite slab with specified temperature and convective boundary conditions, Use of Heisler charts for solving problems of infinite slabs, cylinders and spheres.

UNIT-III

Convection: Dimensional analysis and its use in free and forced convection, Buckingham theorem, Physical significance of different dimensionless numbers, Application of Von-Karman integral equation for the analysis of thermal boundary layer in forced convection of flat plate, Reynold's analogy for flow over plane surfaces, Calculation of heat transfer for flow over plates, cylinders and for flow through tubes in free and forced convection using empirical formulae.

UNIT-IV

Radiation: Definition of absorptivity, reflectivity and transmissivity, Concept of black-body and emissivity. Kirchoff's law, Planck's black body spectral distribution, Wien's and Steffan-Boltzmann law, Monochromatic and total emissive power, radiant heat exchange between two gray surfaces, Shape factor, Thermal circuit for radiant heat exchange between infinite parallel plates and between concentric cylinders, Enclosures with black and gray surfaces, Radiation shields .

UNIT-V

Heat Exchangers: Classification and applications of heat exchangers in industry, Analysis and design of counter flow and parallel flow heat exchanger, Fouling factors, Solving problems for multi pass heat exchanger using non dimensional parameter plots,

Change of Phase: Boiling-pool boiling regimes, nucleate pool boiling, effect of surface wettability on bubble contact angle, Critical heat flux, boiling in forced convection, Condensation: Film condensation, Drop wise condensation, Condensation film thickness, Heat transfer coefficient in film condensation.

Text Books

1. Holman, J.P., "Heat Transfer", McGraw Hill Publication, New Delhi, 2004
2. Rajput, R.K., "Heat and Mass Transfer", S. Chand & Company Ltd, New Delhi, 2004.

Reference Books

3. Sachdeva,R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age International (P) Ltd Publishers, New Delhi, 2004
4. Sukhatme,S.P., "A Text Book on Heat Transfer,", University Press, 2005.
5. Senegal, " A Text Book on Heat Transfer," TMG, New Delhi
6. Ghoshdastida, Heat Transfer, 2nd Edn., Oxford University Press, 2012.

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DESIGN OF MACHINE ELEMENTS
(USAGE OF DATA BOOK IS COMPULSORY)

Instruction (Periods per week)	4 Periods + 1 Tutorial per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To understand the basics of mechanics of materials and design of a machine for static and fatigue strength, rigidity and wear criterions, use of codes and standards.
2. To know the principles of ergonomic design.
3. To learn the principles to design shafts, keys, belt drives, joints and couplings.
4. To Develop, set-up, and solve mechanical component design problems based upon given data and requirements

Outcomes:

1. Students will be able to design machine elements and systems of machine elements to Successfully satisfy the function of the machine.
2. Student will develop corrective action (define the cause for a problem and the design fixes) for field problems.

Unit-I

Introduction, Materials used in machine design and their specifications to Indian standards. Important mechanical properties of materials used in design. Codes and standards used in design. Reliability, Principles of good Ergonomic Design, Manufacturing considerations. Preferred numbers. Value analysis. Analysis of Stress and Strain : Definition of stress and strain, Types of loading, Direct normal stress, bending stress, Torisonal stress, crushing and bearing stresses, Biaxial stress and Triaxial stress. Theories of elastic failure, Stress concentration factor, factor of safety, Design of components for static loads.

Unit-II

Design for Fatigue and Impact loads; Importance of fatigue in design, Fluctuating stresses, fatigue strength and endurance limit. Factors affecting fatigue strength. S-N Diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue, Miner's rule, Design of components for fatigue. Design of components for impact loading.

Unit-III

Design of keys, shafts – solid hollow stepped shafts and splined shafts under torsion and bending loads. Design of belt drive systems, selection of belts and design of pulleys.

Unit-IV

Design of cotter and knuckle joints, riveted and welded joints under direct and eccentric loading. Design of couplings – Muff and Split Couplings, Flange, Flexible and Marine type of couplings.

Unit-V

Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints, design of power screws and screw jack.

Text Books:

1. V.B. Bhandari, *Machine Design*, Tata Mc Graw Hill Publication, 2010.
2. J.E. Shigley, C.R. Mischne, *Mechanical Engineering Design*, Tata Mc Graw Hill Publications, 2011.
3. Siraj Ahmed, 'Mechanical Engineering Design, PHI, 2014.

Suggested Reading

4. Robert L. Norton, *Machine Design: An Integrated Approach*,2/e Pearson Education, 2013
5. P. Kannaiah, *Machine Design*, Science-Tech Publications, 2010
6. M.F. Spotts, *Design of Machine Elements*, Prentice Hall of India, 2013.

Machine Design Data Books:

1. Design Data Hand book for Mechanical Engineers, K. Mahadevan, K. Balaveera Reddy, CBS Publisher 3rd Edition.
2. Design Data book by PSG College – 2012

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CE 444

HUMAN VALUES AND PROFESSIONAL ETHICS

Instructions	: 21 Periods (7*3)
Duration of End Examination	: 3 Hours
End Examination	: 50 Marks
Credits	: Nil

Objectives:

1. To develop the critical ability among students to distinguish between what is of value and what is superficial in life
2. To enable the students understand the values, the need for value adoption and prepare them meet the challenges
3. To enable the students develop the potential to adopt values, develop a good character and personality and lead a happy life
4. To motivate the students practice the values in life and contribute for the society around them and for the development of the institutions /organisation around they are in.
5. To make the students understand the professional ethics and their applications to engineering profession

Outcomes:

1. Students develop the capability of shaping themselves into outstanding personalities, through a value based life.
2. Students turn themselves into champions of their lives.
3. Students take things positively, convert everything into happiness and contribute for the happiness of others.
4. Students become potential sources for contributing to the development of the society around them and institutions / organisations they work in.
5. Students shape themselves into valuable professionals, follow professional ethics and are able to solve their ethical dilemmas.

UNIT-I Concepts and Classification of Values –Need and challenges for value Adoption

Definition of Values – Concept of Values – Classification of Values – Hierarchy of Values – Types of Values –Espoused and Applied Values – Value judgment based on Culture – Value judgement based on Tradition – Interdependence of Values - Need for value education – Findings of Commissions and Committees- Corruption and illegal practices – Science and Technology without values- Exploitation of nature – Increasing use of violence and intoxicants – Lack of education in values – Implications of education in values – Vision for a better India - Challenges for Value adoption – Cultural, Social, Religious, Intellectual and Personal challenges.

UNIT – II: Personal Development and Values in Life

Personal Development: Enlightened self-interest – Accountability and responsibility – Desires and weaknesses – Character development – Good relationships, self-restraint, Spirituality and Purity – The quest for Character – Tests of Character – The key to good character

Values in Life: Building an ethical policy – Integrating values in everyday life – Archaic Social Values – Parenting practices – Critical Thinking - Analyzing and Prioritizing values – Practicing Yoga and Meditation.

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UNIT – III: Practicing Values for the development of Society

Resentment Management and Self-analysis – Positive Thinking and Emotional Maturity – The importance of Women , Children and Taking care of them – Helping the poor and needy – Fighting against addictions and atrocities – Environmental awareness – Working for the Sustainable development of the society - Values in Education system: Present Scenario- Engineering education – Current trends- Need for quality improvement- Adoption of value education – Principles of Integrity-Institutional Development.

UNIT – IV: Basic Concepts of Professional Ethics

Ethics, Morals and Human life , Types of Ethics, Personal Ethics, Professional ethics, Ethical dilemmas, Indian and Global thoughts on ethics, Profession, Professional and Professionalism, Ethical role of a professional Basic ethical principles, Some basic ethical theories, use of ethical theories - Science, Religion Ethics, Genders and ethics, Media and ethics, Computer Ethics, Case Studies on Professional Ethics, Exemplary life sketches of prominent Indian personalities.

UNIT-V: Ethics in Engineering Profession

Engineering profession-Technology and Society-Engineering as Social Experimentation-Engineering ethics-Ethical obligations of Engineering Professionals-Role of Engineers-Engineers as Managers-Professional responsibilities of Engineers- Engineers Responsibility for Safety- A few Case Studies on Risk management - Conflicts of Interest- Occupational Crimes- Plagiarism-Self plagiarism-Ethics Audit-Consideration for ethics audit-Ethics Standards and Bench Marking

Text Books:

1. Subramanian R., " Professional Ethics " , Oxford University Press , 2013
2. Nagarajan R.S., " A Text Book on Human Values and Professional Ethics " New Age Publications , 2007
3. Dinesh Babu S., " Professional Ethics and Human Values " , Laxmi Publications , 2007

Reference Books:

4. SantoshAjmera and Nanda Kishore Reddy " Ethics , Integrity and Aptitude " ,McGrawhill Education Private Limited , 2014
5. GovindaRajan M., Natarajan S., Senthil Kumar V.S." Professional Ethics and Human Values " Prentice Hall India Private Limited ,2012
6. Course Material for Post Graduate Diploma In "Value Education & Spirituality " Prepared by Annamalai University in Collaboration with Brahma Kumaris , 2010

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ME 316

DYNAMICS AND VIBRATIONS LAB

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessionals	25 Marks
Credits	02

Objectives:

1. To demonstrate basic principle and exposure to evaluate CAM Follower Motion and Gyroscopic.
2. Students will understand the importance of static and dynamic balancing
3. Students will acquire the knowledge in evaluating the stability of dynamic systems.

Outcomes:

1. Students will be able to evaluate the effect of gyroscopic couple and CAM Follower Motions in machines.
2. Students will be able to estimate the performance of governers
3. Students will be able to evaluate the static and dynamic balancing of rotating and reciprocating machines.
4. Students will be able to evaluate the stability of systems under dynamic loading.

List of experiments:

(1) To study the motion of follower with the given profile of the cam. (To plot the n-q (Follower displacement Vs Angle of rotation) curves for different cam follower pairs.

(2) To study the gyroscopic effect on a rotating disc.

(3) Determination of the frequency of torsional vibration.

(4) Static and Dynamic balancing in a Rotating mass system.

(5) Study the effect of varying mass on the centre of sleeve in porter governor.

(6) Study the effect of varying the initial spring compression in Hartnell governor.

(7) Undamped torsional vibrations of single rotor system.

(8) Undamped torsional vibrations of double rotor system.

(9) To study the longitudinal vibrations of helical coiled spring.

(10) To study the undamped forced vibration of spring mass system.

(11)To study the force damped vibration of spring mass system.

(12)Determination of critical speed of the given shaft with the given end conditions. (Whirling of Shafts)

(13)Frequency response of spring mass system with and without damping.

(14)Frequency response with random excitations (Seismic response).

Note: Any 12 experiments need to be conducted

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ME 317

THERMODYNAMICS LAB

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives:

1. To demonstrate basic knowledge and exposure to evaluate the performance of the internal combustion engines of petrol engine and diesel engine
2. Students will understand the importance of heat distribution of internal combustion engine
3. Students will acquire knowledge in evaluating the performance of multi-stage reciprocating compressor
4. Student will come to know to estimate the properties of fuel.

Outcomes:

1. Students will be able to evaluate the performance of petrol and diesel engine
2. Students will be able to estimate the actual heat utilized by petrol and diesel engine
3. Students will be able to evaluate the performance of multi stage reciprocating air compressor and its importance over single stage air compressor
4. Students will be able to evaluate the properties of test fuels for internal combustion engines.

List of experiments:

1. To determine volumetric efficiency, isothermal efficiency and mass flow rate of a two stage reciprocating air compressor.
2. To determine valve/ port timing diagram of a Diesel engine.
3. To conduct performance test on a Diesel engine.
4. To conduct heat balance test on a Diesel engine.
5. To conduct Morse test on multi cylinder Petrol engine.
6. To conduct performance test on multi cylinder Petrol engine.
7. To conduct performance test on a two-stroke Petrol engine.
8. To conduct performance test on multi cylinder Diesel engine.
9. To study the performance of a Petrol engine with variable compression ratios and speeds
10. To determine CO and UBHC emissions from a Petrol engine.
11. To measure smoke emissions from a Diesel engine.
12. Determination of viscosity of lubricating oil.
13. Determination of flash and fire points of a fuel

Note: Any 12 experiments need to be conducted

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ME 318

MANUFACTURING PROCESSES LAB

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives:

1. To make the students acquaint with the welding equipment, forming dies & equipment and the sand casting process.
2. To give the students a feel of working with their hands in the areas of welding, casting and forming.

Outcomes:

1. Students can select the welding processes for a given fabrication.
2. Students are able to suggest the various testing methods required for the moulding sand
3. Students can select the die and can give suitable lay out for shearing operation.

Casting

1. Design and manufacturing a simple pattern with various allowances
2. Green sand moulding practice for a single piece pattern.
3. Green sand moulding practice for a split pattern with a horizontal core.
4. Moulding sand testing: GCS, GSS, DCS, DSS Permeability and shatter index.
5. Testing of Bentonite: gel index and swell index.
6. Finding out the GFN, Moisture content and clay content for a given sand sample
7. Melting & Pouring of Aluminum
8. Dimensional inspection & visual inspection of the casting and analysis of dimensional variation & defects.

Welding

1. Study of gas welding equipment and process. Identification of flames, making Butt joint with gas welding.
9. Study of Arc welding process, comparison of the bead geometry with DCSP, DCRP and A.C.
10. Study of resistance welding process and plot the variation of spot area with time and current variation
11. Study of TIG welding process and plotting cooling curve in TIG welding process.
12. Study of SAW Welding process and finding out deposition efficiency of the process.
13. Study of MIG welding process and testing of weld bead formed by MIG welding.

Metal Forming

14. Evaluation of formability using Ericson coupling test.
15. Design study of progressive die, strip layout and making washers with it.
16. Design study of compound die and making washers with it.
17. Design study of combination die and making cups with it.
18. Study of cup drawing process and formulation of cup with simple die
19. Study of blanking operation and cutting the blanks with simple die

Note: Minimum 12 experiments to be conducted

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ME 321 With effect from the academic year 2015-16

CAD and CAM

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End Examination	75	Marks
Sessional	25	Marks
Credits	3	

Objectives:

1. Understand the basic and advanced concepts of computer aided design. Learn the application of CAD in geometric modeling.
2. Students will develop an understanding of the theory and construct the elements of curved surface representation.
3. Explain solid modeling representation schemes and the Euler operators. Understand and be able to perform two-dimensional and three-dimensional geometric transformations on objects.
4. Have an overview of advantages and disadvantages of modeling and analysis packages..

Outcomes:

1. Students will understand the concepts of CAD and understand the programming concepts Ability to apply mathematics and students learn the theory behind the CAD software they use in the laboratory.
2. Solve engineering problems on the topics included in this theory - geometry manipulation, curve and surface representations.
3. Evaluate mathematical transformation, design and model curves, surfaces and solids.
4. Differentiate between the modeling techniques, and apply the principles of geometric modeling, effectively employ solid modeling tools.

UNIT-I

Design Processes: Design criteria, Alternative solutions, Alternative design, Computer aided design and review

Drafting techniques: Basic geometrics elements and their creation

Geometric modeling: Wire frame entities and their definition, interpolation and approximation curves. Concept of Parametric and non-parametric representation of circle and helix curves, properties of splines. Synthetic curves: parametric representation of cubic spline, Bezier and B-spline curves, continuity, properties and characteristics. Introduction to NURBS.

UNIT-II

Surface modeling: analytic surfaces: definition of planar, surface of revolution, tabulated cylinder, synthetic surfaces: cubic and Bezier surfaces. Solid modeling: C – rep and B – rep approaches

Design application: mass property calculations, mechanical tolerancing, finite element analysis, design review 2 D transformations: translation, scaling and rotation about arbitrary point, shear and reflection, homogenous representation, concatenation

UNIT-III

CAD database and data exchange: CAD database and structure, IGES, STEP and STL format Numerical control machine tools: features and elements of NC, positional, paraxial and contouring types. Definition of axes.Definition of interpolation, post-processor, preparatory and miscellaneous functions, canned cycles, tool length and cutter radius compensation. Manual and computer aided part programming (APT) for simple components. Programming with MACROS.

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UNIT-IV

Computer numerical control: CNC, DNC, adaptive control systems. Typical configurations and relative features. Machining centers. Introduction to FANUC, SINUMERIC controllers. Industrial robots: robot anatomy, configurations, controls, drivers, programming methods and applications.

UNIT-V

GT: Part families, layout, part classification and coding system, Optiz, MICLASS code system. CAPP: variant and generative process planning. FMS and CIM: building blocks of flexible manufacturing system and their control. Elements of CIM. Computer aided inspection and QC: Co-ordinate measuring machine, non contact inspection: machine vision, scanning laser beam devices, Quality control: CAD/CAM integration, Turnkey CAD/CAM systems, Introduction to rapid prototyping technique, reverse engineering.

Text Books:

1. Ibrahim Zeid, CAD/ CAM "theory and practice" , McGraw Hill Inc , New York, 2011
2. Grover MP and Zimmers EW "CAD/CAM" Prentice Hall of India, 1989

Suggested Reading:

3. Arvid R Eide , Roland D Jenison, Lane H Mashaw, Larry L Northup, "introduction to engineering design" McGraw Hill 1998
4. Rao PN "CAD/CAM : Principles and applications" 2nd edition, Tata McGraw Hill, New Delhi, 2004
5. YoramKoren, "Computer control of manufacturing systems" McGraw Hill Int, New York, 1994
6. Elanchezhian C Sunder Selwyn , T Shanmuga Sunder G" Computer Aided manufacturing" , Laxmi Publications (P) Ltd, 2nd edition, New Delhi 2007

ME 322 With effect from the academic year 2015-16

METAL CUTTING & MACHINE TOOL ENGINEERING

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessional	25 Marks
Credits	3

Objectives:

1. To provide the basic understanding of cutting tools, geometry in machining processes
2. To make students familiar with cutting forces in turning drilling, milling operations.
3. To make the students to understand various machine tools, like lathe, drilling, milling shaper, planner,
4. To impart knowledge of Thread manufacturing and gear manufacturing

Outcomes:

1. Students are able to select tool geometry for various materials
2. Students are able to calculate forces in turning, drilling and milling processes
3. Students are capable of identifying the machine tools for manufacturing of various components.
4. Students are able to understand thread cutting and gear cutting operations

UNIT-I

Cutting tool materials: High carbon steel HSS, Stellite, Carbides, Diamonds, Tool materials properties

Tool Geometry: Nomenclature of single point cutting tool by ASA& ORS systems, Geometry of drills, milling cutters

Chip formation: Types of chips, BUE, Chip breakers.

Machining: Orthogonal and oblique cutting, Merchants analysis, Shear angle, Solutions of merchant and Lee &shafer.

UNIT-II

Thermal aspects of Metal Cutting: Sources of heat and heat distribution. Various methods of measurement of temperature, cutting fluids and applications

Tool wear and tool life: Criteria for tool wear, flank and crater wear theories, criteria for tool life in roughing and finishing, Measurement of tool wear, Taylor's tool life equation, factors effecting tool life, Machiniability.

Economics of machining: Tool life for maximum production, minimum cost.

UNIT-III

Lathes: Types constructional features, size of lathe, various operations that can be performed on lathes types of lathes, capstan and turret lathes, bar work and chuck work and tool holding devices. Taper turning methods. Thread cutting and accessories of lathe

Drilling Machines: Types and constructional features and applications, Radial drilling machine, drilling operations

Milling Machines: Classifications and types various operations on milling machines, Up and down milling. Types of milling cutters and bars. Dividing head, plain, compound and differential indexing.

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UNIT-IV

Boring machines-Horizontal, Vertical and Jig boring machines and constructional features. Differences between Shaper, Planner and slotter, Quick return mechanisms

Grinding Machines: Types, Classification Abrasives and bonds used for grinding wheel, Selection of grinding wheel, cylindrical grinding and center less grinding.

Screws and Thread production – Thread rolling, thread chasing , thread milling and thread grinding. Gear shaping, gear hobbing, gear shaving and gear grinding

UNIT-V

Jigs and Fixtures: Design principles for location and clamping. Quick clamping devices. Types of jigs and fixtures

Unconventional machining: Principles of working and applications USM,AJM,EDM,ECM,LBM and EBM(Mechanisms and theory MRR and Process parameters in each case)

Text Books:

1. B.L. JuneJa and Shekon, *"Fundamentals of Metal Cutting & Machines Tools"*, Wiley Eastern Ltd. 1987.
2. P.N. Rao, *"Manufacturing Technology – Metal Culling & Machine Tools"*, Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.

Suggested Reading:

3. Jain K.C Chitale, A.K., 'Production Engineering', 2nd Edn., PHI, 2014.
4. M.C. Shaw, "Metal Cutting Principles", Clarendon Press, Oxford 1984.
5. P.C.Pandey & Shan HS "Modern Machining process" Tata McGraw-Hill Education 1980
6. A. Bhattacharya "Metal Cutting Theory and Practice" New Central Book Agency (p) Ltd Calcutta, 1996

ME 323

HYDRAULIC MACHINERY AND SYSTEMS

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. The purpose of this course is to learn the Fluid properties and fundamentals of Fluid statics and fluid flow
2. To introduce the concepts of flow measurements and flow through pipes
3. To introduce the concepts of momentum principles
4. To impart the knowledge on pumps and turbines

Outcomes:

1. Graduates will become familiar with the impact force of jet on different types of vanes.
2. Graduates demonstrate the ability of servicing of reciprocating and centrifugal pumps.
3. Graduates are expected to have ability to design the turbines for power generation.
4. Graduate demonstrate the ability of designing various hydraulic appliances.

UNIT-I

Hydraulic Machines- Classification- Impulse-momentum equation- Lay-out of hydraulic power plant- working principle- Impact jet on vanes- Force exerted by a jet striking (i) a fixed flat vertical vane held normal to the jet flow (ii) at the centre of a fixed symmetrical curved vane (iii) at one end of fixed symmetrical and unsymmetrical curved vanes (iv) flat vertical vane moving in the direction of jet (v) a series of flat vertical moving vanes (vi) at the centre of symmetrical moving curved vanes (vii) symmetrical curved vanes moving in the same direction as that of jet at inlet (viii) at one end of a series of un-symmetrical moving curved vanes

UNIT-II

Reciprocating Pumps: Classification- working principle- single and double acting pumps- discharge, work done and power required to drive the pumps- slip, % slip and negative slip- Variation of pressure head in the suction and delivery pipes due to acceleration of piston- Variation of pressure head due to friction in the suction and delivery pipes- Indicator diagrams- Ideal and actual diagrams- Effect of piston acceleration and pipe friction on indicator diagram- Maximum speed at which the pump must run to avoid separation during suction and delivery strokes- Air vessels- Function of air vessels- Work saved by fitting air vessels to single and double acting pumps- Discharge of liquid into and out of air vessels- Performance characteristic curves

UNIT-III

Centrifugal pumps: Classification- Working principle- Comparison over reciprocating pumps-Velocity triangles- Manometric head- work done per second- Head equivalent of work done- Manometric, mechanical and overall efficiencies- Pressure rise in the impeller- Minimum starting speed- Specific speed- Physical significance of specific speed- Model testing- Conditions of similarity of CF pumps- Priming- Performance characteristic curves- Troubles (operational difficulties), reasons and remedies in CF pumps- Cavitation- effects of Cavitation- Precautions against Cavitation

UNIT-IV

Hydraulic Turbines: Classification- Impulse and reaction turbines- Construction and working of Pelton wheel, Francis turbine and Kaplan turbine- Velocity triangles- Work done (power developed)- Hydraulic, Mechanical and Overall efficiencies- Maximum efficiency- Comparison between Impulse and reaction turbines- Comparison between Francis and Kaplan turbines- Specific speed- Physical

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significance of specific speed- Unit testing -Unit quantities- Model testing of turbines- Conditions for similarity of turbines- Draft tubes (functions and types only)- Surge tanks(functions and types only) - Performance characteristic curves

UNIT-V

Hydraulic Systems (appliances): Working and simple problems on hydraulic press- force applied on the plunger to lift a load- power required to drive the plunger- number of strokes performed by the plunger to lift a load- accumulator- capacity of accumulator- load on the ram- intensifier- Ram- D'Aubuison's and Rankine's efficiency of the ram- jack- lift- direct acting hydraulic lift- Suspended hydraulic lift- crane- efficiency of the crane- air lift pump- gear wheel pump- Control vales (functions and classification only)

Text Books:

1. Bansal, R.K., *"A Text Book of Fluid Mechanics and Hydraulic Machines"*, Laxmi Publication (P) Ltd., New Delhi,2004
2. Modi, P.N. and Seth. S.M., *"Hydraulics and Fluid Machines"*, Standard Book House, New Delhi, 2004

Suggested Reading

3. Ramamrutham, S., *"Hydraulics,Fluid Mechanics and Fluid Machines"*, Dhanpat Rai & Sons, New Delhi,2004
4. Kumar, K.L., *"Engineering Fluid Mechanics"*, Eurasia Publishing House (P) Ltd., New Delhi,2004
5. White, Frank. M., Fluid Mechanics, 5th Edn., McGraw Hill 2003.
6. Madan Mohan Das., "Fluid Mechanics and Turbomachines", PHI Learning Private Limited, New Delhi, 2009

ME 324

With effect from the academic year 2015-16

REFRIGERATION AND AIR CONDITIONING

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. Students will acquire the basic knowledge about the importance of refrigeration and its applications in engineering practice
2. To demonstrate basic knowledge of various types of refrigeration processes like air refrigeration, simple vapor compression refrigeration and absorption refrigeration, steam jet refrigeration and un-convectional refrigeration
3. Students will acquire the basic knowledge on various psychrometric processes
4. Students will acquire knowledge in estimating air conditioning loads

Course Outcomes

1. Students will be able to differentiate refrigeration from air conditioning
2. Students will be able to understand merits and demerits of various refrigeration processes
3. Students will be able to apply a suitable psychrometric process depending on requirement or application
4. Students will be able to design air conditioning system for a particular application

UNIT-I

Introduction to Refrigeration: Definition of Refrigeration and Air-conditioning, Necessity of Refrigeration and its applications, Methods of Refrigeration, Unit of Refrigeration and C.O.P. Reversed Carnot cycle, Limitations, Effect of operating temperatures,

Properties of Refrigerants: Survey, Designation, Desirable properties of refrigerants, Thermodynamic, Chemical and Physical properties, Classification of Refrigerants, Alternative refrigerants, Substitute for CFC Refrigerants, Global warming, Green House Effect and Future of Refrigerants.

Air Refrigeration Systems: Analysis of Bell-Coleman Cycle, Reversed Brayton cycle, Open and Dense air system, Application to aircraft refrigeration, Simple cooling system, Bootstrap simple evaporating system, Regenerative cooling system and Reduced ambient cooling system.

UNIT-II

Vapour compression system: Working principle and essential components of Simple vapor compression Refrigeration cycle, Compressor, condenser, evaporator, and expansion devices, Analysis of cycle, C.O.P, Representation of the cycle on T-S, P-H and H-S charts

Dry and wet compression, Effect of operating conditions like evaporating pressure, condenser pressure, Liquid sub-cooling and Vapor super heating, Performance of the system. Low temperature refrigeration system (with single load system), Compound compression with water inter cooler and Flash intercooler, Cascade refrigeration system-Analysis and advantages

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UNIT-III

Vapour Absorption Refrigeration System; Simple absorption systems, COP, Practical ammonia absorption refrigeration system, Lithium bromide absorption system, Electrolux refrigerator, Common refrigerants and absorbents properties, Comparison with vapor compression refrigeration system

Steam Jet Refrigeration: Principle of working, Analysis of the system, Advantages, limitations and applications.

Non-Conventional Refrigeration Systems: Principle and operation of Thermoelectric Refrigeration Systems, Seebeck effect - Peltier effect - Thomson effect, Analysis, Pulse tube refrigeration system.

Introduction to Cryogenics- Advantages, Limitations and applications

UNIT-IV

Psychrometry- Psychrometric properties, Psychrometric chart, construction, Representation of Psychrometric processes on the chart, Heating and Cooling with Humidification and Dehumidification, Adiabatic dehumidification, Adiabatic chemical dehumidification and mixing processes

Introduction to Air Conditioning Requirements of comfort air conditioning, Thermodynamics of human body, Body temperature, Metabolism, Body defense and Human tolerance, Effect of heat on performance, ASHRE comfort chart, Effective temperature.

UNIT-V

Cooling Load Calculations in Air Conditioning: Concept of bypass factor, Sensible heat factor, Apparatus Dew Point, Room Sensible Heat Factor (RSHF), Gross Sensible Heat Factor (GSHF), Different heating and cooling loads, Problems.

Design of air conditioning systems: All fresh air, Re-circulated air with bypassed air, Design of Summer, Winter and Year round air conditioning systems, Energy conservation in air conditioned building.

Air Conditioning Systems: Types, Components of air conditioner equipments, Humidifier, Dehumidifier, Filter. **Applications of Refrigeration and Air conditioning** Food Preservation, Transport air conditioning, and Industrial applications

Text Books

1. Arora C.P., " *Refrigeration and Air conditioning*", Tata McGraw Hill, New Delhi, 2004.
2. Stocker, W.S., "*Refrigeration and Air conditioning*", McGraw Hill, New Delhi, 2004.

Suggested Reading

3. Jain, V.K., "*Refrigeration and Air Conditioning*", S Chand & Company, New Delhi, 2004.

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4. Manohar Prasad, "*Refrigeration and Air Conditioning*", New Age International, Allahabad, 2007.
5. Rajput, R.K., "*Refrigeration and Air Conditioning*" Laxmi Publications, New Delhi, 2007
6. Edward G Pita, Air conditioning Principles and Sytems: An Energy Approach,4th edn,PHI,2012

With Effect from the Academic Year 2015-2016

ME 325

MACHINE DESIGN
(USAGE OF DATA BOOK IS COMPULSORY)

Instruction	4 Periods + 1 Tutorial per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To learn design criteria of machine components, selection of materials and manufacturing process.
2. To learn application of principles to design helical coiled and leaf springs, gears, curved beams, sliding contact and rolling element bearings and IC engine components.
3. To provide the design concepts of helical and leaf springs.
4. To provide the students the knowledge of design of IC engine parts.

Outcomes:

1. Graduates will become familiar with the design of springs, gears, bearings, engine parts and curved beams.
2. Graduates demonstrate the ability of designing helical springs and leaf springs for static and fluctuating costs.
3. Graduates are expected to have ability to design gears for power transmission considering beam strength, dynamic factors and wear life.
4. Graduate demonstrate the ability of designing curved beams likec-clam and crane hooks.

Unit-I

Mechanical springs: Introduction. Different types of springs. Materials used for springs.

Helical Springs: Whal factor, calculation of stress, Deflection and energy stored in spring. Design for static and fluctuating loads.

Leaf Springs: Stress and Deflection. Nipping of Leaf springs. Design for static and fluctuating loads.

Unit-II

Gears: Introduction of gear drives, different types of gears, Materials used for gears. Standards for gears and specifications.

Spur Gear Design: Lewis equation, Beam strength of gear tooth and static design. Wear load and design for Wear. Dynamic loads on gear tooth. Design of Helical, Bevel and Worm gears, concepts of Design for manufacturability.

Unit-III

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Bearings: Introduction. Materials used for Bearings. Classification of bearings and mounting of bearings.

Design of sliding contact bearings: Properties and types of Lubricants, Design of Hydrostatic and Hydrodynamic sliding contact bearings.

Design of Rolling Contact Bearings: Different types of rolling element bearings and their constructional details, static load carrying capacity. Dynamic load carrying capacity. Load-life relationship, selection of bearing life. Design for cyclic loads and speeds. Design of Ball and Roller bearings.

Unit-IV

I.C. Engine parts: Introduction. Materials used. Design of piston, connecting rod and crank for I.C. Engines.

Unit-V

Design of curved beams: Introduction stresses in curved beams, expression for radius of curvature of neutral axis for rectangular, circular, trapezoidal and T-sections. Design of crane Hook, C-clamp.

Design of chain drives: Power rating of roller chains. Strength of roller chains.

Text Books:

1. Bhandari V.B. *Machine Design*, Tata Mc Graw Hill Publications, 2010.
2. J.E. Shigley , C.R. Misckhe, *Mechanical Engineering Design*, Tata Mc Graw Hill Publication, 2010.

Suggested Reading:

3. P. Kannaiah, *Machine Design*, Science-Tech Publications, 2010.
4. M.F. Spotts, *Design of Machine Elements*, Prentice Hall, 2013.
5. Robert L. Norton, *Machine Design: An Integrated Approach*,2/e Pearson Education, 2013.
6. Siraj Ahmed, 'Mechanical Engineering Design, PHI, 2014.

Machine Design Data Books:

7. Design Data book by PSG College – 2012
8. Mahadevn .K, Balaveera Reddy. K, 'Design Data Hand Book, 4th Edn., CBS Publishers & Distributors, 2013.

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ME 351

CONTROL SYSTEMS THEORY (Elective-I)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To introduce students to the fundamental of feedback control system theory.
2. Use of analytical design methods in designing, analyzing various physical systems and to apply the gained knowledge in developing solutions for real world systems.
3. To develop the ability of formulating mathematical models and designing feedback control systems.
4. To provide students with necessary tools to analyze linear feedback control systems.

Outcomes:

1. Students should be able apply major equations of linearized models and their transfer function
2. Student are learned to apply Final-value Theorem to determine the steady-state response
3. Students should be able to understand how to construct Bode and polar plots for transfer functions
4. Students should be able to understand the applications of Nyquist criteria to find Gain and phase margins

Unit-I

Control Systems Classification: Open Loop & Closed Loop Systems. Mathematical models and Transfer functions from governing equations of mechanical, electrical, hydraulic, pneumatic, thermal systems. AC, DC servomotors & Electromechanical servo systems.

Unit-II

Block diagrams, Block diagram reduction. Signal flow graphs, Mason's gain formula. Transient response. Time domain specifications of 1^{st} and 2^{nd} order systems. Steady state error, Error coefficients, sensitivity and Performance indices.

Unit-III

Routh criteria, Root Locus method. Frequency Response: Bode, Polar plots. Correlation between transient and frequency response, Bandwidth, Experimental determination of transfer functions.

Unit-IV

Nyquist criteria. Gain and phase margins, Lead. Lag and Lead-lag compensator design, PID controller, linearization of Non linear systems.

Unit- V

State space representation: Concept of state, State variable, state models of linear time invariant systems, derivation of state model from transfer functions and differential equations. State transition matrix, solution of state equations by time domain method. Concept of controllability and observability.

Text Books:

1. Ogata, K., *"Modern Control Engineering"*, Prentice Hall, 2004
2. M. Gopal, *"Control Systems"*, Tata McGraw Hill, 2004.

Suggested Reading:

3.Anand kumar.A "control systems", Prentice Hall of India,2014
4. Norman S. Nise, *"Control Systems Engineering"*, John Wiley & Sons, Inc., 2001
5. M. Gopal, 'Modern Control System Theory', New Age International, 1993
6. K.R. VARMAH, 'Control Systems' McGraw Hill, June, 2010

PE 324 **ADDITIVE MANUFACTURING (Elective-I)**

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:
1. To make students understand the basic concepts of various rapid prototyping technologies.
2. To understand and apply criterion for selecting appropriate RPT technique for any given application.
3. To competently use tools to explore digital manufacturing techniques and CAD modeling software

Outcomes:
1. Describe various CAD issues for rapid prototyping and related operations for STL model manipulation, formulate and solve typical problems on reverse engineering
2. Explain and summarize the principles and key characteristics of RP technologies and commonly used RP systems& typical rapid tooling processes for quick batch production of plastic and metal parts
3. The students will be able to critically explore technologies used for rapid prototyping in terms of their parameters, application, limitations, cost, materials, equipment, outcomes and implications

UNIT-I

Introduction to rapid manufacturing, customization and mass customization, classification of rapid manufacturing processes (additive,/subtractive/formative), process chain for additive and other rapid manufacturing processes. Classification of additive (layered) prototyping/ tooling/ manufacturing processes.

UNIT-II

Extruder deposition system, laminated object manufacturing and laminated tooling systems, shaped deposition manufacturing and modular configuration, stereolithography and other liquid based systems. Laser sintering based technologies and their related details

UNIT-III

Construction and basic AM machines: construction of CNC machine – axes, linear motion guide ways, ball screws, motors, bearings, encoders/glass scales, process chamber, safety interlocks, sensors

UNIT-IV

Pre-processing in AM: Pre-processing of CAD model- STL conversion, STL error diagnostics, support generation, transformations, slicing, surface preparation of materials, pre-heating of powders.

UNIT-V

Post processing in AM: Post processing equipment – support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non – thermal and thermal techniques.

Text Books:

1. Gibson I, Rosen DW and Stucker B; Additive manufacturing methodologies : Rapid prototyping to direct digital manufacturing , Springer , 2010
2. Venuvinod, PK; Ma, W; Rapid prototyping – Laser based and other technologies, Kluwer , 2004

Suggested Reading:

3. Chee Kai Chua, Kah Fai Leong , 3D printing and additive manufacturing : principles and application: fourth edition of rapid prototyping
4. Rapid tooling : Technologies and industrial applications by Jacob, Paul F
5. Andreas Gebhanrdt, Understanding Additive Manufacturing,Hanses,2012
6. Alain Brnard, Georges Talliander,Additive Manufacturing,Wiley,2014

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HUMAN RIGHTS AND LEGISLATIVE PROCEDURE (Elective-I)

Instruction	4 Periods per week
Duration of End Examination	3 Hrs
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: To help students

1. To understand the value of human rights
2. To understand the Lawful rights available to him and others
3. To create understanding the rights of under privileged and respect them
4. To understand role of an individual in the Civil Society

Course Outcomes:

1. At the end of the course student will understand the process of evolution of human rights
2. Will understand constitutional protection available
3. Will understand the conditions of under privileged persons and will adopt a positive attitude towards.
4. Will understand the role of Law in protecting environment and will recognize right to life.

Unit-I

Meaning and concept of Human Rights: Notion and classification of Rights, Moral and Legal Rights, Three generations of rights (Civil, and Political Rights, Economic Social and Cultural Rights, Collective/Solidarity Rights). Indian Bill of Rights and Sarodaya. Preamble of Indian Constitution, Fundamental Rights-Directive Principles-Fundamental Duties

Unit-II

Human Rights enforcement mechanism Human Rights Act, 1993, Judicial organs-Supreme Court (Art 32) and High Court (Art 226), Human Rights Commission, National and State Commission of Women/Children/Minority/SC/ST

Unit-III

A Right to development, Socio-Economic and Cultural Effects of Globalization, Right to Education, Transparency in Governance and Right to Information, Consumer Protection act.

Unit-IV

Environment Rights such as right to clean environment and public safety: Issues of Industrial Pollution, Prevention, Rehabilitation: Safety aspects of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment.

Unit-V

Role of Advocacy Groups: (a) Professional bodies: Press, media role of Lawyers – Legal Aid., (b) Educational Institutions (c) Role of Corporate Sector (d) N.G.Os

Text Books:

1. The history of Human rights by M.r. Ishay, Orient Longman, Newdelhi, 2004.
2. S.N. Chaudhary, Human Rights and Poverty in India: Theoretical Issues, Delhi: Concepts, 2005.
3. Anuradha Kumar, Encyclopedia of Human Rights Development of under Privilege, New Delhi: Sarup, 2002.
4. P.M. Katare and B.C. Barik, Development, Deprivation and Human Rights, Violation, New Delhi: Rawat, 2002.

Reference Books:

5. Venket Iyer, (ed.), Democracy, Human Rights and the Rule of Law: Essays in Honour of Nani Palkhivala, New Delhi: Butterworth's, 2000.
6. R.J. Cook and C.G. Ngwena (ed.), Health and Human Rights, OUP, Clarendon, 2007.
7. UNESCO, Ethics of Science and Technology: Explorations of the Frontiers of Science and Ethics, OUP, Clarendon, 2006.
8. K.P. Saksena, (ed.), Human Rights and the Constitution: Vision and the Reality, New Delhi: Gyan Pub.,

2003

PE 353

With effect from the academic year 2015-16

VALUE ENGINEERING (Elective-I)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To enable students to understand the concepts & applications of Value Engineering.
2. To know various alterations processing techniques & materials used in manufacturing.

Outcomes:

1. Ability to apply the concepts of Value Engineering in the context of engineering
2. Ability to apply the concepts of value engineering to various products to be manufactured in industries and in turn to minimize the cost

UNIT-I

An overview of value engineering (VE)-Definition, concepts and approaches of value analysis, concepts and approaches of value analysis and engineering-evaluation of VE. Evaluation of function, problem setting system, problem solving system, setting and solving management decision.

UNIT-II

Type and Services problem, evaluation of value. Results accelerators, basic steps in using the systems value analysis.

UNIT-III

Understanding the decision environment, effect of value analysis on other work in the business. VE Team, coordinate, designer, different services, definitions.

UNIT-IV

Construction Management Contracts Value Engineering Case studies, effective organization for value work, function analysis system techniques- FAST diagram.

UNIT-V

Case Studies: A student is expected to associate with any local industry where Value Engineering is applied and submit a report (or) a question may be set involving a case study where a student has to apply creative idea to reduce the cost without compromise to the end use of the product.

Text Books:

1. Value Engineering by L.D. Miles, Mc-Grawhills
2. Value Engineering Theory by D.E. Parker, Sundarm Publications

Suggested Readings:

3. Value Engineering – practical applications for design, construction and operations by ALPHONSE DELL'LSOLA
4. Value Engineering Practical applications by Dr. John N. Parrigin
5. Value Engineering Mastermind Concept to Value Engineering certification by Anil Kumar Mukhopadhyaya

6. Value Engineering A plan for invention by Richard Park

With effect from the academic year 2015-16

PE 354

SURFACE ENGINEERING (Elective-I)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To impart knowledge on surface engineering and surface modification methods that will come in handy to solve the industrial problems.
2. This will also serve as a precursor for future research in the same field.

Outcomes:

1. Engineering and surface modification methods which are necessary to solve the industrial practical problems that arise and also for the research.
2. It helps the students to get familiarized with the various theories and practice on surface.

UNIT I FRICTION

Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non metallic materials – Friction in extreme conditions – Thermal considerations in sliding contact

UNIT II WEAR

Introduction – Abrasive wear, Erosive, Cavitation, Adhesion, Fatigue wear and Fretting Wear- Laws of wear – Theoretical wear models – Wear of metals and non metals - International standards in friction and wear measurements

UNIT III CORROSION

Introduction – Principle of corrosion – Classification of corrosion – Types of corrosion – Factors influencing corrosion – Testing of corrosion – In-service monitoring, Simulated service, Laboratory testing – Evaluation of corrosion – Prevention of Corrosion – Material selection, Alteration of environment, Design, Cathodic and Anodic Protection, Corrosion inhibitors.

UNIT IV SURFACE TREATMENTS

Introduction – Surface properties, Superficial layer – Changing surface metallurgy – Wear resistant coatings and Surface treatments – Techniques – PVD – CVD – Physical CVD – Ion implantation – Surface welding – Thermal spraying – Laser surface hardening and alloying, Applications of coatings and surface treatments in wear and friction control – Characteristics of Wear resistant coatings – New trends in coating technology – DLC – CNC – Thick coatings – Nano-engineered coatings – Other coatings, Corrosion resistant coatings.

UNIT V ENGINEERING MATERIALS

Introduction – Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Applications – Bio Tribology Nano Tribology.

Text Books:

1. G.W.Stachowiak & A.W .Batchelor , "Engineering Tribology", Butterworth-Heinemann, UK, 2005
2. Rabinowicz.E, "Friction and Wear of materials", John Willey &Sons ,UK,1995

Suggested Readings

3. Halling, J. (Editor) – "Principles of Tribology ", Macmillian – 1984.
4. Williams J.A. "Engineering Tribology", Oxford Univ. Press, 1994.
5. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,"Fundamentals of Tribology", Prentice –Hall of India Pvt Ltd

New Delhi, 2005

6. Fontana G., "Corrosion Engineering", McGraw Hill, 1985

With Effect from the academic Year 2015-16

ME 353 **MECHANICAL VIBRATIONS (Elective-I)**

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To gain the knowledge of mathematical modeling of a physical system and applying the principles of Newton's Second Law and conservation of energy to derive the equations of motion.
2. To study the response of a vibrating system with periodic excitation and understand the principle of vibration isolation.
3. To develop the equations of motion for a continuous system in elongation, bending and torsion to find the natural frequencies and mode shapes.

Outcomes:

1. Develop a mathematical model for a physical system and derive the governing differential equations.
2. Determine the natural frequencies of single and two degrees of freedom systems without and with damping.
3. Determine and analyze the response of machine members or structures in forced vibration with different excitation frequencies.
4. Determine the natural frequencies and mode shapes of bars in elongation and torsion and beams in bending.

UNIT-I

Fundamentals of Vibrations Analysis- Introduction; Elements of vibration; vibration analysis procedure; spring elements-equivalent stiffness; Mass or inertia elements; Damping elements-equivalent damping-Types of damping, Definitions and Terminology, Simple harmonic motion.

Free Vibration Analysis-Single Degree of Freedom Systems Undamped Vibrations: Different methods for equation of motion-Newton's Second Law, D'Alembert's Principle of Virtual displacement, Principle of Conservation of Energy, Rayleigh's method.

Damped Vibrations: Differential equation of motion, critical damping coefficient and damping ratio; Damped natural frequency; Logarithmic decrement; Energy dissipated in viscous damping.

UNIT-II

Forced Vibration Analysis (Single Degree of Freedom System): Response of damped and undamped systems to harmonic excitation; frequency response curve; magnification factor; Harmonic excitation of the base, vibration isolation, transmissibility, force transmission to foundation; response of a damped system under rotating unbalance.

Vibration measuring instruments-working principle of Seismic mass, Vibrometer, Accelerometer.

UNIT-III

Damped and Undamped Vibrations: Free and forced vibration analysis of two degree of freedom system-different methods for the formulation of equation equations of motion, natural frequencies,

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Principal modes-physical interpretation and orthogonality, General method, Eigen value method, Influence coefficients.

UNIT-IV

Torsional Vibrations: Torsional vibration of one, two and three rotor system, Equivalent shafting, Torsional vibration of a geared system, Coordinate coupling-static and dynamic coupling, whirling of rotating shafts.

UNIT-V

Vibrations of Continuous Systems: Vibrations of strings, bars and beams, formulation of equation of motion, characteristic equation, Eigen values, identification of node and mode shape

Text Books:

1. G.S. Grover & Nigam ,Mechanical Vibrations,Nem Chand & Bros, 6th edn,1998
2. S.S. Rao ,Mechanical vibration, 4th edn, Pearson, 2009

Suggested Readings:

3. Thomson , William T, Theory of Vibration with Application,4th edn, Pearson Education,2007
4. V.P. Singh , Mechanical vibration, Dhanpath Rai &Co.,3rd edn,2006
5. Graham Kelley,S., Mechanical vibration – Schaums Outline Series, TMH
6. F.S. Tse, Morse & Hinkle ,Mechanical vibration, Allyn and Bacon, 1978

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ME 326

CAD and CAM LAB

Instruction	3	Periods per week
Duration of End Examination	3	Hours
End Examination	50	Marks
Sessionals	25	Marks
Credits	2	

Objectives:

1. 3D Part modeling – protrusion, cut, sweep, draft, loft, blend, rib , Editing – Move, Pattern, Mirror, Round, Chamfer
2. Assembly (Coupling, Screw jack) – creating assembly from parts – assembly constraints
3. Conversion of 3D solid model to 2D drawing - different views, sections, isometric view and dimensioning , mass property calculations
4. To learn and develop the skill in creating a component by utilizing the Automated Machines.

Outcomes:

1. Draw complex geometries of parts in sketcher mode.
2. Generate freeform shapes in part mode to visualize parts.
3. Create complex engineering assemblies using appropriate assembly constraints.
4. Develop various machine components and their assembly using modeling software
5. Write part programs using G and M codes for lathe and milling operations

Detailed Syllabus:

1. Introduction to Solid Modeling & Solid Works Package, Working with sketch mode of Solid Works
2. Working with creating features and applying on various part models
3. Part modeling of cotter, Knuckle Joints and Couplings
4. Generating, editing and modifying drawings in SolidWorks.

5-8. Assembly modeling of the following
   (a) Screw Jack (b) Stuffing Box (c) Plumber Block (d) Eccentric

9. Generating design drawings with tolerencing from part and assembly modeling

10-11. Step Turning, Taper Turning and Multiple Turning On CNC Lathe Machine

12. Contouring and Facing on CNC Milling Machine

13. Rectangular & Circular pocketing on CNC Milling Machine.

14-15. User of CAM software for various maching operations

Note: Any 12 experiments need to be conducted

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ME 327

METAL CUTTING & MACHINE TOOL ENGINEERING LAB

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives

1. To grind single point cutting tool using HSS as cutting tool
2. To have work shop practice on lathe drilling and milling machines
3. To understand gear cutting and to cut gear on milling machine
4. To measure cutting forces during machining on Lathe machine, milling

Out comes:

1. Student is able to grind single point cutting tool with various angles
2. Student is able to produce various components on lathe, milling machines
3. Student is able to manufacture a gear using milling machine
4. Student is able to measure cutting forces during machining on Lathe machine, milling

List of Experiments:

1. Introduction to Machine Tools, like Lathe, Drilling, Milling and Shaper.
2. Plain and step turning operations on Lathe
3. Step turning and Knurling on Lathe machine
4. Taper turning on Lathe
5. Drilling and Boring on Lathe
6. Thread Cutting on Lathe
7. Grinding of Single Point Cutting Tool
8. Gear Cutting using (a) Plain Indexing (b) Compound Indexing using universal dividing head
9. Measurement of Cutting forces during machining on Lathe machine, milling machine
10. Finding Shear angle experimentally in turning operation
11. Grinding flat surfaces using surface grinding machine and measurement of surface finish
12. Study of Electro Discharge Machining (EDM)
13. Measuring the temperature during machining in lathe and milling

Note: Any 12 experiments need to be conducted

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ME 328

HYDRAULIC MACHINERY AND SYSTEMS LAB

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives:

1. The purpose of the lab course is to support the understanding of the application of theoretical concepts of hydraulics machinery.
2. To conduct performance tests on pumps, turbines and other hydraulic machines.

Outcomes:

1. Student is able to verify the Bernoulli's equation and reasons for it.
2. Student is able to determine the friction factor for a pipe made of a material
3. Student is able to determine impact force of jet on vanes
4. Student is able to determine the performance of (efficiency) of pumps and turbines.

Experiments:

1. Verification of Bernoulli's equation
2. Determination of Darcy's friction factor and nature of water flow through pipes
3. Determination of Cd for V- notch
4. Determination of Cd for rectangular notch
5. Determination of Cd for venturimeter
6. Determination of Cd for Orificemeter
7. Determination of impact force of jet on fixed flat and fixed curved vanes
8. Performance and characteristic curves of reciprocating pump
9. Performance and characteristic curves of centrifugal pump
10. Performance and characteristic curves of self priming pump
11. Performance and characteristic curves of gear pump
12. Performance and characteristic curves of Pelton wheel
13. Performance and characteristic curves of Francis Turbine under constant speed and variable speed conditions
14. Performance and characteristic curves of Kaplan turbine under constant speed and variable speed conditions

Note: Any 12 experiments need to be conducted

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ME 329

INDUSTRY VISIT

At least 3 days in a semester	3 x 8 = 24 Hours
Sessionals	Grade*

A minimum of two industrial visits will be arranged by department and students have to attend the visits and prepare a data report of their visits to the industries and submit to the department. Students are required to present a seminar based on their report which is evaluated by Head of the Department and two senior faculty to award the grade.

* Excellent / Very Good / Satisfactory / Unsatisfactory

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With Effect from the Academic Year 2016 - 2017

ME 411

Thermal Turbo Machines

Instruction	4 Theory + 1 Tutorial Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Student will demonstrate basic knowledge by understanding concepts of various gas dynamics equations, necessary for CFD
2. Student will acquire basic knowledge in designing of nozzles and diffusers used in rockets and aircrafts
3. Student will come to know the design of ducts, combustion chambers and various types of shocks
4. Student will come to know the working principles of various rotary compressors like centrifugal compressor and rotary compressor
5. Student will understand the applications of various steam turbines and velocity triangles in order to calculate power developed by them
6. Student will demonstrate the basic knowledge in gas turbines and various methods to improve efficiency of gas turbine cycles.

Outcomes: At the end of the course, students will be able to

1. Design various configurations of steam nozzles by the principles of gas dynamics which are essential or pre-requisite to computational fluid dynamics
2. Understand Fanno curves along with shock waves
3. Understand the importance of Rayleigh curves in gas dynamics
4. Calculate power required by various types of rotary compressors with the principles of gas dynamics
5. Specify steam turbine as per the application and also calculate power developed by them
6. Calculate thermal efficiency of gas turbines with the principles of gas dynamics and suggest suitable methods to improve work output and efficiency of the plant.

UNIT-I

Introduction to compressible flows: Speed of propagation of pressure waves, Mach number, Acoustic velocity and Mach cone, limits of compressibility, pressure field due to a moving source of disturbance, one dimensional compressible flow. Isentropic flow with variable area, Mach number variation, Area ratio as function of Mach number, flow through nozzles and diffusers. Flow in constant area ducts with friction-Fanno flow, variation of flow properties, variation of Mach number with duct length, isothermal flow with friction

UNIT-II

Flow in constant area duct with Heat Transfer, -The Rayleigh liner, Rayleigh flow relations, variation of flow properties, Maximum heat transfer. Flow with Shock Waves-Development of Normal Shock waves, governing equations, Prandtl -Meyer relation, Rankine-Hugoniot equations, Stagnation pressure ratio across shock.

UNIT-III

Blade nomenclature of an aerofoil, Rotodynamic compressors: Introduction and general classification, Comparison of Reciprocating and Rotary compressors, Positive displacement Rotary compressors, Flow through rotary compressors. Static and total head quantities, Thermodynamic cycles and work done, calculation of various efficiencies. Velocity diagrams and prewhirl. Euler equation for energy transfer between fluid and rotor, Analysis of Centrifugal compressors and analysis of axial flow compressors, Chocking, Surging and Stalling.

UNIT-IV

Steam Turbines: Classification, flow over blades, pressure velocity variations, Compounding of steam turbines- pressure compounding, velocity compounding and pressure-velocity compounding, Impulse turbine with several blade rings, Nozzle efficiency, Blade efficiency and Gross stage efficiency of Impulse turbine, Velocity diagrams for Impulse turbine-De Laval Turbine, blade efficiency of Impulse turbine, Optimum blade speed ratio, Maximum work done and blade efficiency of Impulse turbine, Degree of reaction of Reaction turbine, Parson Reaction turbine, Velocity diagram for Parson Reaction turbine, blade efficiency of Parson Reaction turbine, Maximum work done and blade efficiency of Parson Reaction turbine, Height of blades of Reaction turbine, Balancing of End thrust

UNIT-V

Gas Turbines: Applications and Classification of Gas Turbines- constant pressure and constant volume gas turbines, Joule cycle-configuration diagram and temp-entropy diagram, Thermal efficiency of Joules cycle, Maximum pressure ratio in terms of temperature ratio, optimum pressure ratio for maximum work output with and without considering machine efficiencies, Improvement of gas turbine plant performance- Inter-cooling, Reheating and Regeneration. Simple Problems on Joule cycle.

Air Craft Propulsion: Air craft engine types, air craft propulsion theory, Turbo jet engines, Ramjet engines, Pulse jet engines, Rocket Propulsion: Types of Propellants, Types of Rocket engines, Rocket propulsion theory-Rocket applications

Text Books:

1. Yahya S M, *Fundamentals of Compressible Flow*, New Age International Publishers, Third Edition, 2007.
2. Mathur ML, & Mehta F S, *Thermal Engineering*, Jain Brothers, New Delhi, 2003
3. Dennis G Shepherd, *Aerospace Propulsion*, Elsevier Publishing Company, New York, 1995.

Suggested Reading:

1. Cohen H Rogers G F C, Saravana Mutto H I H, *Gas Turbine Theory*, Longman 5th Edition, New York, 2004.
2. Ganeshan V, *Gas Turbines*, Tata Mc Graw Hills, New Delhi, 2003
3. Yadav, R *Steam and Gas Turbines*, Central Publishing House Ltd, Alllahabad, 2003

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ME 412

Metrology and Instrumentation

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Student will understand the need for measurement and fundamental concepts of measurement.
2. Student will get familiarize with limits, Fits& tolerances and the instruments used to measure these limits.
3. Student will able to have knowledge of various precision linear and angular measuring instruments.
4. Student will learn the importance of Geometric form and how to measure form errors.
5. Equip the student to have knowledge in the concepts of classification of instrument errors and their characteristics.
6. Student will enable to understand the working principles of various instruments used for the measurement of strain, forces, pressure, and temperature.

Outcomes: At the end of the course, students are able to

1. Learn and understand the need for measurement and fundamental concepts of measurement.
2. Demonstrate sound knowledge in gauges design and gauge selection for inspection.
3. Acquire the knowledge about fundamentals of linear and angular measurements and various instruments used for measuring the different parameters.
4. Demonstrate an ability to select and use the appropriate measuring instruments to measure surface roughness and other geometric form errors.
5. Recognize the concepts of errors, classification and instrument characteristics.
6. Apply the skills in measuring various quantities like strain, force, pressure & temperature.

UNIT-I

Limits, Fits and Tolerances: Types of fits, Selective assembly and interchangeability, Taylor's Principle for plain limit gauges, Use of Plug, Ring and Snap gauges, Introduction to Linear and Angular measurements, Slip gauges and End bars, Gauge material and manufacturing methods, Different types of Micrometers, Height gauges, Tomlinson gauges, Sine bar.

UNIT-II

Comparators: Dial indicator, Sigma Mechanical comparator, Back pressure type Pneumatic comparator. Optical projector and its Principle and Applications, Tool maker's Microscope and its Principle and applications, measurement of straightness and flatness, Auto collimator, Roundness measurement with bench centers and talyround, Coordinate Measuring Machine.

UNIT-III

Surface Roughness Measurements: Profilometer, Taylor Hobson Talysurf, Application of screw Thread metrology - 2 wire and 3 wire methods, Best wire size, Spur Gear nomenclature, Gear tooth thickness measurement by gear tooth vernier, Parkinson gear tester.
Introduction to Interferometry and its applications, The N.P.L. flatness Interferometer.

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UNIT-IV

Elements of instrumentation system: Static and Dynamic characteristics of instruments, Types of errors, Strain measurement, Wire and foil type resistance strain gauges, Rosette Gauges, Bonding procedure, Strain Gauge Factor, Application of strain gauges, Strain gauge load cells, measurement of axial load and torsion by strain gauges, Piezo electric load cell.

UNIT-V

Introduction to Transducers: Displacement and acceleration measurement, L.V.D.T, Pressure measurement by Bourdon pressure gauge, Bulk modulus pressure gauge and Pirani gauge, Temperature measurement by thermo couples, Laws of thermo electricity, Types of materials used in thermocouples, Series and parallel circuits.

Text Books:

1. R.K. Jain, *Engineering Metrology*, Khanna Publications, 1996.
2. Doeblin, *Measurement Systems Application and Design*, TMH, 5th Edn., 2004.
3. Anand Bewoore & Vinay Kulkarni, *Metrology & Management*, McGrawhill Education India, 2014.
4. I B.C. Nakra & K.K. Chaudhary , *Instrumentation Measurement and Analysis* , 3rd Edn., McGrawhill, 2014

Suggested Reading:

1. IC Gupta., *Engineering Metrology*, Dhanpat Rai Pub. New Delhi, 1984.
2. Rega Rajendra, *Principles of Engineering Metrology*, Jaico Publishing House, Mumbai, 2008.

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ME 413 **Finite Element Analysis**

Instruction	4 Theory + 1 Tutorial Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Equip the students with the Finite Element Analysis fundamentals and formulations
2. Enable the students to formulate the axial, truss, beam and 2d problems
3. Enable the students to formulate the heat conduction and dynamics problems
4. Able to understand use of numerical integration and Gaussian quadrature
5. Enable the students to understand the convergence requirements and to formulate torsional and 3D problems
6. Enable the students to perform engineering simulations using Finite Element Analysis software (ANSYS)

Outcomes: At the end of the course a student will be able to

1. Apply FE method for solving field problems using Virtual work and Potential energy formulations
2. Analyze linear problems like axial, trusses and beam; 2D structural problems using CST element and analyze the axi-symmetric problems with triangular elements
3. Write shape functions for 4 node quadrilateral, isoparametric elements and apply numerical integration and Gaussian quadrature to solve the problems
4. Solve linear 1D and 2D heat conduction and convection heat transfer problems, analysis of torsion of circular shaft
5. Evaluate the Eigen values and Eigenvectors for stepped bar and beam, formulate 3D elements, check for convergence requirements
6. Apply FE for 1D transient heat conduction, use of FEA software ANSYS for engineering solutions

UNIT-I

Fundamental concepts: Introduction to Finite Element Method, Stresses and Equilibrium, Boundary conditions, Strain-Displacement and Stress-Strain relationship.

One dimensional problems: Finite element modeling coordinates and shapes functions, Virtual work and Potential Energy approach, Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, Analysis of Axial element and Quadratic element.

UNIT-II

Analysis of Trusses and Frames: Element stiffness matrix for a truss member, Analysis of plane truss with two degrees of freedom at each node. Analysis of Beams: Element stiffness matrix for two nodes (two degrees of freedom per node). Analysis of frames with two translations and rotational degrees of freedom per node. Torsion: Analysis of circular shaft subjected to torsion.

UNIT-III

2D Triangular Elements: Plane stress, Plane strain and Axisymmetry, Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Finite element modeling of axi-symmetric solids subjected to axi- symmetric loading with triangular elements.

UNIT-IV

Quadrilateral Elements and Numerical Integration: Two dimensional Four nodded iso-parametric Elements, Numerical Integration and Gaussian Quadrature

Dynamic Analysis: Formulation of finite element model, element mass matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar and a beam

UNIT-V

Heat Transfer Analysis: Steady State Heat Transfer Analysis: One dimensional analysis of a fin and two dimensional analysis of thin plate. Time dependent field problems: Application to one dimensional heat flow in a rod.

3D Elements and FEA Software: Introduction to finite element formulation of three dimensional problems in stress analysis, Convergence requirements, Finite Element Analysis Software: Modeling, Analysis and Post Processing.

Text Books:

1. Ramamurthy, G. *Applied Finite Element Analysis*, I.K. International Publishing House Pvt. Ltd., New Delhi, 2009
2. Tirupathi R, Chandraputla and Ashok D Belagundu, *Introduction to Finite Elements in Engineering*, Practice Hall of India, 1997.
3. Daryl L. Logan, *A First Course in the Finite Element Method*, Cengage Learning, 2011.

Suggested Reading:

1. Rao S S, *The Finite Element Method in Engineering*, Pergamon Press, 1989.
2. Segerlind L J, *Applied Finite Element Analysis*, Wiley Eastern, 1984.
3. Reddy JN, *An Introduction to Finite Element Method*, McGraw-Hill, 1984.
4. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt., *Concepts and Applications of Finite Element Analysis*, 4th Edition. Wiley

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With Effect from the Academic Year 2016 - 2017

ME 414

Operations Research
(for Mech, Prod and I.T)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Students will understand the significance of Operations Research concept and techniques
2. Students will come to know the formulation of LPP models
3. Students will understand the Algorithms of Graphical and Simplex Methods
4. Students will understand the Transportation and Assignment techniques
5. Students will come to know the procedure of Project Management along with CPM and PERT techniques
6. Students will understand the concepts of sequencing and queuing theory

Outcomes: At the end of the course, the students were able to

1. Recognize the importance and value of Operations Research and mathematical formulation in solving practical problems in industry;
2. Formulate a managerial decision problem into a mathematical model;
3. Apply Operations Research models to real time industry problems;
4. Build and solve Transportation Models and Assignment Models.
5. Apply project management techniques like CPM and PERT to plan and execute project successfully
6. Apply sequencing and queuing theory concepts in industry applications

UNIT-I

Introduction: Definition and Scope of Operations Research.

Linear Programming: Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method, Degeneracy in Simplex, Duality in Simplex.

UNIT-II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

UNIT-III

Assignment Techniques: Introduction, Hungarian technique of Assignment techniques, unbalanced problems, problems with restrictions, Maximization in Assignment problems, Travelling salesman problems

UNIT-IV

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, duration of the project, Free float, Independent float and Total float, Crashing of network.

UNIT-V

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two machines, processing 'n' jobs through three machines.

Queuing Theory: Introduction, Kendal's Notation, single channel - poisson arrivals - exponential service times

Text Books:

1. Hamdy, A. Taha, *Operations Research-An Introduction*, Sixth Edition, Prentice Hall of India Pvt. Ltd., 1997.
2. S.D. Sharma, *Operations Research*, Kedarnath, Ramnath & Co., Meerut,2009
3. V.K. Kapoor, *Operations Research*, S. Chand Publishers, New Delhi, 2004

Suggested Reading:

1. Harvey M. Wagner, *Principles of Operations Research*, Second Edition, Prentice Hall of India Ltd., 1980.
2. R. Paneer Selvam, *Operations Research*, Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008.
3. Nita H. Shah, Ravi M. Gor, Hardik Soni, *Operations Research*, PHI Learning Private Limited, 2013

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ME 461

Renewable Energy Sources (Elective – II)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will learn the

1. Need and importance of non-conventional energy resources
2. Extent of solar energy which can be utilized as energy resource
3. Concept of wind energy and its merits and demerits
4. Operating principles of ocean and geothermal energy
5. Advantages and disadvantages of bio-energy over conventional energy
6. Merits and demerits of tidal energy, wave energy and OTEC

Outcomes: At the end of the course, the students are able to

1. Understand the depletion and of environmental impact conventional sources of energy and will suggest suitable and alternative renewable energies in place of fossil energies
2. Know the absorption, conversion and utilization of solar energy
3. Understand the problems associated with utilizing the wind energy
4. Describe the physics of geothermal resources and describe how biomass is currently used as a source of energy
5. Explain the physical principles of wave energy, the generation of tides and how to harness their power
6. Understand the environmental impact of OTEC plants

Unit-I

Statistics on conventional energy sources and supply in developing countries, Definition-Concepts of RES, Limitations of RES, Classification of NCES-Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

Unit-II

Solar Energy- Solar Radiation – Energy available from Sun, Solar Thermal Collectors – Flat Plate and Concentrating Collectors –Solar Applications, Solar engines-Stirling, Brayton engines, fundamentals of photo Voltaic Conversion – p-n junction – PV solar cells and its materials-solar satellite system

Unit-III

Wind energy- merits and demerits-Wind power plant-site selection-classification of wind power plants-Windmill rotors- Horizontal axis and vertical axis rotors-.working principle-New developments.

Unit-IV

Geothermal energy- Layers in earth-Definition and classification of resources.

Biomass energy-Biomass- Source, Composition, Conversion technologies – Direct combustion-Pyrolysis–Gasification, Biomass gasifier –float and fixed dome types

Unit V

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation-single basin and double basin tidal plants-progressive wave.

OTEC power plants- Open and closed OTEC Cycles- Environmental impacts of OTEC

Text Books:

1. S. Hasan Saeed and D.K. Sharma, *Non Conventional Energy Resources*, S.K. Kataria & Sons, New Delhi, 2014
2. Dr. R.K. Singal, *Non Conventional Energy Resources*, S.K. Kataria & Sons, New Delhi, 2005
3. G.D. Rai, *Non Conventional Energy Sources*, Khanna Publishers, New Delhi, 2011

Suggested Reading:

1. Mittal K M, *Non-Conventional Energy Systems*,Wheeler Publishing Co. Ltd, New Delhi, 2003.
2. Ramesh R & Kumar K U, *Renewable Energy Technologies*, Narosa Publishing House, New Delhi, 2004
3. Shali Habibulla, *Non-Conventional Energy Sources*, State Institute of Vocational Education, Hyderabad, 2005
4. Ashok V Desai, *Non-Conventional Energy*, Wiley Eastern Ltd, New Delhi, 2003
5. R.K. Hegde, *Power Plant Engineering*, Pearson Education India, 2015

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ME 462

Computational Fluid Dynamics (Elective – II)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Understanding of governing equations of fluid flow.
2. Student understand finite difference and finite volume methods to solve fluid flow equations.
3. Issues that arise in the solution of such equations.
4. Various methods to overcome those issues and modern trends in CFD.
5. Get exposure to grid generation.
6. Various boundary conditions and their implementation.

Outcomes: At the end of the course, the students were able to

1. Classify basic equations of fluid flow
2. Choose appropriate boundary conditions
3. Choose proper numerical technique to solve equations.
4. Critically analyze different mathematical models and computational methods for flow simulations
5. Interpret computational results.
6. Acquire the required knowledge to take advanced courses in CFD.

UNIT-I

Basic Equations: Continuity, momentum and energy equations, navier-stokes equations, Heat transfer conduction equations for steady and unsteady flows, steady convection-diffusion equation.

UNIT-II

Models: Reynolds and Favre averaged N-S equations, Mixing length model, k-epsilon turbulence model.

Classifications of partial differential equations: Elliptic, parabolic and hyperbolic equations, Initial and boundary value problems.

UNIT-III

Finite Difference Method: Forward, backward and central difference

Parabolic partial differential equations: Euler, implicit and crank Nicholson methods, ADI models, Errors, consistency, stability analysis, Vonnumen analysis, Convergence criteria.

UNIT-IV

Elliptic partial differential equations - Jacobi, Gauss seidel methods, Viscous incompressible flow, Stream-function-vorticity method

Introduction to grid generation- types of grids O, H, C

UNIT – V

Finite Volume Method: Finite volume formulation for diffusion equation, convection diffusion equation, Solution algorithm for pressure velocity coupling in steady flows, staggered grid, SIMPLE algorithm.

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Text Books:

1. J.D. Anderson, Jr., *Computational Fluid Dynamics: The Basic with Applications* McGraw Hill, Inc., 2012
2. H. Versteeg and W. Malalasekra, *An Introduction to Computational Fluid Dynamics*: The Finite Volume Method, Pearson,2nd edn. 2011

Suggested Reading:

1. John F. Wendt (Editor), *Computational Fluid Dynamics - An Introduction*, Springer – Verlag, Berlin, 1992
2. Charles Hirsch, *Numerical Computation of Internal and External Flows*, Vols. I and II. John Wiley & Sons, New York, 1988.
3. K. Muralidhar and T. Sundarajan.. *Computational Fluid Flow and Heat Transfer*, Narosa Publishing House. 2008
4. C.J.Date , *Introduction to CFD*, Dorling Kindersley Pvt Ltd, 2007

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ME 463

Automobile Engineering (Elective – II)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: The student will learn
1. The anatomy of the automobile in general
2. The location and importance of each part
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels
4. Suspension, frame, springs and other connections
5. ignition, controls, electrical systems and ventilation
6. Emissions, pollution regulations, EURO and BHARATH stages

Outcomes: At the end of the course, the student will be able to
1. Identify the different parts of the automobile
2. Explain the working of various parts like engine, transmission, clutch, brakes
3. Describe how the steering and the suspension systems operate.
4. Understand the environmental implications of automobile emissions
5. Develop a strong base for understanding future developments in the automobile industry

Unit I

Types of automobiles: Normal, Hybrid and Hydrogen Fuel vehicles. Engine location and its components, chassis layout; crank shaft proportion, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, inlet and exhaust manifolds, carburetion and fuel injection system, Mechanical Fuel Injection system & Electronic Fuel Injection System.

Unit II

Lubricating Systems: Wet sump, dry sump and petroil systems - Cooling systems: Water pumps, radiators, thermostat control anti freezing compounds - Types of Ignition Systems, Modern Ignition systems, Types of Batteries and charging systems, starting motors, lighting and electrical accessories, automobile air-conditioning.

Unit III

Steering systems: Linkage arrangements and its components modified Ackerman linkage, wheel alignment, caster and camber. Rack and pinion assembly, recent trends, Wheel and tyres: Tyre construction, specification. Tyre wear and causes, wheel balancing, Types q/' Suspension system, Independent suspension, coil and leaf springs, torsion bar, shock absorbers.

Unit IV

Power Train: Clutches, gear and gearbox manual, semi-automatic and automatic gearboxes. Torque converter, propeller shaft, universal coupling differential, four-wheel drive system

Brakes Systems: Description and operation of hydraulic brake, leading and trailing shoe layout, disc brakes, master cylinder and hand brake linkage, Recent Trends.

Unit V

Maintenance: Pollution control, trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul testing equipment, pollution control technologies used for petrol and diesel engines. Types and study of catalytic converters, Euro norms 2 & 3 and Bharat Norms – Recent Trends.

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Text Books:

1. *Crouse & Anglin, Automotive Mechanics*, TataMcGraw Hill. Publishing Co. Ltd., New Delhi, Tenth Edition – 2004
2. Kirpal singh., *Automobile Engineering Vol. I & II* Standard Publishers, Delhi.

Suggested Reading:

1. Joseph Heitner, *Automotive Mechanics*, Affiliated East West Pvt. Ltd.
2. C.P Nakra, *Basic Automobile Engineering*, Dhanpat Rai Publishing Co(P) Ltd., New Delhi, 2003.
3. G.B.S. Narang, *Automobile Engineering*, Khanna Publishers, New Delhi, 2014
4. R.K. Rajput, *A Textbook of Automobile Engineering*, Laxmi Publications, New Delhi, 2012

With Effect from the Academic Year 2016 - 2017

ME 464

Entrepreneurship (Elective – II)
(for Mech, Prod, Civil, EEE, ECE, I.T, Chemical, BioTech and CSE)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. The essence of Entrepreneurship
2. The environment of industry and related opportunities and challenges
3. Concept a procedure of idea generation
4. Elements of business plan and its procedure
5. Project management and its techniques
6. Behavioral issues and Time management

Outcomes: After completing this course, students will be able to:

1. Apply the entrepreneurial process
2. Analyze the feasibility of a new business plan and preparation of Business plan
3. Evaluate entrepreneurial tendency and attitude
4. Brainstorm ideas for new and innovative products or services
5. Use project management techniques like PERT and CPM
6. Analyze behavioural aspects and use time management matrix

UNIT-I

Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries, Types of enterprises, Corporate Social Responsibility.

UNIT-II

Identification and characteristics of entrepreneurs: First generation entrepreneurs, environmental influence and women entrepreneurs, Conception and evaluation of ideas and their sources, Selection of Technology, Collaborative interaction for Technology development.

UNIT-III

Business plan: Introduction, Elements of Business Plan and its salient features, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary.

UNIT-IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden

UNIT-V

Behavioral aspects of entrepreneurs: Personality, determinants, attributes and models, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, *Dynamics of Entrepreneurial Development and Management*, Himalaya Publishing House, 1997.
2. Prasanna Chandra, *Project-Planning, Analysis, Selection, Implementation and Review*, Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, *Entrepreneurial Development*, S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, *Entrepreneurship*, Tata Me Graw Hill Publishing Company Ltd., 5lh Ed., 2005
2. Stephen R. Covey and A. Roger Merrill, *First Things First*, Simon and Schuster Publication, 1994.
3. Sudha G.S., *Organizational Behavior*, National Publishing House, 1996.

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PE 461

Robotics (Elective – II)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Students will understand

1. The configuration, work envelop and motion controls and applications
2. Familiarities with the kinematics of robots.
3. Robot end effectors and their design.
4. Familiarities with the dynamics of robots.
5. Robot Programming methods & Languages of robot.
6. Various Sensors and drives and their applications in robots

Outcomes: At the end of the course, the students will be

1. Equipped with robot anatomy, work volume and robot applications
2. Familiarized with the kinematic motions of robot
3. Having good knowledge about robot end effectors and their design concepts
4. Familiarized with the robot dynamics
5. Equipped with the Programming methods & drives used in robots
6. Equipped with the principles of various Sensors and their applications in robots.

Unit I

Robots: History and evolution of robots, Laws of Robotics, basic configuration, degree of freedom, work envelope, motion control methods, Application in industry, material handling, loading & unloading, processing, welding & painting applications, assembly and inspection, Robot specification requirements

Unit II

Rotation matrix: Homogenous transformation matrix, Denavit-Hartenberg convention, Euler angles, RPY reprensation, Direct and inverse kinematics for industrial robots for position and orientation, Redundancy

Unit III

Manipulator Jacobian: Joint, End effector velocity, direct and inverse velocity nalysis, Trajectory Planning, interpolation, cubic polynomial, linear segments with with parabolic blending, static force and moment transformation, solvability, stiffness, singularities

Unit IV

Robot dynamics: Lagrangian formulation, link inertia tensor and manipulator inertia tensor, Newton-Euler formulation for RR & RP manipulators, Control: Individual joint, computed torque

Unit V

End effectors: position and velocity measurement, Sensors: Proximity and range, tactile, force and torque, Drives for Robots: Electrical, Hydraulic and Pneumatic, Robot vision: Introduction to technique, image acquisition and processing, introduction to robot programming languages

Text Books:

1. Spong and Vidyasagar, *Robot Dynamics and Control*, John Wile and Sons, 1990
2. R.K. Mittal, I.J. Nagrath, *Robotics and control*, Tata Mcgraw-Hill Publishing Company Ltd. 2003
3. Groover, *Industrial Robotics*, Mcgraw-Hill Publishing Company Ltd. 2003

Suggested Reading:

1. Asada and Siotine, *Robot analysis and Intelligence*, Wiley Interscience, 1986
2. K.S. Fu Gon ZalezRC., IEEc.S.G., *Robotics, Control Sensing Vision and Intelligence*, McGraw Hill, Int. Ed., 1987
3. Richard S. Paul, *Robot Manipulators: Mathematics, Programming, and Control*, MIT Press (MA)

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CE 461

Disaster Mitigation and Management (Elective – II)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: Students will understand

1. The basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts.
2. The nature, mechanism causes, consequences and mitigation measures of the various natural disasters including hydro metrological and geological based disasters.
3. Risks, vulnerabilities and human errors associated with human induced disasters including chemical, biological and nuclear warfare agents.
4. The knowledge of various chronological phases in the disaster management cycle.
5. The disaster management framework and legislations in the context of national and global conventions.
6. The applications of geospatial technologies like remote sensing and geographical information systems in disaster management.

Course Outcomes:

1. Ability to analyse and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at local level
2. Ability to choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan.
3. Ability to understand various mechanisms and consequences of natural and human induced disasters for the participatory role of engineers in disaster management.
4. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans
5. Ability to understand various participatory approaches/strategies and their application in disaster management
6. Ability to understand the concepts of remote sensing and geographical information systems for their effective application in disaster management.

UNIT-I:

Introduction to Natural, human induced and human made disasters – Meaning, nature, types and effects; International decade of natural disaster reduction (IDNDR); International strategy of natural disaster reduction (ISDR)

UNIT-II:

Natural Disasters– Hydro meteorological disasters: Causes, impacts, Early warning systems, structural and non-structural measures for floods, drought and cyclones; Tropical cyclones: Overview, cyclogenesis, drought monitoring and management.; Geographical based disasters: Earthquakes and Tsunami- Overview, causes, impacts, zoning, structural and non-structural mitigation measures; Tsunami generation; Landslides and avalanches: Overview, causes, impacts, zoning and mitigation measures. Case studies related to various hydro meteorological and geographical based disasters.

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UNIT III:

Human induced hazards: Risks and control measures in a chemical industry, Causes, impacts and mitigation measures for chemical accidents, chemical disaster management, current status and perspectives; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents and traffic accidents .

UNIT IV:

Use of remote sensing and GIS in disaster mitigation and management; Scope of application of ICST (Information, communication and space technologies in disaster management, Critical applications& Infrastructure; Potential application of Remote sensing and GIS in disaster management and in various disastrous conditions like earthquakes, drought, Floods, landslides etc.

UNIT V:

Concept of Disaster Management: Introduction to disaster management, Relationship between Risk, vulnerability and a disaster, Disaster management cycle, Principles of disaster mitigation: Hazard identification and vulnerability analysis, Early warning systems and forecasting; Infrastructure and development in disaster management; Disaster management in India: National disaster management framework at central, state, district and local levels. Community based disaster management.

Text Books :

1. Rajib, S and Krishna Murthy, R.R, *Disaster Management Global Challenges and Local Solutions*, Universities Press Hyderabad, 2012
2. *Notes / Reading material published by National Disaster Management Institute*, Ministry of Home Affairs, Govt. of India.

Suggested Reading:

1. Navele, P & Raja, C.K., *Earth and Atmospheric Disasters Management, Natural and Manmade*. B.S. Publications, Hyderabad, 2009
2. Fearn-Banks, K, *Crises computations approach: A case book approach*. Route ledge Publishers, Special Indian Education, New York & London, 2011
3. Battacharya, T., *Disaster Science and Management*. Tata McGraw Hill Company, New Delhi., 2012

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ME 415

Thermal Engineering Lab

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives:

1. Student will acquire basic knowledge in determining thermal conductivity of an insulating powder in composite slab or cylinder.
2. Student will demonstrate basic knowledge in evaluating the heat transfer coefficients under natural convection and forced convection phenomena
3. Student will determine the necessary constants pertaining to radiation
4. Student will acquire basic knowledge in understanding the working principles of axial flow fan and its overall efficiency.
5. Student will come to know in estimating overall efficiency of a centrifugal compressors
6. Student will demonstrate basic knowledge the importance of pressure distribution over cylinder and an aerofoil section on turbo machines

Outcomes: At the end of the course, the students were able to

1. Estimate thermal conductivity of insulating powder in composite slab or cylinder
2. Measure the heat transfer coefficients under natural and forced convection phenomena
3. Know the properties associated with radiation heat transfer
4. Determine overall efficiency of axial flow fan
5. Determine overall efficiency of centrifugal fan
6. Determine pressure distribution over cylinder and an aerofoil section and the effect of lift and drag forces on them.

Experiments:

1. Determination of COP of Air Conditioning System
2. Determination of percentage relative humidity and study of Humidification and Dehumidification process in Air Conditioning Systems
3. Determination of COP of Refrigeration Systems using Capillary tube/thermostatic expansion valve
4. Determination of Overall efficiency of Centrifugal Blower
5. Determination of Overall efficiency of Axial Flow Fan
6. Pressure distribution on symmetrical and non-symmetrical specimen in Wind tunnel
7. Measurement of Lift and Drag force of the models in wind tunnel test section
8. Determination of Thermal conductivity of metal bar
9. Determination of efficiency of pin-fin subjected to natural and forced convection
10. Determination of effectiveness of heat parallel flow and counter flow heat exchanger
11. Determination of Emissivity of given test plate
12. Determination of Stefan-Boltzmann constant

Note: Student should complete a minimum of 10 experiments.

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Suggested Reading:

1. Yahya S M, *Fundamentals of Compressible Flow,* New Age International Publishers, Third Edition, 2007.
2. Mathur ML, & Mehta F S, *Thermal Engineering,* Jain Brothers, New Delhi, 2003

With Effect from the Academic Year 2016 - 2017

ME 416

Metrology and Instrumentation Lab

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives:

1. Student will choose the proper measuring instrument for the precise measurement of Length, Height and diameter
2. Student will able to select the proper measuring instrument for the angular measurement.
3. Student will indentify gear & screw thread parameters using optical projector and tool makers microscope.
4. Student will get familiarize with limits & fits, gauge selection and design.
5. Student will enable to understand the working principles in the measurement of Flatness, Roundness and Surface roughness.
6. Student will equip with various aspects regarding displacement.

Outcomes: At the end of the course, the students were able to

1. Identify methods and devices for measurement of length, height and diameter.
2. Acquire the knowledge about angular measurement and various measuring instruments.
3. Recognize & measure the gear and screw thread parameters using profile projector and tool maker microscope.
4. Demonstrate the sound knowledge in gauges selection and design.
5. Acquire adequate knowledge in the measurement of flatness, roundness and surface roughness.
6. Demonstrate the measurement of displacement.

Experiments:

1. Measurement with inside, outside and depth micrometers.
2. Measurement with height gauges, height masters, etc.
3. Measurement of Linear and Angular dimensions with Tool Maker's Microscope – Diameter of a thin wire and single point cutting tool angle.
4. Measurement with Dial Indicator and its calibration.
5. Measurement of angles with Sine bar and Bevel protractor.
6. Measurement of roundness errors with bench centers.
7. Measurement of flatness errors (surface plate) with precision level.
8. Measurement with optical projector.
9. Checking machined components with plug gauges and adjustable snap gauges.
10. Surface roughness measurement by Taylor Hobson -Talysurf.
11. Measurement of Gear tooth thickness.
12. Displacement measurement with LVDT.

Note: Student should complete a minimum of 10 experiments.

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Suggested Reading:

1. IC Gupta, *Engineering Metrology*, Dhanpat Rai Pub., New Delhi, 1984.
2. B.C. Nakra & K.K. Chaudhary , *Instrumentation Measurement and Analysis*, , 3rd Edn. McGrawhill, 2014

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ME 417

Computer Aided Engineering Lab

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives: Students will understand

1. The fundamental knowledge on using analytical tools like ANSYS for Simulation.
2. Various fields, where these tools can be used to improve the output of a product.
3. How these tools are used in Industries by solving some real time problems.
4. Models of trusses, plate structure, beams using ANSYS general purpose software
5. The solve heat transfer problems using ANSYS
6. Evaluating and interpret FEA results for design

Outcomes: At the end of the course a student should be able to:

1. Use FEA software to analyze complex structural systems.
2. Perform modal analysis of parts
3. Perform steady-state and transient heat transfer analysis
4. Produce graphical displays, including animations, of the results.
5. Perform buckling analysis
6. Acquire knowledge on utilizing ANSYS.

Experiments:

1. Analysis of plane truss & special truss with various cross sections and materials
2. 2D & 3D beam analysis with different sections, different materials for different loads
3. Static analysis of plate with a hole.
4. Plane stress, plane strain and axisymmetric loading on the in plane members.
5. Static analysis of connecting rod with tetrahedron and brick elements.
6. Static analysis of flat and curved shell due to internal pressure.
7. Buckling analysis of plates, shells and beams to estimate BF and modes.
8. Modal analysis of beams, plates and shells for natural frequencies and mode shapes.
9. Harmonic analysis of a shaft and transient analysis of plate.
10. Steady state heat transfer analysis of chimney and transient analysis of castings.
11. Non linear analysis of cantilever beam.
12. Coupled field analysis

Note: 1. Student should complete a minimum of 10 experiments.

2. Any of FEA software ANSYS/ABAQUS/NASTRAN/NISA/CAEFEM/ADINA may be used

Suggested Reading:

1. Tadeusz, A. Stolarski, Y. Nakasone, S. Yoshimoto, *Engineering Analysis with ANSYS Software*, 1st Edition, Elsevier Butterworth-Heinemann publications, 2007
2. ANSYS Inc. *User Manuals for Release 15.0*

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ME 418

Project Seminar

Instruction	3 Periods per week
Sessionals	25 Marks
Credits	1

The objective of the project seminar is to actively involve the student in the initial work required to undertake the final year project. Dealing with a real time problem should be the focus of the under graduate project.

It may comprise of

- Problem definition and specifications.
- A broad understanding of the available techniques to solve a problem of interest.
- Presentation (Oral & written) of the project.

The department should appoint a project coordinator who will coordinate the following.

- Grouping of students as project batch(a maximum of 3 in group)
- Allotment of projects and project guides
- Project monitoring at regular intervals.

Each project group/batch is required to

1. Submit a one page synopsis of the seminar to be delivered for display on notice board.
2. Give a 30-40 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write up on the talk delivered.

Three (3) teachers will be associated with the evaluation of the project seminar for the award of the sessional marks which should be on the basis of performance on all the three items stated above.

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ME 419

Industrial Administration and Financial Management (for ECE and EEE)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Students able to learn

1. The roll importance and functions of Management in Industrial Organization
2. Various types of business organizations and organization structures.
3. Importance of plant location and plant layout
4. Importance of industrial engineering like method study and work measurement.
5. The importance of project management techniques
6. The total cost of a product based on elements of cost

Outcomes: At the end of the course, the students will be able to

1. Understand the role and importance of management and its principles.
2. Understand the need and importance of various types of layouts used in manufacturing industries
3. Apply the techniques of method study and work measurement in industry to enhance productivity
4. Apply the techniques of project management in industry
5. Understand the importance of quality control and plot the control charts
6. Calculate the total cost of the product based on its elements.

UNIT-I

Industrial Organization: Definition of an organization, types of various business organizations, organization structures and their relative merits and demerits, functions of management.

Plant location and layouts: Factors affecting the location of plant and layout, types of layouts and their merits and demerits.

UNIT-II

Work study: Definitions, objectives of method study and time study, steps in conducting method study, symbols and charts used in method study, principles of motion economy, calculation of standard time by time study and work sampling, performance rating factor, types of ratings, jobs evaluation and performance appraisal, wages, incentives, bonus, wage payment plans

UNIT-III

Inspection and quality control: Types and objectives of inspection, S.Q.C., its principles. Quality control chart and sampling plans, quality circles, introduction to ISO.

Production planning and control: Types of manufacture, types of production, principles of PPC and its function, production control charts.

UNIT-IV

Optimization: Introduction to linear programming and graphical solutions, assignment problems.

Project Management: Introduction to CPM and PERT, determination of critical path.

Material Management: Classification of materials, materials planning, duties of purchase manager, determination of economic ordering quantities, types of materials purchase.

UNIT-V

Cost accounting: Elements of cost, various costs, types of overheads, break even analysis and its applications, depreciation, methods of calculating depreciation fund, nature of financial management, time value of money, techniques of capital budgeting and methods, cost of capital, financial leverage.

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Text Books:

1. Pandey I.M. , *Elements of Financial Management*, Vikas Publ. House, New Delhi, 1994
2. James C Van Horne, John M Wachowicz, Jr., *Fundamentals of Financial Management*, 13th edition, Prentice Hall Financial Times
3. Khanna O.P., *Industrial Engineering and Management*, Dhanapat Rai & Sons

Suggested Reading:

1. S.N. Chary, *Production and Operations Management*, Tata McGraw Hill, 3rd Edition, 2006.
2. Paneer Selvam, *Production and Operations Management*, Pearson Education, 2007.
3. Joseph Monk, *Operations Management*, TMH Publishers, New Delhi, 2004.
4. Buffa Elwood S, *Modern Production /Operations Management* , John Wiley Publishers, Singapore, 2002
5. Everrete E. Adama & Ronald J. Ebert, *Production & Operations Management*, Prentice Hall of India, 5th Edition, 2005.
6. S.D. Sharma, *Operations Research*, Kedarnath, Ramnath & Co., Meerut,2009

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ME 421

Production and Operations Management

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Understand plant layout design to facilitate material flow and processing of a product in the most efficient manner
2. Understand work study methods to improve the performance of workers
3. Gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management and strategy.
4. Understand how Materials Requirement Planning and MRPII systems are used in managing operations
5. Recognize the importance of Inventory control to ensure their availability with minimum capital lock up.
6. Evaluate the quality processes in manufacturing and service sector to improve the operational performance

Outcomes: At the end of the course, the student will be able to

1. Identify and evaluate the processes, tools and principles of production and operations management to better understand the logistics and supply chain operations
2. Demonstrate the ability to apply mathematical forecasting techniques
3. Identify future challenges and directions that relate to production and operations management to effectively and efficiently respond to market changes
4. Apply the tasks, tools and underlying principles of operations management in the manufacturing an d service sectors to improve organizational performance
5. Explain and evaluate the quality process in manufacturing and service sector to improve the operational performance

UNIT-I

Production & Operations Management: Introduction: Types of Production Systems, job shop, batch, flow shop

Plant location and layout: Factors affecting plant location, plant layout objectives, types of layouts, merits and demerits.

Work Study: Introduction to method study and work measurement, standard time calculations, methods of rating, work sampling, wages and incentives, types of incentive plans.

UNIT-II

Forecasting: Introduction, forecasting objectives and uses, demand patterns, qualitative models, market survey, Delphi, quantitative models, moving average, weighted moving average, simple exponential smoothing, trend adjusted exponential smoothing, least square method, simple regression, multiple regression.

Forecast Errors: Mean Absolute Deviation (MAD), Mean Square Error (MSE), Mean Forecast Error (MFE), Mean Absolute Percentage Error (MAPE)

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UNIT-III

Aggregate planning and master scheduling: Introduction, objectives of aggregate planning, cost in aggregate planning, strategies in aggregate planning, master production scheduling

Materials Requirement Planning (MRP): Importance of MRP, MRP system inputs and outputs, MRP calculations, bill of materials.

UNIT-IV

Inventory Control: Importance of inventory control, types of inventory models, inventory costs deterministic inventory models, basic EOQ model, production model without shortages, purchase model with instantaneous replenishment and with shortages, production model with shortages, inventory model with price breaks, fixed order quality system, periodic review system and inventory model with probabilistic demand.

UNIT-V

Quality Control: Introduction, history and early contributions by quality gurus, quality tools, process capability, quality control by control charts, control charts for variables and attributes, sampling plans, operating characteristic curves, introduction to total quality management

Text Books:

1. Stevenson, *Production operation Management*, Mc-Graw Hill International
2. Joseph Monks, *Operations Management*, TMH Publishers, New Delhi, 2004.
3. Buffa Elwood S, *Modern Production /Operations Management* , John Wiley Publishers, Singapore, 2002

Suggested Reading:

1. Everrete E. Adama & Ronald J. Ebert, *Production & Operations Management*, Prentice Hall of India, 5th Edition, 2005
2. Panneer Selvam R, *Production and Operations Management*, Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2006.
3. S.D. Sharma, *Operations Research*, Kedarnath, Ramnath & Co., Meerut,2009
4. S.N. Chary, *Production and Operations Management*, Tata McGraw Hill, 3rd Edition, 2006.

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With Effect from the Academic Year 2016 - 2017

ME 422

Production Drawing

Instruction	6 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Students will understand

1. The need and the importance of production drawing
2. How to make part drawing from given assembly drawings.
3. Indication of size, form and positional tolerances on the drawing sheets
4. Surface finish and heat treatment process on the drawing sheets.
5. Writing process sheets
6. Notations, symbols and abbreviations on production drawings

Outcomes: On completion of the course the students will develop abilities to

1. Draw part drawings from given assembly drawings of machine parts.
2. Indicate tolerance values on the parts drawn on sheet as per alpha numeric codes for given assembly drawings
3. Indicate form tolerances and position tolerances on the parts drawn on the sheet as per universally accepted norms for a given assembly drawing
4. Indicate values of surface finished and heat treatment process on the parts drawn for a given assembly drawings.
5. Write process sheet for every part that is drawn from given assembly drawings
6. Interpret a production drawing and process sheet.

UNIT-I

Parts-I: Format of drawing sheet, title block, columns for materials, Processes, parts list, conventional representation of parts: screwed joints, welded joints, springs, gears.

UNIT-II

Parts II: Elements of electrical, hydraulic and pneumatic circuits, machine tool elements), methods of indicating notes on drawing

UNIT-III

Limits and Fits: Basic definition of terms, alpha numeric designation of limits/fits, types of fits, Interchangeability and selective assembly, Exercises involving selection/interpretation of fits and calculation of limits, dimensional chains

UNIT-IV

Production Drawing: Conventional practices of indicating tolerance on size and geometrical form, position, surface finish, surface treatments, part drawing from assembled drawings (Stuffing box, Screw jack, I.C engine connecting rod, Revolving center, Square tool post, Single tool post, Universal coupling, Flange coupling, Steam engine cross head, Drill jig (plate type), Non return valve, Blow off cock), specification and indication of above features on the drawings, calculation of limits suggesting suitable fits for mating parts

UNIT-V

Assignments: Sketches of conventional representation of parts described with syllabus at (1) process sheets, tolerances and finishes obtainable from different processes. Study of IS 2709 on limits and fits

NOTE: Tolerance charts to be provided in the examination hall for calculation of limits

Text Books:

1. K.L. Narayana, P. Kannaiah and K. Venkat Reddy, *Production Drawing*, New Age Intl., (P) Ltd., Revised Edition, 1997.
2. P. Narasimha Reddy, T.A. Janardhan Reddy and C. Srinivasa Rao, *Production Drawing Practice*, Hitech Publishers, 2001

Suggested Reading:

1. Venkata Reddy, *Production Drawing*. New Age International. ISBN 978-81-224-2288-7, 2009
2. Farazdak Haideri, *Machine Drawing & Computer Graphics*, Nirali Prakashan. ISBN 978-93-8072-527-7
3. R.L. Murthy, *Precision Engineering in Manufacturing*, New Age International Private Ltd., 1996
4. Doeblin, *Measurement Systems Application and Design*, TMH, 5 th Edn., 2004.

ME 471

Power Plant Engineering (Elective – III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will learn

1. Different types of power plants and their site selection criteria
2. Operation of thermal power plant
3. About hydraulic power plant, dams and spillways
4. Different types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
5. The power plant economics
6. The environmental and safety aspects of power plant operation.

Outcomes: At the end of the course, the student will be able to

1. Select the suitability of site for a power plant.
2. Propose ash handling, coal handling method in a thermal power plant
3. Understand the flow-sheet of hydro-power plant
4. Explain working principle of different types of nuclear power plant.
5. Know the various factors of plant load and economy
6. Indicate safety aspects of power plants

Unit - I

Introduction: Power plant, classification of power plants, conventional and non-conventional power plants

Steam power plant: Plant Layout, types of coals, coal handling equipment, Ash handling systems

UNIT II

Steam power plant: Combustion Process - Overfeed and Underfeed stokers-traveling grate stokers, spreader stokers, retort stokers- Pulverized fuel burning system-cyclone furnace-Fluidized bed combustion (FBC).

UNIT III

Hydro electric power plant: Hydrological cycle, flow measurement, Hydrographs - drainage area characteristics, Types of hydroelectric power plants- storage and pondage - classification of dams and spill ways.

UNIT - IV

Nuclear power plant: Nuclear fuel - breeding and fertile materials - types of reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Gas cooled Reactor-Radioactive waste disposal.

UNIT - V

Power plant economics and environmental considerations:

Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor - related exercises-Fixed cost and variable cost-methods to find depreciation cost Effluents from power plants and Impact on environment – pollutants - Pollution control.

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Text Books:

1. R.K. Rajput, *A Text Book of Power Plant Engineering* 4th edition, Laxmi Publications (P) Ltd., New Delhi, 2015
2. P.K. Nag, *Power Plant Engineering* 4th edition, McGraHill Education(India) Private Limited, New Delhi, 2014
3. S.C. Arora and S. Domukundwar, *A Course in Power Plant Engineering*, Dhanpat Rai & Sons, New Delhi, 2005

Suggested Reading:

1. R. Yadav, *Fundamentals of Power Plant Engineering*, Central Publishing House, Allahabad, 2012
2. R.K. Hegde, *Power Plant Engineering*, Pearson Education India, 2015
3. P.C. Sharma, *A Text Book of Power Plant Engineering*, S.K. Kataria & sons, New Delhi, 2016

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ME 472

Intellectual Property Rights (Elective – III)

(for Mech, Prod, Civil, ECE, EEE, CSE, IT)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will learn
1. Fundamental aspects of IP
2. Aspects of IPR acts.
3. Awareness of multi disciplinary audience
4. Awareness for innovation and its importance
5. The changes in IPR culture
6. About techno-business aspects of IPR

Outcomes: At the end of the course, a student
1. Will respect intellectual property of others
2. Learn the art of understanding IPR
3. Develop the capability of searching the stage of innovations.
4. Capable of filing a patent document independently.
5. Completely understand the techno-legal business angle of IP. .
6. Capable of converting creativity into IP and effectively protect it.

UNIT-I

Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR), IPR in India – Genesis and Development, IPR abroad, Some important examples of IPR. Importance of WTO, TRIPS agreement, International Conventions and PCT

Patents: Macro economic impact of the patent system, Patent and kind of inventions protected by a patent, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Why protect inventions by patents. Searching a patent, Drafting of a patent, Filing of a patent, the different layers of the international patent system, (national, regional and international options), compulsory licensing and licensers of right & revocation, Utility models, Differences between a utility model and a patent. Trade secrets and know-how agreements

UNIT-II

Industrial Designs: What is an industrial design. How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?

UNIT-III

Trademarks: What is a trademark, Rights of trademark? What kind of signs can be used as trademarks. Types of trademark, function does a trademark perform, How is a trademark protected? How is a trademark registered. How long is a registered trademark protected for? How extensive is trademark protection. What are well-known marks and how are they protected? Domain name and how does it relate to trademarks? Trademark infringement and passing off.

UNIT-IV

Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights covered by copyright? Copy rights in computer programming.

UNIT-V

Enforcement of Intellectual Property Rights: Infringement of intellectual property rights Enforcement Measures Emerging issues in Intellectual property protection. Case studies of patents and IP Protection.

Unfair Competition: What is unfair competition. Relationship between unfair competition and intellectual property laws.

Text Books:

1. Ajit Parulekar and Sarita D' Souza, *Indian Patents Law – Legal & Business Implications*; Macmillan India ltd , 2006
2. B. L.Wadehra; *Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications*; Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan*; Law of Copyright and Industrial Designs*; Eastern law House, Delhi 2010

Suggested Reading:

1. Cronish W.R1 *Intellectual Property; Patents, copyright, Trad and Allied rights*, Sweet & Maxwell, 1993.
2. P. Narayanan, *Intellectual Property Law*, Eastern Law Edn., 1997.
3. Robin Jacob and Daniel Alexander, *A Guide Book to Intellectual Property Patents, Trademarks, Copy rights and designs*, Sweet, Maxwell 4th Edition.

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With Effect from the Academic Year 2016 - 2017

ME 473

Mechatronics (ELECTIVE - III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. How to identify, formulate, and solve engineering problems
2. The design a system, component, or process to meet desired needs within realistic constraints
3. The how to use the techniques, skills, and modern engineering tools necessary for engineering practice
4. The use of drive mechanisms and fluid power systems
5. The use of industrial electronic devices
6. The demonstrate the design of modern CNC machines, and Mechatronics elements

Outcomes: At the end of the course, the students will be able to

1. Model and analyze electrical and mechanical systems and their interconnection
2. Integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems
3. Do the complete design, building, interfacing and actuation of a mechatronics system for a set of specifications
4. Be proficient in the use of fluid power systems in various mechatronics applications
5. Demonstrate the use of industrial electronic devices
6. Demonstrate the design of modern CNC machines, and mechatronics elements

UNIT-I

Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, Flow chart of Mechatronics system, elements of Mechatronics system, drive mechanisms, actuators, feedback devices and control system, application in industries and systems development

UNIT-II

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems

Introduction to electrical actuators: A.C. servomotors, D.C. servomotors, stepper motors

UNIT-III

Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps & accessories, hydraulic circuits & mechanical servo control circuits, Electro-hydraulic and Hydro-pneumatic circuits

UNIT-IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits, Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion, signal processing using operational amplifiers, introduction to micro processor & micro controller, Temperature measurement interface and LVDT interface, Systems response

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UNIT-V

Design of modern CNC machines and Mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems, Flexible manufacturing systems, Multipurpose control machines, PLC programming

Text Books:

1. William Bolton, *Mechatronics: Electronic control systems in mechanical and electrical engineering*, 6th edition, Pearson Education
2. HMT Ltd, *Mechatronics*, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998

Suggested Reading:

1. Michaels Histand & David G, Alciatore, *Introduction to Mechatronics and Measurement Systems*, Tata McGraw-Hill International Edition
2. Devdas Shetty, Richard A. Kolk, *Mechatronics System Design*, Cengage Learning
3. S.R. Majumdar, *Oil Hydraulic Systems – Principles & Maintenance*, McGraw-Hill Publishing Company Limited, New Delhi
4. Godfrey Onwubolu, *Mechatronics: Principles and Applications*, Butterworth-Heinemann

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ME 474

Mechanics of Composite Materials (ELECTIVE - III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand the

1. Properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
2. How to predict the elastic properties of long fiber composites based on the constituent properties. An ability to rotate stress, strain and stiffness tensors using ideas from matrix algebra.
3. Linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior. An ability to analyze a laminated plate in bending using classical lamination theory.
4. How to predict the failure strength of a laminated composite plate. A knowledge of issues in fracture of composites.
5. Exposure to recent developments in composites, including metal and ceramic matrix composites.
6. How to use the ideas developed in the analysis of composites towards using in industrial application.

Outcomes: At the end of the course, a student should be able to

1. Understand the various fabrication methods of composite materials.
2. Understand the specifics of mechanical behavior of layered composites compared to isotropic materials.
3. Determine stresses and strains in composites.
4. Apply constitutive equations of composite materials and understand mechanical behavior at micro and macro level.
5. Understand the failure of composites including fracture.
6. Understand the theory of plate and shell; understand the bending analysis of composite beams.

Unit-I

Introduction: Fibers, matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites and carbon composites.

Unit-II

Micromechanics of lamina and mechanical properties: Prediction of elastic constants, micromechanical approach, Halpin-Tsai equations, thermal properties, hygro properties, mechanics of load transfer from matrix to fibre.

Unit-III

Macro-mechanics of lamina: Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects, simplified composite beam solutions, bending of laminated beams.

Unit-IV

Strength, fracture, fatigue and design: Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: single and multiple fractures, de-bonding, fibre pullout and de-lamination.

Strength of an orthotropic lamina: Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria, designing with composite materials

Unit-V

Manufacturing processes: Hand lay-up, prepregs, bag molding, autoclave processing, RTM, pultrusion, filament winding, gel time test for resins, curing cycle,

Measurement of basic composite properties: Fiber and matrix tests, tensile test, compressive test, in-plane shear test, inter-laminar shear test, flexure test.

Text Books:

1. Jones, R.M., *Mechanics of Composite Materials*, Mc Graw Hill Co., 1967
2. B.D. Agarwal et.al, *Analysis and performance of fiber composites*, 3rd edition, Wiley sons., 2013
3. P.K. Mallick, *Fiber Reinforced Composites Materials*, Manufacturing, and Design, Taylor & Francis, Third Edition 2007 ,

Suggested Reading:

1. Ever J Barbero, *Introduction to composite materials design*, Taylor &Francis, 1999.
2. Hyer, M.W., *Stress Analysis of Fibre Reinforced Composite Materials*, McGraw Hill Co., 1998.
3. Carl. T. Herakovich, *Mechanics of Fibrous Composites*, John Wiley Sons Inc., 1998.

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ME 475

Supply Chain Management (Elective – III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand
1. The significance of supply chain management in engineering.
2. The awareness about transportation and warehouse management systems.
3. The designing supply chain networks.
4. The concept of demand and supply and integrating it with supply chain management.
5. The acquainted with planning and managing inventories.
6. The pricing and revenue management

Outcomes: At the end of the course, the student is able to
1. Apply supply chain management concepts in engineering applications
2. Plan an effective transportation and warehouse management systems
3. Design an effective supply chain networks
4. Integrate and optimize demand and supply gaps
5. Apply inventory management techniques
6. Understand and design a pricing and revenue management systems

UNIT-I

Concept of SCM, Concept of Logistics Management, Supply Chain, Types of supply chain, functions in SCM, Transportation Management, Warehousing Management, Warehouse management systems.

UNIT-II

Designing the supply chain Network, Designing the distribution network, Network Design, Network Design in an uncertain environment.

UNIT-III

Planning and Demand:Planning demand & supply in a supply chain, demand forecasting, aggregate planning, planning supply & demand.

UNIT-IV

Planning & managing inventories in a supply chain, managing economies of scale, cycle inventory, and managing uncertainty safety inventory optimal level of product availability

UNIT-V

Sourcing, Transporting & Pricing Products, sourcing decisions, transportation, pricing & revenue management. Coordination & technology in the supply chains, coordination in supply chain, information technology and supply chain.

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Text Books:

1. N. J. Kumar & Mukesh Bhatia, *Supply Chain Management*, Neha publishers & Distributors,2010
2. Michael H. Hugos, *Essentials of Supply Chain Management*, 3rd edition, John Wiley & Sons, Inc, Hoboken, New Jersy,2011
3. Sunil Chopra & Peter Meindl, *Supply Chain Management* – Strategy, Planning and Operation, Pearson Education, Inc., Upper Saddle River, New Jersey, 2003

Suggested Reading:

1. Martin Christopher, *Logistics & Supply Chain Management*, 5th edition, Financial Times Series,2010
2. Dobler Donald. W, David.N.Burt, *Purchasing & supply Management Text & Cases*. McGraw-Hill, 1996
3. Chitale A.K. Gupta R.C, *Materials Management-Text and Cases*, Prentice-Hall Of India Pvt. Limited, 2007

PE 471

Manufacturing Systems and Simulation (Elective – III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. The systems, subsystems for manufacturing techniques
2. The information technologies relevant to manufacturing systems
3. The discrete and continuous systems
4. The system simulation and associated concepts
5. The queuing theory concepts applied to system simulation
6. The awareness about programming with GPSS and SIMSCRIPT

Outcomes:

1. Student is able to have overall view of various manufacturing processes
2. Capable of applying information systems and automation to manufacturing
3. Ability to build various models suitable for appropriate manufacturing facility
4. Able to understand and conceptualize systems simulations
5. Ability to simulate discrete and continuous systems
6. Capable of programming with GPSS and SIMSCRIPT

UNIT-I

Manufacturing Systems: Definition of systems, basic concepts and problems concerning systems, systems design, decision making procedures, Structural, transformational and procedural aspects of manufacturing, modes of production, process systems for manufacturing, logistic systems, material flow & technological information flow, management & information systems for manufacturing, managerial information flow in manufacturing systems

UNIT-II

Information Systems: Fundamentals of information technology, information systems, information networking, parts oriented production information systems and computerized production scheduling, online production control systems, Computer based production management systems, Automation systems for manufacturing, Industrial automation, Kinds of automation, principles of CIM, effectiveness of CIM, factory automation, automatic machine tools for mass production, NC machine tools, computer controlled manufacturing systems, FMS, automated assembly, automatic material handling, automatic inspection & testing, computer integrated automation systems- unmanned factory

UNIT-III

System Models: Concepts, continuous and discrete systems, systems modeling, type of models, subsystems, corporate model and system study

System simulation: Techniques, comparison of simulation and analytical methods, types of simulation, distributed log model, cobweb models

UNIT-IV

Continuous system Simulation: Numerical solution of differential equation, analog computers, hybrid computers, continuous system simulation languages CSMP, system dynamic growth models, logistic curves

Discrete systems simulation: Events generation of arrival patterns, simulation programming tasks, analysis of simulation output

Queuing theory: Arrival pattern distribution, service times, queuing disciplines and measure of queues

UNIT-V

GPSS and SIMSCRIPT: General description of GPSS and SIMSCRIPT, programming in GPSS simulation programming techniques: Data structures, implementation of activities, event and queues, event scanning, simulation algorithms in GPSS and SIMSCRIPT

Text Books:

1. Geofery Gordan, *Systems Simulation*, Prentice Hall, 1980
2. Allan Carrie, *Simulation of Manufacturing Systems*, John Wiley & Sons Ltd,1998

Suggested Reading:

1. Adelaide Marzano, *Manufacturing system simulation*, VDM Verlag
2. Davi Bedworth & James Bailey, *Integrated Production Control system Management, analysis & design*, 2nd edition, John Wiley & Sons Ltd.,2010
3. Ronald Zskin & Charles Standridge, *Modeling and Analysis of Manufacturing Systems*, John Wiley & Sons Ltd.,2011
4. Deo. N., '*ystem simulation with Digital Computers*, Prentice Hall, 1980

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PE 412

Modern Machining and Forming Methods (ELECTIVE – IV)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will learn

1. The importance of non-conventional machining processes
2. Various non-conventional machining processes and their process parameters
3. The relative merits, limitations and applications of various non-conventional machining processes
4. The knowledge regarding working media and its functions of non-conventional machining processes
5. The concepts of non-conventional forming processes such as rubber pad forming, hydro forming, stretch forming, etc.,
6. The concepts of HERF and to provide the description of HERF process

Outcomes: At the end of the course, the students are able to

1. Select the non-conventional machining process for a particular application
2. Demonstrate the capability of comparison of various non-conventional machining methods
3. Describe the various non-conventional machining processes
4. Exhibit the proficiency of selecting working media for various non-conventional machining processes
5. Exhibit the basic understanding of non-conventional forming processes
6. Compare various non-conventional forming processes based on their merits, limitations and applicability

UNIT-I

Mechanical Energy Methods:

Ultrasonic Machining (USM): Introduction, Process description, abrasive slurry, Abrasive materials and their characteristics, Functions of liquid medium in slurry, Types of transducers, effect of process parameters, applications and limitations

Abrasive Jet Machining (AJM): Principle of operation, process details, process variables and their effect on MRR and accuracy, equation for MRR, advantages, disadvantages and applications

Water Jet Machining (WJM): Schematic diagram, equipment used, advantages and applications

Abrasive Water Jet Machining (AWJM): Process, advantages, limitations and applications

UNIT-II

Thermal methods: Electro Discharge Machining (EDM): Process description with schematic diagram, process parameters, functions and characteristics of dielectric medium, dielectric fluids, over cut and side taper, flushing, mechanism of metal removal, crater volume, types of power supply circuits, mathematical analysis of metal removal rate (MRR), equations for surface finish, characteristics of spark eroded surfaces, advantages, disadvantages and applications

Wire EDM: Process description and applications

LASER Beam Machining (LBM): Principle of LASER beam production, materials used, process parameters, advantages, limitations and applications,
Plasma Arc Machining (PAM): Introduction, equipment used, process description and parameters, types of plasma arc: transferred arc and non transferred arc and process applications,
Electron Beam Machining (EBM): Schematic of the process, process parameters, principle of production of electron beam, equipment used, advantages, disadvantages and applications,

UNIT-III
Electro chemical, Chemical and other machining processes: Electro-chemical machining (ECM): Schematic of process parameters, function and characteristics of electrolyte, chemistry of the process, MRR for pure metal and alloys, electrode feed rate (EFR), advantages, limitations and applications
Chemical Machining: Chemical blanking and chemical milling, advantages, limitations and applications
ION Etching: Process description, merits, limitations and applications, hot machining, high speed machining, process parameters, advantages and applications

UNIT-IV
High Energy Rate Forming Processes (HERF): Introduction, applications, advantages,
Explosive Forming: Principles, explosive materials, Equipment, types of explosive forming, standoff operation and contact operation, the pressure pulse, gas bubble and the process applications
Electro-Hydraulic Forming (EHF): Schematic of process, description and its applications,
Electro-Magnetic Forming (EMF): Process description, merits, limitations and applications

UNIT-V
Other Forming Processes:
Rubber Pad Forming: Principle of the process, process details and its types, Guerin, wheelon, Mar forming and Hydro forming processes and applications,
Stretch Forming: Introduction, types of stretch forming, stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming.
Tube spinning: introduction, methods of tube spinning, backward spinning, forward spinning, machines and tools used, machine variables, speeds and feeds, effect of tube spinning on work metal properties and applications.

Text Books:
1. P.C. Pandey and H.S. Shah, *Modern Machining Process* Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1980
2. J Paulo Davim, *Modern Machining Technology, A Practical Guide*, 1st Edition, Woodhead Publishing in Mechanical Engineering

Suggested Reading:
1. Hassan Abdel-Gawad El-Hofy, *Advanced Machining Processes, Nontraditional and Hybrid Machining Processes*, McGraw Hill Publishing Co. Ltd.,
2. Davies and Austin, *Developments in High Speed Metal Forming*, The Machinery Publishing Co. Ltd., 1985
3. Production Technology, HMT
4. A. Bhattacharya, *New Technology*, The Institution of Engineers (India), 1984

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With Effect from the Academic Year 2016 - 2017

PE 481

Micro Manufacturing (ELECTIVE - IV)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand
1. The importance of micromachining, Nano polishing, Micro forming and Micro welding.
2. Micromachining processes
3. The Nano polishing methods
4. The micro forming processes
5. The concepts of micro welding to the students
6. The recent trends and applications of micro manufacturing

Outcomes: At the end of the course, the students are able to
1. Suggest suitable micromachining process to a particular application.
2. Select the process parameters of particular micro machining process
3. Describe the various micro, machining, welding and forming processes
4. Compare various micro machining / forming/ welding processes based on relative merits and demerits.
5. Demonstrate the understanding of various nano machining operations.
6. Exhibit the knowledge regarding the recent trends in micro-manufacturing processes

UNIT I

Micro Machining I: Introduction, scaling laws, mechanical micro machining, ultra sonic micro machining, abrasive jet micro machining, water jet micro machining, abrasive water jet micro machining, micro turning, chemical and electro chemical micro machining, electric discharge micro machining, electro discharge grinding.

UNIT II

Micro Machining II: Beam energy based micro machining, electron beam micro machining, laser beam micro machining, ion beam micro machining, plasma beam micro machining, hybrid micro machining, electro chemical spark micro machining, electrolytic in process dressing.

UNIT III

Nano Polishing: Abrasive flow finishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing, magnetic float polishing, elastic emission machining, chemo-mechanical polishing

UNIT IV

Micro Forming and Welding: Micro extrusion, micro and nano structured surface development by nano plastic forming and roller imprinting, micro bending with laser, laser micro welding, electron beam for micro welding.

UNIT V

Recent Trends and Applications: Metrology for micro machined components, ductile regime machining, AE based tool wear compensation, machining of micro gear, micro nozzle, micro pins and applications.

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Text Books:

1. Jain V. K., *Micro Manufacturing Processes*, CRC Press, Taylor & Francis Group, 2012
2. Janocha H., *Actuators – Basics and applications*, Springer publishers, 2012
3. Jain V.K., Introduction to Micro machining, Narosa Publishing House, 2011

Suggested Reading:

1. Bharat Bhushan, *Handbook of nanotechnology*, springer, Germany, 2010.
2. Bandyopadhyay. A.K., *Nano Materials*, New age international publishers, New Delhi, 2008, ISBN:8122422578.
3. Jain V.K., *Advanced Machining Processes*, Allied Publishers, Delhi, 2002
4. Mcgeoug.J.A., *Micromachining of Engineering Materials*, CRC press 2001, ISBN-10:0824706447.

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PE 482

Non - Destructive Testing and Evaluation (ELECTIVE - IV)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student has to understand the

1. Need, basic concepts and technologies of Non Destructive Testing (NDT)
2. Security precautions from Radiography, protection from radiation and measurement of radiation received by personnel.
3. Technology of acoustic emission (AE), the associated instrumentation and applications
4. Technologies like neutron radiography; laser induced ultrasonics, surface analysis and thermography
5. Merits and demerits of the different NDT Technologies
6. Latest research and developments in NDT

Outcomes: At the end of the course, the students will be able to demonstrate

1. the knowledge of different NDT techniques.
2. clear understanding of liquid penetrant inspection and magnetic particle inspection.
3. view and interpret radiographs, utilize the various principles of radiography for different components of different shapes.
4. the knowledge of acoustic emission for NDT and the instrumentation used for NDT.
5. the ability to analyze and prepare a technical report.
6. the knowledge of latest research, developments and trends in NDT.

UNIT-I

Liquid penetrate inspection: Principles of penetrate inspection, characteristics of a penetrate, water washable system, post emulsification system , solvent removable system, surface preparation and cleaning, penetrate application, development, advantages limitations, and applications.

Magnetic particle instruction: Principle, magnetization methods, continuous and residual methods, sensitivities, demagnetization, magnetic particles, applications advantages and limitations.

UNIT-II

Eddy current testing: Principle, lift-off factor, and edge effect, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, display methods and applications.

UNIT-III

Ultrasonic testing: Generation of ultra sound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, display systems, probe construction, type of display, inspection techniques, identification of defects, Immersion testing , sensitivity and calibration. Reference standards. Surface condition, Applications.

UNIT-IV

Radiography: Principle and uses of radiography, limitation principle, radiation sources, production of X-Rays, x-ray spectra, attenuation of radiation, radiographic equivalence, shadow formation enlargement and distortion, radio graphic film and paper, Xeroradiography, fluoroscopy, exposure factors, radiographic screens, identification markers and image quality indicators, inspection of simple shapes, inspection of complex shapes, viewing and interpretation of radiographs, radiation hazard, protection against radiation, measurement of radiation received by personnel.

UNIT-V

Acoustic Emission: Physical Principles, Sources of emission, instrumentation and applications, Other NDT Techniques: Neuron radiography, Laser induced ultrasonics, surface analysis, and thermography.

Text Books:

1. Barry Hull & Vernon John, *Non Destructive Testing*, 1988.
2. H J Frissell (Editorial Coordinator), Non-*Destructive Evaluation and quality control*, ASM handbook-International Publication USA, 1989..
3. Dove and Adams, *Experimental Stress analysis and Motion Measurement*, Prentice Hall of India, Delhi

Suggested Reading:

1. *Non-Destructive Examination and Quality Control*, ASM International, Vol.17, 9th edition (1989)
2. J. Prasad and C. G. K. Nair, *Non-Destructive Test and Evaluation of Materials*, Tata McGraw-Hill Education, 2nd edition (2011).
3. B. Raj, T. Jayakumar and M. Thavasimuthu, Practical *Non Destructive Testing*, Alpha Science International Limited, 3 rd edition (2002).
4. T. Rangachari, J. Prasad and B.N.S. Murthy, *Treatise on non-destructive testing and evaluation*, Navbharath Enterprises, Vol.3, (1983

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PE 483

Product Design and Process Planning (ELECTIVE – IV)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand
1. The Product Design and Process Functions
2. The essence of innovation in product development
3. The Human Machine Interactions (ergonomics)
4. The various Intellectual Property Rights
5. The interaction between Design, Manufacturing, Quality and Marketing
6. The awareness about overall view of Process Planning

Outcomes: At the end of the course, the student is able to
1. Have overall view of Product Design and Process Planning
2. Apply creativity techniques in Product Development
3. Applying ergonomically enabled concepts in developing a new product
4. Have awareness and apply Intellectual Property Rights
5. Integrate various stages of developing a new product
6. Develop and execute an effective Process Plan

UNIT-I
Product Design and Process Design functions: selection of right product, systematic procedure of product innovation, factors contributing to successful technological innovation, need for creativity and innovation, techniques of innovation like brain storming and Delphi techniques

UNIT-II
Product Selection and Evaluation: Function of design, design with Human Machine Interaction (HMI) and collection of ideas and purpose of project, selection criteria, screening ideas for new products using evaluation techniques, principles of ergonomics.

UNIT-III
New Product Planning: Interaction between the functions of design, manufacture, quality, testing and marketing, design and material selection, steps for introducing new products after evaluation.

UNIT-IV
New Product Development: Research and new product development, patents, definitions, patent search, patent laws, international code for patents, Intellectual Property Rights (IPR).

UNIT-V
Process Selection and Planning: Process selection, process planning, process sheets, selection of manufacturing process, estimation of machining time in various cutting operations, estimation of costs for manufacture, value engineering in product design, group technology, concepts of concurrent engineering.

Text Books:

1. Niebel BW & Draper AB, *Production Design & Process Engg*, McGraw Hill, Kogakusha, 1974
2. K. G. Swift & J. D. Booker, *Process Selection*: From Design to Manufacture", Butterworth-Heinemann Ltd; 2nd Revised edition, 2003
3. Bhaskaran Gopalakrishnan, *Product Design and Process Planning in CE (Design & Manufacturing*", Chapman and Hall publishers, 1994

Suggested Reading:

1. Harry Nystrom, *Creativity and Innovation*, John Wiley & Sons,
2. Brain Twiss, *Managing Technological Innovation*, Pittman Publications, 1992
3. Harry, B.Waton, *New Product Planning*, Prentice Hall Inc., 1992
4. Chitale, A. K. & Gupta RC., *Product Design & Manufacturing*, PHI, 1997

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PE 484

Nano Materials and Technology (Elective – IV)
(for Mech, Prod and Chemical)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will learn the
1. Nanotechnology approach and challenges
2. Materials of nanotechnology
3. Nano structures
4. Nano fabrication
5. Special nano materials
6. Bio materials

Outcomes: At the end of the course
1. Understand the developments and challenges in nano technology
2. Understand synthesis and properties of nanostructured materials
3. Analyze magnetic and electronic properties of nano materials
4. Analyze nano fabrication methods and their applications
5. Understand the characterization of nano and bio materials and their use
6. Analyze the synthesis and characterization of nano wires and tubes

Unit I
Introduction: Nanoscale, Properties at Nanoscale, advantages and disadvantages, importance of Nanotechnology, Bottom-up and Top-down approaches, challenges in nanotechnology, proximal probe technologies

Unit II
Materials of Nanotechnology: Introduction, Si-based materials, Ge-based materials, Ferroelectric materials, Polymer materials, GaAs& InP (HI-V) group materials, Nanotribology and materials, characterization using Scanning Probe Microscope, AFM, FFM

Unit III
Nano Structures: Zero dimensional Nanostructure (Nano particles), synthesis procedure, characterization techniques, properties and applications of Nano particles
One dimensional Nanostructures (Nano Wires, Nano Tubes), various Synthesis procedure, characterization procedure and principles involved, properties and applications of Nano Wires, Types of Nano Tubes, Synthesis procedure, characterization properties and applications of Nano Tubes

Unit IV
Nano Fabrication: Introduction, Basic fabrication techniques (Lithography, thin film deposition, and doping), MEMS fabrication techniques, Nano fabrication techniques (E-beam Nano-imprint fabrication, Epitaxy and strain engineering, Scanned probe techniques)

Unit V
Special Nano Materials: Nano Composites: Introduction, Synthesis procedures, various systems (metal-polymer, metal-ceramics and Polymer-ceramics), Characterization procedures, applications,
Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, principles involved, applications

Text Books:

1. A.K. Banopadyay, *Nano Materials*, New Age Publications
2. T. Pradeep, *Textbook of Nanoscience and Nanotechnology*, McGraw Hill Education (India) Private Limited, New Delhi
3. Dieter Vollath, *Nanomaterials: An Introduction to Synthesis, Properties and Applications*, Wiley, 2013

Suggested Reading:

1. Carl C. Koch, *Nano Materials Synthesis, Properties and Applications*, Jaico Publishing House
2. Willia Tllsey Atkinson, *Nano Technology*, Jaico Publishing House
3. George W. Hanson, *Fundamentals of Nanoelectronics*, Pearson Education, 2009
4. T. Pradeep, *Nano: Essentials-understanding Nano Science and Technology*, TMH, 2007
5. Sabu Thomas, Nandakumar Kalarikkal, A. Manuel Stephan, B. Raneesh, *Advanced Nano-materials*: Synthesis, Properties, and Applications, Apple Academic Press

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CSE 481

Information Security (Elective – IV)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand the

1. Information assurance as practiced in computer operating systems, distributed systems, networks and representative applications.
2. Several ethical issues in information system
3. Principal concepts, major issues, technologies, and basic approaches in information security.
4. Prevalent network and distributed system attacks, defenses against them, and forensics to investigate the aftermath.
5. Cryptography, how it has evolved, and some key encryption techniques used today.
6. Security policies (such as authentication, integrity and confidentiality), as well as protocols to implement such policies in the form of message exchanges.

Outcomes: At the end of the course, the students are able to understand the

1. Basic concepts and goals of Information security such as Confidentiality, Integrity, Authentication, Non-Repudiation, Authorization, and Availability and their relevance in various Contexts.
2. Classical cryptosystems and techniques used to break them.
3. Ideas of public key cryptosystems and digital signature schemes
4. Different network issues as well as database security issues and the solutions for them through firewall, intrusion detection system
5. Critical evaluation of a range of access control and authentication mechanisms
6. Legal privacy and ethical issues in computer security

Unit I

Introduction: History, critical characteristics of information, NSTISSC SECURITY MODEL, Components of an information system, securing the components, balancing security and access, The SDLC, The Security SDLC

Need for security: Business needs, Threats, Attacks-secure software development

Unit II

Legal, Ethical and Professional Issues: Law and Ethics information security, relevant U.S. laws, international laws and legal bodies, Ethics and information security

Risk Management: Overview, Risk Identification, risk assessment, Risk Control Strategies, selecting a risk control strategy, Quantitative versus qualitative risk control practices, Risk Management discuss points, recommended risk control practices

Unit III

Planning for security: Security policy, standards and practices, security blue print, security education, continuity strategies, Security technology

Firewalls and VONs: Physical design, firewalls, protecting remote connections

Unit IV

Security Technology: Intrusion detection, access control and other security tools, Intrusion detection and prevention systems, scanning and analysis tools, access control devices

Cryptography: Foundations of cryptology, cipher methods, crypryptographic algorithms, cryptographic tools, protocols for secure communications, attacks on cryptosystems

Unit V

Implementing Information Security: Information security project management, technical topics of implementation, Non-technical aspects of implementation, security certification and accreditation,

Security and personnel: Positioning and staffing security function, Employment policies and practices, internal control strategies

Information Security Maintenance: Security management models, the maintenance model, digital forensics

Text Books:

1. Michael E. Whitman and Hebert J. Mattord, *Principles of Information Security*, 4th edition, Ed. Cengage Learning, 2011
2. Thomas R. Peltier, Justing Peltier, John Blackley, *Information Security Fundamentals*, Auerbacj Publications, 2010

Suggested Reading:

1. Detmar W Straub, Seymor Goodman, Richard L Baskerville, *Information Security Policy Processes and Practices*, PHI, 2008
2. Marks Merkow and Jim Breithaupt, *Information Security, Principle and Practices'*, Pearson Education, 2007
3. Mark Rhodes-Ousley, *Information Security, The Complete Reference* McGraw-Hill Education, New York, 2013
4. Alberts, Christopher and Dorofee, Audrey, *Managing Information Security Risks: The OCTAVE Approach* Addision-Wesley Publications, 2003

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ME 423

Seminar

Instruction	3 Periods per week
Sessionals	25 Marks
Credits	1

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of state of the art topics in a broad area of his /her specialization.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to following aspects of seminar presentations.

- Literature survey
- Consolidation of available information
- Power point Preparation
- Technical writing

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.

2. Give twenty(20) minutes presentation through OHP/ PPT/ Slide Projector followed by Ten(10) minutes discussion

3. Submit a report on the seminar topic with list of references and hard copy of the slides.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule should be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar should be from any peer reviewed recent journal publications.

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ME 901

Project

Instruction	6 Periods per week
Duration of End Examination	Viva Voce
End Examination	100 Marks
Sessionals	50 Marks
Credits	9

Dealing with a real time problem should be the focus of under graduate project.

All projects will be monitored at least four times in the II-semester through individual presentations (Project batch wise).

Every student should maintain a project dairy, wherein he/she needs to record the progress of his/her work and get it signed at least once in a week by the guide(s). If working outside and college campus, both the external and internal guides should sign the same.

Sessional marks should be based on the marks, awarded by a project monitoring committee of faculty members as well as the marks given by the guide.

Common norms are established for final documentation of the project report, the students are directed to download from the website regarding the guidelines for preparing the project report and the project report format.

The project report shall be evaluated for 100 Marks by the External Examiner.

If the project work found inadequate in the end examination, the candidate should repeat the project work with a new problem or improve the quality of work and report it again.

Break up for 100 Marks in the end examination:

1. Power point presentation 30 Marks
2. Thesis/Report preparation 20 Marks
3. Viva-voce 30 Marks

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16MT C01

ENGINEERING MATHEMATICS – I

Instruction	3L + 1T Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	4

Course Objectives:

1. To solve Linear System of Equations using Matrix Methods
2. To Know the Partial Derivatives and use them to interpret the way a function of two variable behaves
3. To analyse the Shape of the Graph of a given Curve
4. To Evaluate Double and Triple integrals of various functions and their significance
5. Formulate and solve the Differential Equations of First Order
6. To know the methods to solve real life problems.

Course outcomes: On the successful completion of this course student shall be able to

1. Solve system of linear equations and identify the Eigen values and Eigen vector in engineering problems
2. Expand and find extreme values of functions of two variables
3. Trace and interpret curve behavior in physical systems
4. Find the areas, volumes and surface of solids revolution
5. Use-differential equations to model engineering phenomena such as circuit theory, networks
6. An ability to solve the problems and interpret it in geometrical approach

UNIT- I

Linear Algebra: Review of Rank & Consistency, Eigen values, Eigen vectors- properties (without proofs). Cayley- Hamilton Theorem (statement only) inverse and powers of a Matrix by Cayley-Hamilton Theorem. Reduction of Quadratic form to Canonical form by linear transformation, rank, positive, negative, definite, semi-definite, index and signature

UNIT- II

Functions of several variables: Partial differentiations, Homogenous function, Euler"s theorem, Implicit functions, Jacobins, Taylor"s series in one and two variables, Maxima and Minima for function of two variables with and without constraints

UNIT- III

Differential Calculus: Curvature and Radius of curvature centre of curvature, circle of curvature. Evolutes, involutes and Envelopes, Curve tracing-Cartesian, polar and parametric curves

UNIT- IV

Multiple Integrals: Double Integrals, Triple Integrals, Change of order of Integration, Applications of integration, rectification, areas, volumes and surfaces of solids of revolution in Cartesian coordinates, Centre of Gravity, PAPPUS theorem.

UNIT- V

First order differential equations and its application: Exact differential equations, Orthogonal trajectory"s, Electrical circuits, Newtons law of cooling

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Text Books:

1. Ervin Kreyszig "Advanced Engineering " 10 Edition, john wiley & sons -publishers

2. A R.K.Jain&S.R.K.Iyenger "Advanced Engineering Mathematics" , 3rd edition, Narosa Publications
3. AlenJaffery "Mathematics for Engineers and Scientists", 6th edition : CRC press, Taylor & Francis Group.(Elsevier),2013

Suggested Reading:

1. Kanti.B.Datta "Mathematical Methods of science and engineering", Aided with MATLAB, .Cengage Learning India Pvt. Ltd, Pratapgang ,New Delhi
2. B.S.Grewal "Higher Engineering Mathematics" , Khanna Publishers
3. William E.Boyce /Richard C.Dip "Elementary differential equations" , 9th Edition

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With effect from academic year 2016-2017

16CY C01

ENGINEERING CHEMISTRY

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives

The syllabus has sought to fulfill the objective of making the student of engineering and technology realize that chemistry is the real base of his profession and that therefore he must have a good understanding of chemistry before he can use it in his profession.

" the study of chemistry is profitable not only in as much as it promotes the material interest of mankind ,but also because it furnishes us with insight into the wonders of creation , which immediately surround us and with which our existence, life and development, are most closely connected." ----- Justus Von Leibig (German Chemist)

The various units of the syllabus is so designed to fulfill the following objectives.

1. This syllabus helps at providing the necessary introduction of the chemical principles involved and devices in a comprehensive manner understandable to the students aspiring to become practicing engineers.
2. The aim of framing the syllabus is to impart intensive and extensive knowledge of the subject so that students can understand the role of chemistry in the field of engineering.
3. Thermodynamics and Electrochemistry units give conceptual knowledge about spontaneous processes and how can they be harnessed for producing electrical energy and efficiency of systems.
4. Fuels have been taught with a view to give awareness as to materials which can be used as sources of energy
5. To understand importance of analytical instrumentation for different chemical analysis.

Course Outcome

1. This syllabus gives necessary theoretical aspects required for understanding intricacies of the subject and also gives sufficient exposure to the chemistry aspects in different disciplines of engineering
2. The above knowledge also helps students to carry out inter disciplinary research such that the findings benefit the common man.
3. This syllabus imparts a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

UNIT – I

Chemical Thermodynamics : Introduction and definition of the terms, the concept of reversible and irreversible processes, Work done in isothermal and adiabatic processes, Success and limitations of First law of thermodynamics, need for second law of thermodynamics, statements of second law of thermodynamics, Carnot cycle, heat engine and its efficiency, Carnot theorem, concept of Entropy - Entropy changes in reversible and irreversible processes, physical significance of entropy criteria of spontaneity in terms of entropy and Gibb"s free energy function , Gibb"s-Helmholtz equation and applications, Numericals.

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UNIT – II

Phase rule & Chemical Equilibria

Phase rule : Statement , definition of the terms - phases, components , degrees of freedom with examples, Phase diagram - one component system (water system), two component system (siver-lead system) , desilverisation of lead.

Chemical Equilibria - Homogenous and Heterogenous Equilibria - applications

UNIT – III

Fuels: Classification, requirements of a good fuel, calorific value, types of calorific value, calculation of CV using Dulong"s formula, Combustion - calculation of air quantities by weight and volume, Numericals.

Solid fuels: coal - analysis of coal – proximate and ultimate analysis - importance.

Liquid fuels - crude oil - fractional distillation, cracking - Fixed bed catalytic cracking, knocking, antiknocking agents (TEL, MTBE), octane number, cetane number, unleaded petrol.

Gaseous fuels - LPG, CNG - composition and uses

UNIT – IV

Electrochemistry Introduction, construction of electrochemical cell, sign convention, cell notation, cell emf, SOP and SRP, electrochemical series and its applications, Nernst equation and applications, Types of Electrodes - Standard Hydrogen Electrode, Saturated Calomel Electrode, Quinhydrone electrode and Ion selective electrode (Glass electrode), construction, Numericals

UNIT –V

Instrumental Techniques in Chemical Analysis: Principle, method and applications of Conductometry (acid-base titration), Potentiometry (acid-base, redox titration), pH- metry (acid – base titration), Colorimetry (Beer Lambert"s law)

Green Chemistry - outlines and Principles

Text Books:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Pub, Co., New Delhi (2002)
2. Puri & Sharma, "Principles of Physical Chemistry
3. S.S.Dara & S.S.Umare, "Engineering Chemistry", S.Chand company
4. J.C. Kuriacase & J. Rajaram, "Chemistry in engineering and Technology", Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
5. B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
6. P.R.Vijayasarathi, "Engineering Chemistry" PHI Learning Private Limited, New Delhi (2011)

Suggested Reading:

1. Physical chemistry by P.W.Atkin (ELBS OXFORD PRESS)
2. Physical chemistry by W.J.Moore (Orient Longman)
3. Physical Chemistry by Glasstone
4. Physical Chemistry by T.Engel & Philip Reid, Pearson Publication.
5. B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd.,Meerut (2001).

With effect from academic year 2016-2017

16PY C02

APPLIED PHYSICS

Instruction	2L Periods per week
Duration of End Examination	2 Hours
End Examination	50 Marks
Sessional	20 Marks
Credits	2

Course Objectives: The objectives of the course is to make the student
1. Learn the concepts of modern physics
2. Gain knowledge of wave mechanics and statistical mechanics
3. Know the different kinds of materials and their characterization techniques

Course Outcomes: At the end of the course, the student will be able to
1. Understand the advances in laser physics, holography, optical fibers and apply them in engineering & technology
2. Explain the importance of wave mechanics and band theory of solids
3. Analyze and apply distributions of statistical mechanics for problem solving
4. Identify the materials with semiconducting and superconducting properties for engineering applications
5. Understand the role of novel materials and their characterization techniques in engineering and technology

UNIT – I
Lasers &Holography: Characteristics of lasers – Spontaneous & stimulated emission of radiation – Einstein"s coefficients – Population inversion – Lasing action – He-Ne laser – Semiconductor laser – Applications. Basic principle of Holography – Recording & Reconstruction of hologram – Applications
Optical Fibers: Principle and Construction – Propagation of light through an optical fibre – Acceptance angle – Numerical aperture – Pulse dispersion – Classification of optical fibers: Single mode & Multi mode and Step-index & Graded-index optical fibers – Double crucible method – Applications.

UNIT – II
Wave Mechanics: Schrödinger time independent and time dependent wave equations – Physical significance of wave function – Infinite square well potential (particle in a box) – Potential barrier – Tunneling effect .
Band Theory of Solids: Origin of energy band formation – Electron in periodic potential – Kronig-Penny model (qualitative) – Classification of solids

UNIT – III
Elements of Statistical Mechanics: Maxwell-Boltzmann statistics – Bose-Einstein statistics – Fermi-Dirac statistics – Photon gas – Planck"s" law of black body radiation – Wien"s law and Rayleigh-Jean"s law from Planck"s law – Concept of electron gas (qualitative) – Fermi energy level.

UNIT – IV
Semiconductors: Intrinsic and extrinsic semiconductors – Carrier concentration in intrinsic semiconductors – Energy gap – Hall Effect – Construction & working of solar cell.
Superconductors: General properties of superconductors – Meissner"s effect – Type I and Type II superconductors – BCS theory (qualitative) – Applications.

UNIT – V
Nanomaterials: Properties of materials at reduced size – Surface to volume ratio – Quantum confinement –Preparation of nanomaterials: Bottom-up approach (Sol-gel method) & Top-down

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approach (Ball milling method) – Elementary ideas of carbon nanotubes – Applications of nanomaterials.

Techniques for Characterization of Materials: X-ray fluorescence – Auger (OJ) process – Scanning electron microscope (SEM) – Tunneling electron microscope (TEM) – Atomic force microscope (AFM).

Text Books:

1. B.K. Pandey and S. Chaturvedi, "Engineering Physics", Cengage Publications, 2012.
2. M.N. Avadhanulu and P.G. Kshirsagar, "A Text Book Engineering Physics", S. Chand Publications, 2014.
3. Satya Prakash, "Statistical Mechanics", Kedar Nath Ram Nath Publications, 2008.
4. S.L. Gupta and Sanjeev Gupta, "Modern Engineering Physics", Dhanpat Rai Publications, 2011.

Suggested Reading:

1. R. Murugeshan and Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publications S. Chand Publications, 2014.
2. M. Arumugam, "Materials Science", Anuradha Publications, 2015.
3. P.K. Palanisamy, "Engineering Physics", Scitech Publications, 2012.
4. Hitendra K Malik and A.K. Singh, "Engineering Physics", Tata McGraw Hill Education Publications, 2011

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With effect from academic year 2016-2017

16CS C01

PROGRAMMING AND PROBLEM SOLVING

Instruction	3L + 1T Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	4

Course Objective:
1. To acquire problem solving Skills.
2. To be able to write Algorithms.
3. To understand structured programming Approach.
4. To understand Memory structure.
5. To implement I/O Programming.
6. To be able to write program in C Language.

Course Outcomes: Student will be able to:
1. Develop algorithms for scientific problems.
2. Explore algorithmic approaches to problem solving.
3. Understand the components of computing systems.
4. Choose data types and structure to solve mathematical problem.
5. Develop modular programs using control structure, arrays and structures.
6. Write programs to solve real world problems using structured features.

UNIT – I

Introduction to Computers: Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts.

Introduction to C Language: Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements

Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.

UNIT – II

Control Statements: Bitwise Operators, Relational and Logical Operators, If, If-Else, Switch-Statement and Examples. Loop Control Statements: For, While, Do-While and Examples. Continue, Break and goto statements.

Functions: Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Parameter Passing-Call-by-value, call-by-reference, Recursion.

UNIT – III

Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers.

Arrays: Concepts, Using Arrays in C, Array Applications, Two- Dimensional Arrays, Multidimensional Arrays.

Searching and Sorting: Linear and Binary Search, Selection Sort and Bubble Sort.

UNIT – IV

Pointers: Introduction, Pointers to Pointers, Compatibility, Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocation Functions, Array of Pointers, Programming Applications, Pointers to void, Pointers to Functions, Command-line Arguments.

Strings: Concepts, String Input /Output Functions, Arrays of Strings, String Manipulation Functions.

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UNIT – V

Structures: Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Unions, Type Definition (typedef), Enumerated Types.

Input and Output: Introduction to Files, Modes of Files, Streams, Standard Library Input/output Functions, Character Input/output Functions

Preprocessors: Preprocessor Commands.

Text Books:

1. Pradip Dey and Manas Ghosh "Programming in C 2/e" Oxford University Press , 2nd Edition 2011.
2. B. W. Kernighan and D.M. Ritchie, "The 'C' Programming Language" Prentice Hall India, 2nd Edition. 1990.
3. B.A.Forouzan and R.F. Gilberg A Structured Programming Approach in C, Cengage Learning,2007.

Suggested Reading:

1. Rajaraman V. "The Fundamentals of Computers" 4th Edition, Prentice Hall of India, 2006.
2. R S Bichker "programming in c" University Press ,2012.

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With effect from academic year 2016-2017

16ME C01

ELEMENTS OF MECHANICAL ENGINEERING

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. Student will understand different types of engineering materials and their applications.
2. Student will come to know working principles of Petrol & Diesel engines with basic knowledge of thermodynamics.
3. Student will understand various making processes.
4. Student will come to know various power transmission devices.
5. Student will understand the importance of principles of management in industry.
6. Student will come to know aspects of various quality control techniques.

Course Outcomes: At the end of the course, students will be able to

1. Select the material depending upon requirement.
2. Evaluate performance of Petrol & Diesel engines.
3. Demonstrate his/her knowledge in preparing process chart for various machining operations.
4. Estimate the power required for various power transmitting devices like belt and gear trains.
5. Become a successful entrepreneur after studying principles of management.
6. Apply various quality control techniques after studying principles of industrial engineering.

UNIT – I

Engineering Materials: Metals and their alloys, Ductile and brittle materials, Ceramics, Polymers, Composite materials

Simple Stresses & Strains: Stress-strain diagram (for ductile and brittle materials), Poison"s ratio, Young"s Modulus, Rigidity modulus, Bulk modulus, Failure theories, factor of safety.

UNIT – II

Thermodynamics: Zeroth, First, Second and Third laws of thermodynamics and corollaries

I.C. Engines: Working principle of Two stroke and Four stroke SI and CI engines, Calculations of efficiencies

Heat Transfer: Fourier law of conduction in single coordinates, Newton"s law of conduction, Stephens & Boltzmann law of radiation

UNIT – III

Basic Manufacturing Processes: Introduction to Welding, Brazing & Soldering, Principles of gas welding & arc welding processes, Casting, Principles of sand casting and die casting, Principles of Turning, Drilling, Milling, Grinding, Knurling, Tapping and Honing operations

UNIT – IV

Kinematics: Definitions of kinematic link, pair, mechanism and machine

Gear Trains: Simple, Compound, Inverted and Epicyclic gear trains

Belt Drives: Open and crossed belt drives, length of belts, ratio of belt tensions for flat belt, condition for maximum power transmission for flat belt

Fluid Mechanics: Definition and basic properties of fluids, types of fluids and fluid flows, stream lines, streak lines, stream function and velocity potential

UNIT – V

Industrial Engineering & Management: Introduction to scientific management, basics and importance of work study, steps in conducting work study, time study, standard time, organization and types of organization, Quality definition and its importance, introduction to quality control, types of inspection.

Text Books:

1. Jonathan Wickert and Kemper E. Lewis, An Introduction to Mechanical Engineering,3rd Ed, Cengage learning, USA, 2013
2. Yunus A. Cengel, Heat Transfer: A Practical Approach, Mcgraw-Hill, 2nd edition, 2002
3. Mahesh M Rathore, Thermal Engineering, Tata Mc Grw Hill Eduation Pvt. Ltd., 2010

Suggested Reading:

1. R K Rajput, Thermal Engineering, Laxmi Publications, 2010
2. Michael Geoffrey Stevenson, Industrial Engineering, University of N.S.W., Division of Postgraduate Extension Studies, 1972
3. PN Rao, Manufacturing Technology, Volume-I, 3rd Edition, Tata McGraw-Hill, Education, 2009
4. Thomas Bevan, Theory of Machines, 3rd Edition, Pearson Education India, 1986
5. P. N. Modi, S. M. Seth, Hydraulics and Fluid Mechanics: Including Hydraulic Machines, Standard Book House, 2011

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With effect from academic year 2016-2017

16EC C01

ELEMENTS OF ELECTRONICS AND COMMUNICATION ENGINEERING

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. To understand the elementary concepts of electronic devices.
2. To study basics of Boolean algebra and working of digital circuits.
3. To understand basic operations of AM, FM, filters and multiplexing .
4. To enable the students to understand the working of commonly used communication systems.
5. To give an exposure to the selected applications.

Course Outcomes: The students will be able to

1. Familiar with the basic electronic devices and simple circuits
2. Work with Boolean algebra principles, build the simple combinational and sequential circuits
3. Appreciate the need for modulation, filtering and multiplexing
4. Understand the working principles of a few communication systems
5. Familiar to the selected applications

UNIT – I

Basics of Passive and Active devices

Classification of passive and active devices and their symbols; current flow in a semiconductor; Operating principle of a diode, its application as a rectifier; Operating principle of a transistor (BJT and JFET), Principle and use of Zener diode, Photo diode and LED.

UNIT-II

Introduction to Digital Electronics

Number systems, Binary addition and subtraction, ASCII code, Boolean algebra (Theorems and properties), Logic gates, Combinational circuits such as Half adder, Full adder and Half subtractor, Introduction to sequential logic, Basic Flip flop, Evolution of ICs, block diagram description of Microprocessor and Microcontroller.

UNIT – III

Principles of Communication Engineering (Elementary treatment only)

Basic Communication system components; Concept of Modulation, Introduction to AM, FM and comparisons; Introduction to wired and wireless communication; Concepts of filtering, LPF, HPF, BPF and BSF; concept of multiplexing, TDM and FDM.

UNIT-IV

Overview of Communication systems

Radio spectrum and applications, Modes of propagation;
Basic cellular network and concepts of a cell, frequency reuse, hand-off and cross-talk;
Basic Radar block diagram and applications; Introduction to communication satellite, Geostationary satellites and subsystems, Applications of satellites, GPS, DTH, Remote Sensing;

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UNIT –V

Basic operating principles of selected applications:

Block diagram of CRO and application; Software Defined Radio (SDR)-Definition and it"s block diagram; Smart phone-features; Introduction to Wireless sensor networks (Bluetooth and ZigBee), RFID- and its types, basic functions; Introduction to Modem.

Text Books:

1. "Electronic Principles" by Albert Malvino and David J Bates, 7th Edition, 2006
2. "Digital Priniciples and Applications", by Donald P Leach, Albert Paul Malvino, Gautham saha, Tata McGraw Hill, 6^{th} Edition, 2009
3. "Electronic Communication Systems", by Kennedy and Davis, Tata Megra Hill Publications, 4^{th} Edition, 2008

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16CE C03

PROFESSIONAL ETHICS AND HUMAN VALUES

Instruction	1L Periods per week
Duration of End Examination	2 Hours
End Examination	50 Marks
Sessional	- - -
Credits	1

Course Objectives:

1. To develop the critical ability among students to distinguish between what is of value and what is superficial in life
2. To enable the students, understand the values, the need for value adoption and prepare them meet the challenges
3. To enable the students, develop the potential to adopt values, develop a good character and personality and lead a happy life
4. To motivate the students, practice the values in life and contribute for the society around them and for the development of the institutions /organisation around they are in.
5. To make the students understand the professional ethics and their applications to engineering profession

Course Outcomes:

1. Students develop the capability of shaping themselves into outstanding personalities, through a value based life.
2. Students turn themselves into champions of their lives.
3. Students take things positively, convert everything into happiness and contribute for the happiness of others.
4. Students become potential sources for contributing to the development of the society around them and institutions/ organisations they work in.
5. Students shape themselves into valuable professionals, follow professional ethics and are able to solve their ethical dilemmas.

UNIT-I Concepts and Classification of Values –Need and challenges for value Adoption -Definition of Values – Concept of Values – Classification of Values – Hierarchy of Values – Types of Values – Interdependence of Values

Need for value education – Lack of education in values – Benefits of value education- Challenges for Value adoption – Cultural, Social, Religious, Intellectual and Personal challenges

UNIT – II: Personal Development and Values in Life

Personal Development: – Accountability and responsibility – Desires and weaknesses – Character development – Good relationships, self-restraint, Spirituality and Purity - Integrating values in everyday life

UNIT – III: Practicing Values for the development of Society

Resentment Management and Self-analysis – Positive Thinking and Emotional Maturity – The importance of Women , Children and Taking care of them – Helping the poor and needy – Fighting against addictions and atrocities – Working for the Sustainable development of the society

Principles of Integrity-Institutional Development - Vision for better India.

UNIT – IV: Basic Concepts of Professional Ethics

Ethics, Morals and Human life , Types of Ethics, Personal Ethics, Professional Ethics, Ethical dilemmas, Science – Religion - Ethics, Case Studies on Professional Ethics, Exemplary life sketches of prominent Indian personalities like Sri.M.Visweshwarayya, Dr.APJ Abdul Kalam and JRD Tata

UNIT-V: Ethics in Engineering Profession
Engineering Profession-Technology and Society- Ethical obligations of Engineering Professionals-Roleand responsibility of Engineers - A few Case Studies on Risk management safety and Risk Management Plagiarism-Self plagiarism- -Ethics Standards and Bench Marking

Text Books:
1. Subramanian R, " Professional Ethics " , Oxford University Press , 2013
2. Nagarajan R S, " A Text Book on Human Values and Professional Ethics " New Age Publications ,2007
3. Dinesh Babu S, " Professional Ethics and Human Values " , Laxmi Publications , 2007

Suggested Reading:
1. SantoshAjmera and Nanda Kishore Reddy , "Ethics , Integrity and Aptitude",McGrawhill EducationPrivate Limited, 2014
2. Govinda Rajan M, Natarajan S, Senthil Kumar V S,"Professional Ethics and Human Values",Prentice Hall India, Private Limited,2012
3. Course Material for Post Graduate Diploma In "Value Education & Spirituality" Prepared by Annamalai University in Collaboration with Brahma Kumaris, 2010

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PROGRAMMING LABORATORY

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
CIE	15 Marks
Credits	1

1. Demonstration of Control Structures
2. Demonstration of Switch case (menu driven)
3. Demonstration of Parameter passing Methods
4. Demonstration of Functions using Recursion
5. Demonstration of Array Operations on Matrix
6. Implementation of Bubble sort
7. Implementation Selection Sort
8. Implementation of Linear and Binary Search
9. Implementation of String manipulation operations with and without library function
10. Demonstration using Pointers
11. Demonstration of Array of Structures
12. Sequential file operations

Text Books:

1. Pradip Dey and Manas Ghosh, "Programming in C", 2/e, Oxford University Press, 2nd Edn 2011
2. B.W. Keringhan and D.M. Ritche, "The 'C' Programming Language", Prentice Hall India, 2nd Edition, 1990

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16ME C03 With effect from academic year 2016-2017

MECHANICAL AND IT WORKSHOP

Instruction	: 3 periods per week
Duration of Semester End Examination	: 3 hours
Semester End Examination	: 50 Marks
CIE	: 25 Marks
Credits	2

MECHANICAL WORKSHOP

Trades for Practice 1. Fitting 2. Tin Smithy 3. Carpentry 4. House Wiring

Exercises in Fitting:

1. To make a perfect rectangular MS flat
2. To do parallel cuts using Hack saw.
3. To drill a hole and tap it
4. To make male and female fitting using MS flats-Assembly 1
5. To make male and female fitting using MS flats-Assembly 2

Exercises in Tin Smithy:

1. To make a square may from the given sheet metal
2. To make a rectangular box from the given sheet metal with base and top open. Solder the corners
3. To make a scoop
4. To make a dust pan from the given sheet metal
5. To make a pamphlet box

Exercises in Carpentry:

1. To plane the given wooden piece to required size
2. To make a cross lap joint on the given wooden piece according to the given dimensions
3. To make a Tee lap joint on the given wooden piece according to the given dimensions
4. To make a dove tail-joint on the given wooden piece according to the given dimensions
5. To make a bridle joint on the given wooden piece according to the given dimensions

Exercises in House Wiring:

1. Wiring of one light pint controlled by one single pole switch, a three pin socket controlled by a single pole switch, and wiring of one buzzer controlled by bell push.
2. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs.
3. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
4. Stair case wiring-wiring of one light point controlled from two different places independently using two 2-way switches.
5. Go-down wiring

Demonstration of plumbing and welding trades.

Note: A minimum of 12 exercises from the above need to be done

1. Workshop Practice Manual, K. Venkata Reddy, B.S. Publications Sixth Edition, 2008.

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IT WORKSHOP

List of Tasks:

Task 1: MS Word: formatting text, inserting images, tables, equations and hyperlinks

Task 2: MS Excel: Functions and formulas and graph plotting

Task 3: MS Power point presentation: Guidelines for effective presentation, inserting objects, charts, hyperlinks, and navigation between slides.

Task 4: Essentials Search Engines & Net etiquette, Plagiarism, Open source tools and other utility tools

Suggested reading:

1. Scott Mueller's Upgrading and Repairing PCs, 18/e, Scott.
2. The Complete Computer upgrade and repair book, 3/e, Cheryl A Schmidt, Dreamtech

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APPLIED PHYSICS LABORATORY

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
CIE	15 Marks
Credits	1

Course Objectives: The objectives of the course is to make the student

1. Acquire knowledge in experiments of modern physics
2. Understand the characteristics of various semiconductor devises
3. Work with lasers and optical fibers

Course Outcomes: At the end of the course the student will be able to

1. Understand the various applications of semiconductor devices and their suitability in engineering
2. Demonstrate the working of lasers and optical fibers and their applications in the field of communication.
3. Analyze the electrical properties of a given solid based on its energy band gap.
4. Verify the resistance and thermoelectric given power properties with temeperature variation.
5. Demonstrate the concept of electron and its chare experimentally.

List of Experiments:

1. Planck's Constant – Determination Planck's Constant using photo cell.
2. Solar Cell – Study of I-V characteristics of given solar cell and calculation of fill factor , efficiency and series resistance.
3. Hall Effect-Determination of Hall coefficient, carrier concentration & mobility of charge carriers of given semiconductor specimen.
4. P-N Junction Diode-Study of V-I characteristics and calculation of resistance of given diode in forward and reverse bias
5. Laser – Determination wavelength of given semiconductor red laser
6. Fibre Optics – Determination of NA and power losses of given optical fibre
7. Energy Gap-Determination of energy gap of given semiconductor
8. Thermistor – Determination of temperature coeffieient of resistance of given thermistor
9. e/m of an Electron by Thomson's Method
10. Thermoelectric Power-Determination of thermoelectric power of given sample

Note: A student must perform a minimum of eight experiments

Suggested Reading:

1. "Applied Physics", - Manual by Department of Physics, CBIT, 2016
2. S.K. Gupta, Engineering "Physics Practical", Krishna's
3. O.P. Singh, V. Kumar and R.P. Singh, "Engineering Physics Practical Manual", Ram Prasad & Sons Publications, 2009

16CY C03 With effect from academic year 2016-2017

APPLIED CHEMISTRYLABORATORY

Instruction	2 Hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
CIE	15 Marks
Credits	1

Course Objectives:

1. To impart fundamental knowledge in handling the equipment/glassware and chemicals in chemistry laboratory
2. For practical understanding of theoretical concept of chemistry

Course Outcomes:

1. This syllabus helps the student to understand importance of analytical instrumentation for different chemical analysis.
2. The above knowledge also helps students to carry out interdisciplinary research such that the findings benefit the common man.

List of Experiments:

1. Introduction to chemical analysis
2. Preparation of standard solution of oxalic acid and standardization of NaoH.
3. Estimation of amount of Fe^{+2} in the given solution using Mohr's salt and $KMnO_4$
4. Estimation of amount of Fe^{+2} in the given solution using Mohr's salt and K_2 C_rO_7
5. Estimation of amount of copper in the in the given solution using hypo solution
6. Estimation of amount of HCI pH metrically using NaOH solution.
7. Estimation of amount of CH_3COOH pH metrically using NaOH solution
8. Determination of concentration of given KMnO4 solution Calorimetrically
9. Determination of centration of given K2Cr2O7 solution Colorimetric ally
10. Distribution of acetic acid between n-butanol and water
11. Distribution of benzoic acid between benzene and water
12. Preparation of urea-formaldehyde/phenol-formaldehyde resin

Suggested Reading:

1. Vogel S text book of quantitative chemical analysis by J. Mendham and Thomas, Pearson education Pvt. Ltd. New Delhi 6th Edn., 2002
2. Laboratory Manual on Engineering Chemistry by Dr Subdhrarani Dhanpat Rai Publishing, 2012
3. A Text book on experiment and calculation in engineering chemistry by S.S. dara, S. Chand and Company, 9th edition, 2015

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With effect from academic year 2016-2017

16 MT C02

ENGINEERING MATHEMATICS – II

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. To know the relevant methods to solve higher order differential equations.
2. To learn the Laplace and Inverse Laplace transforms for solving engineering problems.
3. To know improper integrals such as Beta, Gamma functions.
4. To learn Vector Differential Operator and its physical interpretations.
5. To evaluate vector line, surface & volume integrals.
6. Learn to apply all the above mathematical methods/techniques to interpret the results in physical and technical terms.

Course outcomes:

1. Solve the solutions of Differential Equations which arise in electrical circuits, vibrations and other linear systems.
2. Able to solve solutions of differential equations with initial and boundary value problems.
3. Evaluating definite integrals using Beta, Gamma functions.
4. Understating the significance of gradient, divergent and Curl.
5. Use Greens, Gauss and Stoke"s theorems to find the surface and volume integrals.
6. Able to solve and analyse the Engineering problems.

UNIT-I Ordinary differential Equations: Linear Differential equations of higher order with constant coefficients, complementary function and particular integrals when RHS is of the forms $e^{ax}, \sin ax, \cos ax, x^m, e^{ax}(v), x^m(v)$, where v-is a function of x, Cauchy"s equation, electrical circuits of second order

UNIT-II Laplace Transforms: Laplace transforms of standard functions, Laplace transforms of piecewise continuous functions, first shifting theorem, multiplication by „t", division by „t". Laplace transforms of derivatives and integrals of functions-Unit step function- Periodic functions (without proofs). Inverse Laplace transforms-by partial fractions (Heaviside method), Convolution Theorem, Solving Ordinary differential equations by Laplace Transforms

UNIT-III Beta and Gamma Functions: Definitions of Beta and Gamma functions-elementary Properties of both Beta and Gamma functions, Relation between Beta and gamma functions, differentiation under the integral sign.

UNIT-IV Vector Differentiation: Scalar and vector fields- directional derivative- Gradient of a scalar- Divergence and Curl of a vector point function. Properties of divergence, curl, Solenoidal and Irrotational vectors

UNIT-V Vector Integration: Evaluation of Vector Line integrals, surface integrals and volume integrals, Greens, Gauss divergence and Stokes theorems (without proofs) and its applications

Text Books:

1. Erwin Kreyszig "Advanced Engineering Mathematics,"10th edition, John Wiley & Sons -Publishers.
2. R.K.Jain & S.R.K.Iyenger "Advanced Engineering Mathematics" , 3rd edition, Narosa Publications
3. Alen Jaffery "Mathematics for Engineers & Scientists" , 6th ed 2013 CRC press, Taylor & Francis Group. (Elsevier)

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4. Dr.B.S.Grewal "Higher Engineering Mathematics", 43rd edition, Khanna Publishers.

Suggested Reading: (for further reading and examples on applications)

1. A.Craft and Robert Davison "Mathematics for Engineers-a modern interactive approach" -Willey
2. Loius Pipes "Applied Mathematics and physicists" Mc Graw Hill publishers.
3. Kanti.B.Datta "Mathematical Methods of Science & Engg," Aided with MATLAB,. Cengage Learning India Pvt.Ltd.
4. AR Collar and A. Simpson "Matrices for Engineering Dynamics" -John Willey & sons.

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With effect from academic year 2016-2017

16PY C01

ENGINEERING PHYSICS

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives: The objective of the course is to make the student

1. Understand the general concepts of physics
2. Acquire knowledge of different kinds of waves and their behavior
3. Familiar with crystal physics and materials
4. To introduce the general concepts of physics

Course Outcomes: At the end of the course, the student will be able to

1. Describe the types of oscillations and analyze them
2. Demonstrate the wave nature of the light
3. Develop the concepts related to electromagnetic behavior
4. Identify the various crystal systems and defects
5. Explain the origin of magnetism and dielectric polarization and applications of these materials in the field of engineering & technology

UNIT – I Waves and Oscillations: Review of free oscillations - Superposition of two mutually perpendicular linear SHMs of same frequency and 1:2 ratio frequency – Lissajous figures – Damped vibrations – Differential equation and its solution – Logarithmic decrement - Relaxation time – Quality factor – Forced vibrations – Differential equation and its solution – Amplitude resonance- Torsional pendulum.

Ultrasonics: Production of ultrasonics by piezoelectric and magnetostriction methods – Detection of ultrasonics – Determination of ultrasonic velocity in liquids – Applications.

UNIT – II Interference: Division of amplitude – Interference in thin films (reflected light) – Newton"s rings – & division of wavefront – Fresnel"s biprism.

Diffraction: Distinction between Fresnel and Fraunhoffer diffraction – Diffraction at single slit – Diffraction grating (N Slits) – Resolving power of grating.

UNIT – III Polarization: Malus"s law – Double refraction – Nicol"s prism – Quarter & Half wave plates – Optical activity – Laurent"s half shade polarimeter.

Electromagnetic Theory: Review of steady and varying fields – Conduction and displacement current – Maxwell"s equations in differential and integral forms – Electromagnetic wave propagation in free space, dielectric and conducting media – Poynting theorem.

UNIT – IV Crystallography: Space lattice - Crystal systems and Bravais lattices – Crystal planes and directions (Miller indices) – Interplanar spacing – Bragg"s law – Lattice constant of cubic crystals by powder diffraction method.

Crystal Imperfections: Classification of defects – Point defects – Concentration of Schottky and Frenkel defects – Line defects – Edge dislocation – Screw dislocation – Burger"s vector.

UNIT – V Magnetic Materials: Classification of magnetic materials – Langevin theory of paramagnetism – Weiss molecular field theory – Domain theory – Hysteresis curve – Structure of ferrites (spinel & Inverse spinel) – Soft and hard magnetic materials.

Dielectric Materials: Dielectric polarization – Types of dielectric polarization: electronic, ionic, orientation and space-charge polarization (Qualitative) – Frequency and temperature dependence of dielectric polarization – Determination of dielectric constant (Schering bridge method) – Ferroelectricity – Barium titanate – Applications of ferroelectrics.

Text Books:

1. B.K. Pandey and S. Chaturvedi, "Engineering Physics", Cengage Publications, 2012
2. M.N. Avadhanulu and P.G. Kshirsagar, "A Text Book Engineering Physics", S. Chand Publications, 2014.
3. M. Arumugam, "Materials Science", Anuradha Publications, 2015.
4. S.L. Gupta and Sanjeev Gupta, Modern Engineering Physics, Dhanpat Rai Publications, 2011.

Suggested Reading:

1. R. Murugeshan and Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publications S. Chand Publications, 2014
2. V. Rajendran, "Engineering Physics", McGahill Education Publications, 2013
3. P.K. Palanisamy, Engineering Physics", Scitech Publications, 2012
4. V. Raghavan, "Materials Science and Engineering", Prentice Hall India Learning Private Ltd., 6th Revised edition, 2015

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With effect from academic year 2016-2017

16CY C02

APPLIED CHEMISTRY

Instruction	2L Periods per week
Duration of End Examination	2 Hours
End Examination	50 Marks
Sessional	20 Marks
Credits	2

Course Objectives:

Applied chemistry is a fascinating area with the profound implications for engineers as well as biologists. Materials fabricated and used in our daily life are derived from chemicals, both natural and synthetic and their range of utility are growing day by day. It is imperative that engineers of different disciplines acquire sufficient knowledge of the materials and their characteristics for making proper selection of their end -use application.

The various units of the syllabus is so designed to fulfill the following objectives.

1. To impart technological aspects of modern chemistry and to lay foundation for the application of chemistry in engineering and technology disciplines
2. The student should be conversant with the
    i. Principles of water characterization and treatment of water for potable and industrial purposes.
    ii. Principles of polymer chemistry and engineering applications of polymers in domestic and engineering areas
3. Knowledge to prevent corrosion of machinery and metallic materials and water chemistry which require serious attention in view of increasing pollution, has been included in the syllabus.
4. Study of polymers is insisted as it gives better insight to industrial personnel by being exposed to wider aspects of polymer science.
5. Study of fuel cells is given importance as fuel cells are the alternate energy sources for generating electrical energy on spot and portable applications.
6. Newer materials lead to discovering of technologies in strategic areas like defense and space research. Recently modern materials synthesized find applications in industry and technology and in order to emphasize them, topics like composite materials, polymers, conducting polymers and nano materials have been incorporated in the curriculum.
7. To enable students to apply the knowledge acquired in improving the properties of engineering materials.
8. To give an insight into nano materials and composite materials aspect of modern chemistry.

Course Outcomes:

1. At the end of the course, the students will be familiar with the fundamentals of water technology; corrosion and its control; applications of polymers in domestic and engineering areas; nano materials and their applications.
2. The engineer who has the above background can effectively manage the materials in his designing applications and for discovering & improving the systems for various uses in industry, agriculture, health care, technology, telecommunications and electronics.
3. The above knowledge also helps students to carry out inter disciplinary research such that the findings benefit the common man.
4. Study of nano related materials helps to update the knowledge necessary to launch into the demands of the world.

UNIT –I

Water Chemistry: Hardness of water – Types, units of hardness, Disadvantages of hard water - Boiler troubles - scales & sludge formation - causes and effects, softening of water by ion exchange method and Reverse Osmosis. Specifications of potable water & industrial water, disinfection of water by chlorination, Ozonization, UV radiation.

UNIT -II

Corrosion Science : Introduction, chemical corrosion – oxidation corrosion , electro chemical corrosion and its mechanism , Galvanic corrosion and types of differential aeration corrosion (waterline corrosion) , Factors affecting corrosion (position of the metals in galvanic series, relative areas of anode and cathode, nature of corrosion product – solubility and volatility of corrosion product, nature of corroding environment – temperature, humidity and P^H. Corrosion control methods – cathodic protection, sacrificial anodic protection

UNIT – III

High Polymers: Definition of polymer, degree of polymerization. Thermo plastics and thermo sets. Preparation, properties and uses of plastics (Polyvinyl chloride, Bakelite), fibers (Kevlar, polyurethane), Rubbers – natural rubber and its chemical structure, vulcanization and its significance. Preparation, properties and uses of silicone rubber, conducting polymers – definition, classification and applications

UNIT – IV

Battery Technology: Types of batteries - Primary batteries - Dry cell, Lithium battery; Secondary batteries - lead acid storage cell , Lithium ion battery ; Fuel cell - H_2-O_2 fuel cell, methanol-oxygen fuel cell – its advantages and applications
Solar cells – photo voltaic cells

UNIT–V

Engineering Materials: Nano materials – Introduction to nano materials and general applications, basic chemical methods of preparation – Sol-gel method. Carbon nanotubes and their applications
Composite materials – definition, types of composites, fibre reinforced, glass fibre reinforced and carbon fibre reinforced composites and applications.

Text Books:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Pub, Co., New Delhi (2002)
2. Applied Chemistry "A text for Engineering & Technology" Springer (2005).
3. ShasiChawla, "Text Book of Engineering Chemistry", Dhanpat Rai Publishing Company, NewDelhi (2008).
4. S.S. Dara "A text book of engineering chemistry" S.Chand & Co.Ltd., New Delhi (2006).
5. B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
6. Applied Chemistry by N. Krishnamurthy:P. Vallinavagam. And K. Jeysubramanian TMH
7. Chemistry of Engineering Materials by CV Agarwal,C.P Murthy, A.Naidu, BS Publications.
8. Chemistry of Engineering Meterials by R.P Mani and K.N.Mishra, CENGAGE learning

Suggested Reading:

1. B.K.Sharma, "Engineering chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001)
2. Water Treatment : F. I. Bilane, Mir publisher
3. Fundamentals of Corrosion: Michael Henthorne, Chemical Engineering.
4. A textbook of Polymer Science: Fred, Billmeyer Jr., Wiley India Third edition.
5. Chemistry of Advanced Materials: CNR Rao, Rsc Publication.
6. Materials Science and Engineering an Introduction, William D. Callister, (Jr. Wiley publisher).
7. Introduction to nano materials by T.Pradeep.

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With effect from academic year 2016-2017

16EE C01

ELEMENTS OF ELECTRICAL ENGINEERING

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. To understand the basic concepts of electrical circuits.
2. To understand the principles of electromagnetic induction.
3. To know about different types of batteries, charging and discharging of batteries and types of fuel cells etc.
4. To know about different types of electrical wires and cables, domestic and industrial wiring.
5. To understand safety rules and methods of earthing.

Course Outcomes: After completion of the course, the student will be able to:

1. Acquire the knowledge of basic concepts of electrical circuits such as Ohm"s law, Kirchhorff"s laws etc.
2. Acquire the knowledge of basic Faraday"s laws of electromagnetic induction.
3. Acquire the knowledge to solve the problem of AC circuits.
4. Acquire the knowledge of specifications of batteries, types of cells and sources of renewable energy.
5. Acquire the knowledge of electrical wiring and cables and their types and electrical equipment and their specification.
6. Acquire the knowledge of safety precautions in handling electrical appliances, importance of grounding and methods of earthing.

UNIT-I DC Circuits
Current, voltage, power and energy, sources of electrical energy, independent and dependent sources, source conversion, circuit elements, Resistor, Inductor, Capacitor Ohm"s law, Kirchhoff"s laws, analysis of series, parallel and series-parallel circuits, star-delta conversion, Node and Mesh analysis (with independent sources only).

UNIT-II : Electromagnetism & AC Circuits Electric charge, electric field, lines of force, electric field intensity, electric flux and flux density, Faraday"s laws of electromagnetic induction, static and dynamically induced EMF.
A.C. Circuits: Generation of alternating voltage and current, equation of alternating voltage and current, average and rms values of sinusoidal quantities, form and peak factors, phasor representation of sinusoidal quantities, AC through pure resistance pure Inductance, pure capacitance, RL,RC,RLC circuits.

UNIT-III: Batteries and Fuel Cell
Introduction to batteries, simple cell, EMF and internal resistance of a cell, primary and secondary cells, cell capacity, types and specifications of batteries, charging and discharging of battery, safe disposal of batteries; fuel cell, principle and types of fuel cell, different sources of renewable energy.

UNIT-IV: Electrical Wiring
Types of wires and cables, types of connectors and switches, system of wiring, domestic and industrial wiring, simple control circuit in domestic installation, electrical equipment and their specifications

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UNIT-V: **Safety & Protection**

Safety precautions in handling electrical appliances, electric shock, first aid for electric shock, other electrics hazards, safety rules, importance of grounding and earthing of electrical equipment, methods of earthing, circuit protection devices: Fuses, MCB, ELCB and Relays.

Text Books:

1. Edward Hughes, "Electrical and Electronics Technology", 10th Edition, Peasson Publishers 2010.
2. V.K. Mehta & Rohit Mehta, "Principles of Electrical Engineering", S.Chand Company Limited 2008
3. B.L. Theraja & A.K. Theraja, "Electrical Technology", Vol.I, S.Chand Company Limited 2008.

Suggested Reading:

1. P.V.Prasad & S. Siva Nagraju, "Electrical Engineering: Concepts & Applications", Cengage Learning, 2012.
2. S. Rao, "Electrical Safety, fire safety engineering & Safety Management", Khanna publications, 1998.
3. Surjit singh & Ravi Deep Singh, "Electrical Estimating and Costing", Dhanapath Rai & Co., 1997.

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16CE C01

ENGINEERING MECHANICS

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives: During this course, students should develop the ability to:

1. Work comfortably with basic engineering mechanics concepts required for analyzing static structures
2. Identify an appropriate structural system to study a given problem and isolate it from its environment.
3. Analyze and model the problem using free-body diagrams and equilibrium equations
4. Apply pertinent principles to the system to solve and analyze the problems subjected to frictional forces.
5. Understand the meaning of centroid/ centers of gravity and moments of Inertia using integration methods.
6. Communicate the solution to all problems in an organized and coherent manner and elucidate the meaning of the solution in the context of the problem.

Course Outcomes: At the end of the course the student will be able to:

1. Solve problems dealing with forces in planar force systems
2. Draw free body diagrams to analyze the forces in the given structure
3. Understand the concept of moments and couples in plane systems.
4. Understand the mechanism of friction and can solve friction problems
5. Determine the centroid of plane areas and centers of gravity of bodies using integration methods
6. Determine moments of inertia, product of inertia for all areas and mass moments of inertia for bodies,

UNIT – I

Force Systems: Resolution of coplanar and non-coplanar force systems (both concurrent and non-concurrent), Determining the resultant of planar force systems. Moment of force and its applications and couples

UNIT – II

Equilibrium of force system: Free body diagrams, equations of equilibrium of planar force systems and its applications. Problems on general case of force systems

UNIT – III

Theory of friction: Introduction, types of friction, laws of friction, application of friction to a single body & connecting systems. Wedge and belt friction

UNIT– IV

Centroid: Significance of centroid, moment of area, centroid of line elements, plane areas, composite areas, theorems of Pappus & its applications. Center of gravity for elementary and composite bodies

UNIT – V

Moment of Inertia: Definition of MI, Polar Moment of Inertia, radius of gyration, transfer theorem, moment of Inertia of elementary & composite areas, product of inertia. Mass moments of inertia for elementary and composite bodies

Text Books:

1. K. Vijay Kumar Reddy and J. Suresh Kumar, Singer"s Engineering Mechanics, BS Publications, Hyderabad, 2011.
2. Ferdinand L Singer, Engineering Mechanics, Harper and Collins, Singapore, 1904.

Suggested Reading:

1. A. Nelson, Engineering Mechanics, Tata McGraw Hill, New Delhi, 2010.
2. S. Rajashekaran & G. Sankarasubramanyam, Engineering Mechanics, Vikas publications, Hyderabad, 2002.
3. S.B. Junarkar and H.J Shah, Applied Mechanics, Charotar publishers, New Delhi, 2001.
4. Basudeb Bhattacharyya, Engineering Mechanics, Oxford University Press, New Delhi, 2008.
5. A K Tayal, Engineering Mechanics, Umesh Publications, New Delhi, 2010

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With effect from academic year 2016-2017

16EG C01

PROFESSIONAL COMMUNICATION IN ENGLISH

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. To enable the students to understand the role and importance of communication and to develop their basic communication skills in English.
2. To strengthen the students" usage of grammar and to develop their vocabulary.
3. To improve the students" listening skills and introduce them to different reading strategies.
4. To equip the students with appropriate writing skills.
5. To enhance imaginative and critical thinking through literary texts and book review.

Course Outcomes: The students will

1. Understand the nature, process and types of communication and will communicate effectively without barriers.
2. Understand the nuances of listening and will learn to make notes
3. Read different texts, comprehend and draw inferences and conclusions.
4. Write effective paragraphs, letters and reports
5. Critically analyze texts and write book reviews

UNIT- I Understanding Communication in English: Introduction, nature and importance of communication. Process of communication. Basic types of communication - verbal and non verbal. One way vs. Two way communication. Barriers to communication. Intrapersonal and interpersonal communication. Johari Window.

Grammar & Vocabulary: Parts of speech, figures of speech – Euphemism, Hyperbole, Irony, Metaphor, Onomatopoeia, Oxymoron, Paradox, Personification, Pun & Simile

UNIT- II Developing Listening Skills: Exposure to recorded and structured talks, class room lectures-problems in comprehension and retention. Types of listening, barriers to listening, effective listening strategies. Note –taking.

Grammar & Vocabulary: Articles, Prepositions, Phrasal verbs, Idioms.

UNIT- III Developing Writing Skills: Sentence structure. Brevity and clarity in writing. Cohesion and coherence. Paragraph writing. Letter writing - form and structure, style and tone. Kinds of Letters – Apology and request letters. Email etiquette. Report writing.

Grammar & Vocabulary: Tense, Conditionals, homonyms, homophones.

UNIT - IV Developing Reading Skills: The reading process, purpose, different kinds of texts. Reading comprehension. Techniques of comprehension – skimming, scanning, drawing inferences and conclusions. Note-making

Grammar &Vocabulary: Concord, Connectives, Active and Passive voice, Words often confused.

UNIT- V: Reading for Enrichment

1.	The Road Not Taken	Robert Frost
2.	Goodbye Party For Miss Pushpa T. S	Nissim Ezekiel
3.	The Open Window	Saki
4.	The Romance Of A Busy Broker	O. Henry

Book reviews -Oral and written review of a chosen / novel/ play - a brief written analysis including summary and appreciation. Oral presentation of the novel/play

Grammar & Vocabulary: Indianisms, Common errors, Parallelisms.

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Text Books:

1. Vibrant English, Orient Blackswan Ltd,

Suggested Reading:

1. M .Ashraf Rizvi, Effective Technical Communication, Tata Mc Graw- Hill, New Delhi
2. Meenakshi Raman and Sangeetha Sharma, Technical Communication - Principles and Practice, Oxford Univ. Press, New Delhi.
3. Sunil Solomon, English for Success, Oxford University Press, 2015
4. Krishna Mohan, Meera Banerji, Developing Communication Skills, McMillan India Ltd.
5. Michael McCarthy, English Vocabulary in Use.
6. Brikram K Das, Kalyani Samantray, An Introduction to Professional English and Soft Skills Cambridge Univ. Press, New Delhi.

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With effect from academic year 2016-2017

16CE C02

ENVIRONMENTAL STUDIES

Instruction	1L Periods per week
Duration of End Examination	2 Hours
End Examination	50 Marks
Sessional	- - -
Credits	1

Course Objectives:

1. To equip the students with inputs on the environment, natural resources and their conservation.
2. To study the interrelationship between the living organisms and the natural environment and also to enable the students to understand the structure and functioning of the ecosystems.
3. To understand the importance of biodiversity and create awareness on its threats and conservation strategies.
4. To enable the students become aware of pollution of various environmental segments including their causes, effects and control measures.
5. To create awareness about environmental legislations in the context of national conventions.

Course Outcomes: At the end of the course, the student should have learnt

1. To understand the scope and importance of environmental studies, identify the natural resources and ecosystems and contribute for their conservation.
2. To understand the ecological services of biodiversity and contribute for their conservation.
3. To develop skills to solve the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
4. To relate the social issues and the environment and contribute for the sustainable development.
5. To understand the essence of the ethical values of the environment for conserving depletable resources and pollution control.

UNIT – I

Environmental Studies: Definition, Scope and importance, need for public awareness.

Natural resources: Water resources- hydrological cycle, use and over utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Food resources- Changes caused by modern agriculture, fertilizers-pesticide problems, water logging and salinity. Forest resources-use and over exploitation, deforestation. Mineral resources- Use and exploitation, effects of mining. Energy resources- Growing energy needs, various renewable and non-renewable energy sources. Land resources- land as a resource, land degradation- causes and effects, Role of individuals in conservation of natural resources.

UNIT – II

Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, concept of food chains, food webs, ecological pyramids.

UNIT – III

Biodiversity: Types/classification of biodiversity, India as a mega diversity nation, values of biodiversity, threats to biodiversity, Conservation of biodiversity.

UNIT – IV

Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, Soil pollution, Noise pollution and Thermal pollution.

Environmental Legislations: Environment protection act, Air, Water, Forest & Wild life acts

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UNIT – V

Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development, Population explosion and Climate change: Global warming, Acid rain, Ozone layer depletion.

Text Books:

1. P. D.Sharma, "Ecology & Environment", Ashish publications, 1994
2. Y. Anjaneyulu, "Introduction to Environmental Science", B S Publications, 2004

Suggested Reading:

1. Dr. Suresh K. Dhameja, "Environmental Studies", S. K. Kataria & Sons, 2009
2. C. S. Rao, "Environmental Pollution Control Engineering", Wiley, 1991
3. S. S. Dara, "A Text Book of Enviromental Chemistry & Polution Control", S. Chand Limited, 2006

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16ME C02

ENGINEERING GRAPHICS

Instruction	1L + 3D Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. To provide an exposure in understanding the drawings during a multidisciplinary approach towards a problem
2. To train up in perception and imagination of a three dimensional scenario.

Course Outcomes:

1. To understand theory of projections
2. Ability to improve visualization skills
3. Ability to sketch Engineering Objects

UNIT – I

Introduction to Engineering Drawing: Drawing Instruments and their uses, types of lines, use of pencils, Lettering, Rules of dimensioning

Conic Sections: Ellipse, Parabola, Hyperbola including the Rectangular Hyperbola (General method only)

Cycloidal curves: Construction of cycloid, epi-cycloid, hypo-cycloid & involutes

UNIT – II

Orthographic Projections: Principles of Orthographic Projections – Conventions , Projection of Points, Projection of Lines - inclined to both planes.

UNIT – III

Projections of Planes: Projections of regular Planes – Perpendicular planes and Oblique planes.

UNIT – IV

Projections of Solids: Projections of Regular Solids – Regular Polyhedra, solids of revolution, (Simple position only)

Sections of Solids: Types of cutting planes – their representation – sections of solids in simple position.

UNIT – V

Introduction to Graphic packages: Getting started, Basic drawing and editing commands, creating lines, planes and solids.

Note: Syllabus for external examination will be from unit 1 to unit 4 only & unit-5 is exempted from external examination. Unit 5 is for internal examination only.

Text Books:

1. N.D.Bhatt," Elementary Engineering Drawing", Charotar Publishers, 2012
2. Basanth Agrawal and C M Agrawal "Engineering Drawing 2e ", McGraw-Hill Education(India) Pvt. Ltd.

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Suggested Reading:

1. K.L.Narayana and P.K.Kannaiah, "Text Book of Engineering Drawing", Scitech Publications, 2011
2. P.S.Gill" "Engineering Graphics", Kataria Publications, 2011
3. K.Veenugopal, "Engineering Drawing and Graphics + Autocad", New Age International Pvt. Ltd, 2011
4. Shaw M.B and Rana B.C., "Engineering drawing", Pearson, 2nd edition, 2009
5. P I Varghees, " Engineering Graphics ",Tata McGraw-Hill publications, 2013
6. Bhattacharya. B, "Engineering Graphics", I. K. International Pvt. Ltd, 2009
7. Dhawan R.K., "Principles of Engineering Graphics and Drawing", S. Chand, 2011

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16PY C03

ENGINEERING PHYSICS LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives: The objectives of the course is to make the student

1. Apply theoretical physics knowledge in doing experiments
2. Understand the behavior of the light experimentally
3. Analyze the behavior of magnetic and dielectric materials

Course Outcomes: At the end of the course, the student will be able to

1. Understand the concept of errors and find the ways to minimize the errors
2. Demonstrate interference and diffraction phenomena experimentally
3. Distinguish between polarized and unpolarized light
4. Determine the loss of energy of a ferromagnetic material and its uses in electrical engineering
5. Understand the suitability of dielectric materials in engineering applications

List of Experiments:

1. Error Analysis – Estimation of errors in the determination of time period of a torsional pendulum
2. Newton"s Rings – Determination of wavelength of given monochromatic source
3. Single Slit Diffraction – Determination of wavelength of given monochromatic source
4. Diffraction Grating – Determination of wavelengths of two yellow lines of mercury light
5. Malus"s Law – Verification of Malus"s law
6. Double Refraction – Determination of refractive indices of O-ray and E-ray of given calcite crystal
7. Polarimeter – Determination of specific rotation of glucose
8. B-H Curve – Determination of hysteresis loss of given specimen
9. Dielectric Constant – Determination of dielectric constant of given PZT sample
10. Ultrasonic Interferometer – Determination of velocity of ultrasonics in given liquid

Note: A student must perform a minimum of eight experiments.

Suggested Reading:

1. "Engineering Physics" - Manual by Department of Physics, CBIT, 2016
2. S.K. Gupta, "Engineering Physics Practical", Krishna"s Educational Publishers, 2014
3. O.P. Singh, V. Kumar and R.P. Singh, "Engineering Physics Practical Manual", Ram Prasad & Sons Publications, 2009

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16CY C04

APPLIED CHEMISTRY LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives:

13. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory
14. For practical understanding of theoretical concept of chemistry.
15. The student should be conversant with the principles water characterization and treatment of potable and industrial purposes.

Course Outcomes:

1. This syllabus helps the student to understand importance of analytical instrumentation for different chemical analysis.
2. The above knowledge also helps students to carry out inter disciplinary research such that the findings benefit the common man.

LIST OF EXPERIMENTS

1. Introduction to chemical analysis
2. Preparation of standard solution of oxalic acid and Standardization of NaOH
3. Estimation of amount of oxalic acid in the given solution using Mohr"s salt and $KMnO_4$
4. Estimation of total hardness of water using EDTA solution
5. Estimation of temporary hardness and permanent hardness of water using EDTA solution
6. Estimation of amount of carbonate in the given solution using HCl link solution
7. Estimation of amount of carbonate and bicarbonate in the given solution using HCl link solution
8. Estimation of amount of HCl conductometerically using NaOH solution
9. Estimation of amount of CH_3COOH conductometerically using NaOH solution
10. Estimation of amount of HCl and CH_3COOH present in the mixture of acids conductometerically using NaOH solution
11. Estimation of amount of HCl potentiometrically using NaOH solution
12. Estimation of amount of Fe^{+2} potentiometrically using $KMnO_4$ solution

Suggested Reading:

1. Applied Chemistry: Theory and Practice (Latest ed.), By O.P. Vermani & A.K. Narula
2. Vogel"s Textbook of Quantitative Chemical Analysis (Latest ed.), Revised by G.H. Jeffery, J. Bassett, J. Mendham & R.C. Denney
3. Instrumental methods of Chemical Analysis, MERITT & WILLARD East-West Press

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16EG C02

PROFESSIONAL COMMUNICATION LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives:

1. To introduce students to phonetics and the different sounds in English.
2. To familiarize the students with the software and give them sufficient practice in correct pronunciation.
3. To enable students to speak English correctly with focus on stress and intonation.
4. To help students overcome their inhibitions while speaking in English and to build their confidence. The focus shall be on fluency rather than accuracy.
5. To understand team work, role behavior and to develop the ability to analyze, evaluate, construct and refute arguments.

Course Outcomes:

1. The students will understand the speech sounds in English and the nuances of pronunciation.
2. The students will understand tone, intonation and rhythm and apply stress correctly.
3. The students will be able to participate in group discussions with clarity and confidence.
4. The students will speak confidently on stage with appropriate body language.
5. The students will debate on various issues and learn to work in teams.

Exercises

1. **Introduction to English Phonetics**: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English**: Phonetic sounds and phonemic sounds, introduction to International Phonetic Alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters.
3. **Aspects of connected speech**: Strong forms, weak forms, contracted forms, elision.
4. **Word stress**: Primary stress, secondary stress, functional stress, rules of word stress.
5. **Rhythm & Intonation**: Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
6. **Listening skills** – practice with IELTS and TOEFL material
7. **Situational dialogues and role play**
8. **Public speaking** is to be shown by incorporating narrative examples and extracts from speeches.
9. **Group Discussions**– videos to be shown and practice sessions
10. **Poster making** – preparation and presentation
11. **Debate** - Differences between a debate and a group discussion. Essentials of a debate, conducting a debate.

Suggested Reading:

1. E Suresh kumar et al, . English for Success (with CD), Cambridge University Press India Pvt Ltd. 2010.
2. Aruna Koneru, Professional Speaking Skills, Oxford University Press, 2016
3. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
4. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
5. Edgar Thorpe. Winning at Interviews, Pearson Education, 2006
6. Priyadarshi Patnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd 2011

16MT C05

ENGINEERING MATHEMATICS-III

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course objectives:

1. To study the expansion of functions in various intervals.
2. To form P.D.E and to find its solution.
3. To solve Wave, Heat & Laplace equations.
4. To learn Differentiation and Integration of complex valued functions.
5. To evaluate Complex Integration.
6. To evaluate Real definite integrals.

Course outcomes: On the successful completion of this course the student will be able to

1. Expand functions in the given intervals.
2. Solve linear and non linear PDEs.
3. Solve one-dimension, two-dimension, Heat steady state equations and also one-dimension wave equation.
4. Solve problems on Analytic functions, Cauchy's theorem and Cauchy's integral formula.
5. Expand functions by using Taylor's and Laurent's series.
6. Solve Real and Complex integrals by using Cauchy Theorems.

UNIT – I

Fourier series: Definition of Periodic, Single valued, finite maxima and minima of functions. Euler's Formulae, Dirichlets Conditions for Fourier expansion, Functions having points of discontinuity, Change of interval, Expansion of odd and even functions, Half-range sine series and cosine series.

UNIT-II:

Partial differential equations: Formation of partial differential equations by eliminating the arbitrary constants or arbitrary functions, solutions of linear partial differential equation of first order by using Lagrange's Method, solution of Non-linear partial differential equations of first order by using standard types, Charpit's Method.

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UNIT - III

Applications of Partial differential equations: Solution of partial differential equations by using method of separation of variables, solution of vibration of a stretched string (1D-Wave equation), one dimensional heat equation, Two dimensional heat equation under steady state conditions.

UNIT - IV

Theory of Complex variables: Analytic functions, Cauchy Riemann equations (Cartesian and polar forms), construction of Analytic functions by using Milne-Thomson's method. Harmonic function. Complex line integrals, Cauchy's theorem, Cauchy's Integral formula and its derivatives and problems related to the above theorems.

UNIT - V

Expansion of functions, Singularities & Residues: Taylor's and Laurent's series Expansions (Only statements). Zeros, types of singularities, Residues and Cauchy's Residue theorem, Evaluation of real integrals by Cauchy's residue theorem. Evaluation of improper real integrals of the type: $\int_{-\infty}^{\infty} f(x)dx$ Where f(x) has no poles on real axis and $\int_0^{2\pi} f(\sin\theta, \cos\theta)d\theta$.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publishers, 2015.
2. M.D. Raisinghania, Advanced Differential equations, 7th edition, S Chand publishers, 2013.
3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th edition, McGraw Hill publishers, 2003.

Suggested Reading:

1. N P Bali and Manish Goyal, A Text Book of Engineering Mathematics, 9th Edition, Laxmi publishers, 2016.
2. Alan Jeffrey, Mathematics for Engineers and Scientists, 6th Edition, Chapman & Hall/CRC publishers, 2013.
3. A R Vasistha and R K Gupta, Integral transforms, Krishna prakashan publishers, 2004.
4. R.K.Jain & S.R.K.Iyenger, Advanced Engineering Mathematics, 3rd edition, Narosa Publications, 2007.

16ME C04

MATERIAL SCIENCE AND METALLURGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: Students will

1. Enable the student to understand structure property relations, analyze the failures of metals and their prevention.
2. Broad understanding of phase diagrams.
3. Acquire basic knowledge in various heat treatment operations, their purpose and applications.
4. Expose to various methods of extractive metallurgy techniques.
5. Understand various modes of failure and suggest mechanisms for preventions of failures.
6. Understand applications of conventional metals and alloys.

Course Outcomes: On the successful completion of this course the student will be able to

1. Know the fundamental science and engineering principles relevant to material.
2. Suggest appropriate physical metallurgy methods (phase diagrams).
3. The type of heat treatment operation to be given to any metal in order to improve desire Mechanical properties.
4. Basic ability to plan an extraction process for given ore.
5. Suggest the appropriate methods for prevention of failures.
6. To analyze the applications of conventional metals and alloys

UNIT–I

Imperfections in crystals, dislocation in crystals, types of dislocations, effect of slip and twinning on the plastic deformation, cold and hot working, strain hardening and Bauchinger effect, recovery, recrystallization, grain growth and its effect on mechanical properties of metals.

Fracture: Types of fracture in metals, modes of fracture, Griffith theory of brittle fracture, crack propagation, ductile fracture, fracture under combined stress.

UNIT–II

Fatigue: S–N curve, Structure of fatigue fracture specimen. Fatigue crack propagation, effect of metallurgical variables on fatigue of metal, low cycle fatigue, experimental determination of fatigue strength (RR–Moore Test).

Creep: Creep strength, creep curve, creep deformation mechanisms, creep test.

Diffusion: Fick's law of diffusion, application of diffusion theory in mechanical engineering.

UNIT–III

Structure of Alloys: study of eutectic, eutectoid, peritectic peritectoid reactions, iron–iron carbide equilibrium diagram, construction and interpretation.

Types of plain carbon steels, cast iron and their properties and characteristics.

UNIT–IV

Heat Treatment: Annealing, normalising, hardening, tempering, construction and interpretation of T–T–T diagram, austempering and martempering, case hardening, carburizing, nitriding, carbo–nitriding, flame hardening, induction hardening.

UNIT–V

Introduction to Extractive Metallurgy: Method of production of pig iron by blast furnace, cast iron by cupola furnace, method of production of steel by Bessemer convertor, L.D process, electric arc process.

Alloy Steels: Effects of alloying elements like nickel, chromium, manganese, silicon and tungsten, titanium, study about stainless steels, HSS, brass, bronze their composition and properties.

Text Books:

1. V. Raghavan, Materials Science and Engineering, Prentice Hall of India Ltd., 4th Edn., 2005.
2. S.H. Avner, Introduction to Physical Metallurgy, Tata McGraw Hill Publishers, 2nd Edn., 2005.

Suggested Reading:

1. S.P. Nayak, Engineering Metallurgy and Material Science, Charoter Publishing House, 6th Edn., 2005.
2. E. Dieter, Mechanical Metallurgy, Metric Edition, Tata McGraw Hill, 3rd Edn, 2005.
3. K.L. Kakani, Material Science, New Age Publications (P) Ltd.,2008.

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16ME C05

MECHANICS OF MATERIALS

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Pre-Requisites: Engineering Mathematics, Engineering Mechanics.

Course Objectives:

1. Student is exposed to the concept of different types of loads, stresses, strains and analysis of members for axial loads.
2. Student will acquire knowledge in drawing bending and shear force diagrams of beams for various loads.
3. Student becomes familiar with methods of evaluation of deflection of beams of various configurations and stresses that arise due to simple bending.
4. Student is exposed to the concept of principal stresses and phenomenon of torsion.
5. Student will acquire knowledge in estimating stresses for thin and thick cylindrical shells.
6. Student will acquire knowledge in estimating crippling load in buckling for various columns and struts.

Course Outcomes:

Students who successfully complete this course will have demonstrated ability to:

1. Classify the materials, stresses, strains and understand engineering constants, poisons ratio along with relation between them. Also analyze axially loaded members.
2. Draw shear force, bending moment diagrams for different types of beams and calculate stresses and strains due to simple bending.
3. Determine slope and deflection for various configurations of beams using different methods and stress, strain and deflection due to torsion of circular members.
4. Analyze shear stress distribution in different sections of beams.
5. Understand compound stresses, calculation of principal stresses analytically and graphically using Mohr's circle.

6. Estimate stresses in thin and thick cylinders. Also estimate critical load in buckling for various columns and struts.

UNIT–I

Stresses and Strains: Definitions, types of stresses and strains, elasticity and plasticity. Hooke's law, stress-strain diagrams for engineering materials, modulus of elasticity. Poisson's ratio, relationship between elastic constants, linear and volumetric strains, bars of uniform strength, temperature stresses, compound bars.

UNIT–II

Beams: Definition of bending moment and shear force; relationship between intensity of loading, shear force and bending moment; bending moment and shear force diagrams for cantilever, simply supported and overhanging beams; simple theory of bending, moment of resistance, modulus of section.

UNIT–III

Slopes and Deflections: Slope and deflection measurements of cantilever, simply supported beams with Macaulay's and double integration methods subjected to point loads and uniformly distributed loads.

Torsion: Derivation of torsion formula for circular sections, torsional stresses, angle of twist, power transmission, effect of combined bending and torsion.

UNIT–IV

Shear Stresses in beams: Distribution of shear stresses in rectangular, I-section and T-section for solid and hollow sections.

Compound stresses, principal stresses and strains. Mohr's circle of stress.

UNIT–V

Cylinders: Stresses in thin and thick cylinders with internal and external pressures. Hoop and longitudinal stresses in cylinders, stresses in compound cylinders.

Columns and struts: Euler's and Rankine's formulae for axial load applications. Secant and Perry formulae for eccentrically loaded columns.

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Text Books:

1. S.S.Rattan, Strength of materials, Tata Mc-Graw Hill, 3rd Edition, 2016.
2. S. Ramamrutham, Strength of Materials, Dhanpatrai and Sons, 1993.
3. G.H.Ryder, Strength of materials, 3rd Edition in SI Units, Macmillan India Limited, Delhi 2002.

Suggested Reading:

1. S.S. Bhavakatti, Strength of Materials, Vikas Publication, 2003.
2. B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Pub., 1992.
3. G.H. Ryder, Strength of Materials, 3rd Edition in SI units, Macmillan India Limited, Delhi, 2002.

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16ME C06

FLUID DYNAMICS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: Student will understand
1. the fluid properties and different fluids.
2. the centre of pressure and stability conditions.
3. the importance of stream function and velocity potential function.
4. the equations related to Fluid dynamics.
5. different types of fluid flows.
6. major and minor losses of fluid flows.

Course Outcome: On the successful completion of this course the student will be able to
1. differentiate different types of fluids.
2. calculate centre of buoyancy and metacentric height.
3. differentiate rotational and irrotational flows.
4. determine forces exerted on fluid body.
5. differentiate laminar over turbulent flows.
6 determine various losses incurred in fluid flows.

UNIT–I

Properties of fluids: Definition of fluid and concept of continuum. Difference between ideal and real fluids. Classification of fluids. Fluid properties: Pressure, Density, Specific weight, Specific volume, Dynamic and Kinematic viscosity, Compressibility and Bulk modulus, Surface tension and Capillarity.

Pressure measurement: Fluid pressure at a point, pascal's law, Hydrostatic law, Measurement of pressure by different manometers.

UNIT–II

Fluid Statics: Total pressure, centre of pressure, total pressure and centre of pressure on plane surfaces like horizontal plate, vertical plate, inclined plate and curved surfaces.

Buoyancy and Floatation: Buoyancy, buoyant force, centre of buoyancy, Meta centre, stability for submerged and floating bodies.

UNIT-III

Fluid Kinematics: Classification of fluid flow: steady and unsteady, uniform and non-uniform, laminar and turbulent, rotational and irrotational, one, two and three dimensional flows, General concepts of path line, stream line and stream tube. Definition and properties of stream function, velocity potential function and use of flow nets.

UNIT–IV

Fluid Dynamics: Energy of fluid body, potential energy and potential head, pressure energy and pressure head, kinetic energy and kinetic head, derivation of Euler's and Bernoulli's equations and their applications like venturi meter, orifice meter, pitot tube, impulse momentum equation and applications. Discharge equations for weirs and notches.

UNIT–V

Laminar and Turbulent flow in pipes: Distinction between laminar and turbulent flows, Reynold's number and its significance, upper and lower critical values of Reynold's number for flow in pipes, development of laminar and turbulent flow in circular pipes. Hagen–Poiseuille equation, frictional losses in pipes, Darcy equation, estimation of Darcy's friction factor, empirical formulae and Moody's chart.

Flow through pipes: Loss of energy in pipes, Major losses, Minor losses, Hydraulic gradient and total energy lines.

Text Books:

1. P.N.Modi and S.M.Seth, Hydraulic and Fluid Mechanics, Standard Book House, 2010.
2. R.K.Rajput, Fluid Mechanics and Hydraulic Machines, S. Chand and Company, 2010.

Suggested Reading:

1. K.L.Kumar, Engineering Fluid Mechanics, Eurasia Publishing House, 2005.
2. V.L.Streeter, Fluid Mechanics, Mc.Graw Hill Co. Ltd., 2005.
3. D.S.Kumar, Fluid Mechanics, S.K. Kataria and Sons, 2010.

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16ME C07

MACHINE DRAWING

Instruction	1L+2D Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	2

Pre-Requisites: The student is required to have an idea about Engineering Drawing

Course Objectives:

1. Understand drawing and develop capacity to represent any object with the help of sketch.
2. Study the conventions and rules to be followed by engineers for making accurate drawings.
3. Understand the basic dimensioning practices that have to be followed in the preparation of Drawings.

Course Outcomes:

On successful completion of this course the students will be able to:

1. Draw conventional representation of different materials and mechanical components.
2. Read the working drawings in the machine shop.
3. Draw the orthographic projections and sectional views of machine parts.
4. Draw missing views as well as to analyze and interpret drawings of machine components.
5. Understand the shape and structure of different types of screws, keys, couplings, and rivets.
6. Draw assembly drawings of certain Machine Tools, Engine parts and Valves etc.

1. INTRODUCTION:

Format of drawing sheet, title block, conventions of drawing lines and dimensions, First and third angle projections, conversion of Pictorial view to orthographic views, convention for sectional views. Orthographic projections including sectional views of simple machine elements.

2. DRAWING OF FASTENERS, JOINTS AND COUPLINGS:

Practices of sketching work: Free hand sketches of typical machine elements for simple cases for riveted and screwed fastening, joints, and couplings (To indicate proportions).

3. ASSEMPBLY DRAWING:

Preparation of assembly drawings from given details, Ability to supply additional views. The exercises will be drawings of typical machine parts like:

1. Bearings-Plummer block(Pedestal bearing),
2. Petrol Engine Connecting rod,
3. Eccentric,
4. Cross head,
5. Stuffing box,
6. Pipe vice,
7. Screw jack,
8. Lathe Tail-stock
9. Single Tool Post,
10. Revolving centre.

Note: The test is for the ability of the student to read and interpret drawing. The drawing should include part list in standard format.

Text Books:

1. N. Siddeshwar, Machine Drawing, Tata McGraw Hill Publishing Co., Ltd., 5th edition, 2004.
2. N.D. Bhatt, V.M. Panchel, Machine Drawing, Cherotar Publishing house, Anand, New Delhi, 49th edition, 2014.

Suggested Reading:

1. K.L. Narayan, P. Kanniah, K. Venkat Reddy, Machine Drawing, New Age International (P) Ltd., 2nd 2009.
2. K.C. John, Text book of Machine Drawing, PHI Learning, 2010.
3. Ajeet Singh, Machine Drawing, Galgotia Publications, 2010.

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16MB C01

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: Students will:

1. Introduce managerial economics and demonstrate its importance in managerial decision making.
2. Develop an understanding of demand and relevance of its forecasting in the business.
3. Provide the basics of market structure and the concept of equilibrium in different market structures.
4. Examine the economic analysis of production process, types of inputs and to explain different costs and their relationship with the output.
5. Understand the importance of project evaluation in achieving a firm's objective.
6. Explain the concept of Accountancy and provided knowledge on preparation and analysis of Final accounts.

Course Outcomes: After completion of the course, student will be able to:

1. Apply fundamental knowledge of Managerial economics concepts and tools.
2. Understand various aspects of demand analysis and forecasting.
3. Understand price determination for different markets.
4. Study production theory and analyze various costs and benefits involved in it so as to make best use of resources available.
5. Analyze different opportunities and come out with best feasible capital investment decisions.
6. Apply accountancy concepts and conventions, Final accounts and financial analysis.

UNIT-I:

Introduction to Managerial Economics: Introduction to Economics and its evolution - Managerial Economics - its scope, importance, Its usefulness to engineers - Basic concepts of Managerial economics.

UNIT-II:

Demand Analysis: Demand Analysis - Concept of demand, determinants, Law of demand, its assumptions, Elasticity of demand, price, income and cross elasticity, Demand Forecasting – Types of Market structures. (Simple numerical problems).

UNIT-III:

Production and Cost Analysis: Theory of Production - Firm and Industry - Production function - input-out relations - laws of returns - internal and external economies of scale. Cost Analysis: Cost concepts - fixed and variable costs - explicit and implicit costs - out of pocket costs and imputed costs - Opportunity cost - Cost output relationship - Break-even analysis. (Theory and problems).

UNIT-IV:

Accountancy: Book-keeping, principles and significance of double entry book keeping, Journal, Subsidiary books, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments.

UNIT-V:

Capital Budgeting: Introduction to capital budgeting, Methods: traditional and discounted cash flow methods. Introduction to Working capital management. (Numerical problems).

Text Books:

1. Mehta P.L., Managerial Economics – Analysis, Problems and Cases, Sultan Chand and Son's Educational publishers, 2013.
2. Maheswari S.N., Introduction to Accountancy, Vikas Publishing House, 2013.
3. Panday I.M., Financial Management, Vikas Publishing House, 11th Edition, 2015.

Suggested Reading:

1. Varshney and KL Maheswari, Managerial Economics, Sultan Chand, 2014.
2. M.Kasi Reddy and S.Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007.
3. A.R.Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2013.

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16ME C08

MATERIAL SCIENCE AND METALLURGY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: Students will

1. Acquire basic knowledge by understanding iron-carbide diagram and its application in engineering.
2. Expose to Metallographic study and analysis of various metals.
3. Acquire knowledge in determining the hardness of metals before and after various Heattreatment operations.
4. Understand differences between different heat treatment methods.
5. Expose to T-T-T curve and its application in engineering metallurgy.
6. Understand the relation between micro structure and properties.

Course Outcomes: On successful completion of this course the students will be able to:

1. identify crystal structure of various metals.
2. measure hardness and can correlate with microstructure.
3. perform a suitable heat treatment operation based on desired properties.
4. underlines the importance of grain size in evaluating the desired mechanical properties.
5. Understand the process of heating and cooling for various heat treatment methods.
6. Correlate the heat treatment methods and the mechanical properties obtained.

List of the Experiments

1. Study of: Metallurgical Microscope, Allotropes of Iron, Iron-Iron carbide diagram, Procedure for specimen preparation.
2. Observations for the following specimens - i) Low carbon steels, ii) Medium carbon steels, iii) Eutectoid steels, iv) High Carbon steels, v)Stainless steels, vi) Case carburized, vii)HSS, viii) White, cast iron, ix) Gray cast iron, x) Malleable cast iron, xi)Spheroidal cast iron, xii) Al–Si alloy and determination of grain size using Image Analyzer.
3. Preparations of the following specimens : i) $\alpha-\beta$ Brass, ii)Normalised steel iii)Medium carbon steel iv)Nodular cast iron v) Grey cast iron.

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4. Heat Treatment Processes i) Annealing, ii) Normalizing, iii) Hardening.

Text Books:

1. V. Raghavan, Materials Science and Engineering, Prentice Hall of India Ltd., 4th Edn., 2005.
2. S.H. Avner, Introduction to Physical Metallurgy, Tata McGraw Hill Publishers, 2nd Edn., 2005.

Suggested Reading:

1. S.P. Nayak, Engineering Metallurgy and Material Science, Charoter Publishing House, 6th Edn., 2005.
2. E. Dieter, Mechanical Metallurgy, Metric Edition, Tata McGraw Hill, 3rd Edn, 2005.
3. K.L. Kakani, Material Science, New Age Publications (P) Ltd, 2008.

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16ME C09

MECHANICS OF MATERIALS LABORATORY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives:

1. To apply mechanics of materials theory on real specimens and learn the practical testing procedures and concepts.
2. Demonstrate an understanding of tension, and the relationship between stress, strain and application of Hooke's law.
3. Demonstrate an understanding of types of beams, deflections and measurement of material property through deflections.
4. Demonstrate an understanding of torsion and deformations resulting from torsion.
5. To demonstrate the understanding of hardness and its measurement using different scales like Brinnel and Rockwell.
6. To demonstrate an understanding of measurement of shear modulus and young's modulus for machine members like helical and leaf springs through loading respectively.

Course Outcomes: Students who successfully complete this course will have demonstrated ability to:

1. Draw stress-strain curve for an isotropic material and understand the salient features of it.
2. Demonstrate in determining the Young's modulus of various beam materials by conducting load-deflection test.
3. Evaluate rigidity modulus of a given shaft specimen by torsion test.
4. Able to find out Young's modulus and shear modulus for mechanical components like leaf spring and closely coiled helical spring through load-deflection test respectively.
5. Evaluate hardness of different materials using different scales and also estimate the impact resistance of a material by conducting impact tests.

6. Find the compressive and crushing strengths of concrete cubes and bricks.

List of Experiments

1. Uni-axial tension test using UTM.
2. Brinnel's and Rockwell's hardness tests.
3. Deflection test on propped cantilever.
4. Deflection test on a helical spring to determine the rigidity modulus.
5. Torsion of shaft to determine the rigidity modulus of shaft material.
6. Defection test on a cantilever beam to determine the Young's modulus.
7. Deflection test on a simply supported beam to determine the Young's modulus.
8. Deflection test on continuous beam to determine the Young's modulus.
9. Load-deflection test on a leaf spring to find out the young's modulus of leaf material.
10. Crushing and compression test on bricks and concrete cubes.

Text Books:

1. S.S.Rattan, Strength of materials, Tata Mc-Graw Hill, 3rd Edition, 2016.
2. S. Ramamrutham, Strength of Materials, Dhanpatrai and Sons, 1993.
3. G.H.Ryder, Strength of Materials, 3rd Edition in SI Units, Macmillan India Limited, Delhi 2002.

Suggested Reading:

1. S.S. Bhavakatti, Strength of Materials, Vikas Publication, 2003.
2. B.C. Punmia, Strength of Materials and Theory of Structures, Laxmi Pub., 1992.
3. G.H. Ryder, Strength of Materials, Third Edition in SI units, Macmillan India Limited, Delhi, 2002

16ME C10

COMPUTER DRAFTING LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: Students will

1. Student will acquire knowledge in solid modeling by exposing to Solid works.
2. Student will acquire knowledge in graphic communication.
3. Student is exposed to design methodologies.
4. Student will acquire knowledge in concept of layers.

Course Outcomes On successful completion of this course the students will be able to:

1. demonstrates Graphics and design competencies.
2. apply CAD techniques for 2D modeling.
3. develops an ability to think 3D and interpret data from blue prints and sketches, layers concepts.
4. apply and draw orthographic projections with the knowledge of correct graphics communication (drawings).
5. draw 2D drawings and sectional views of part models.
6. draw 2D drawings and sectional views of assembly models.

Application Software Tool: Auto CAD / Solid Works

1. INTRODUCTION TO SOLIDWORKS DRG EDITOR/ AUTOCAD :

XY Coordinate system, Angular measurement, Setting of Units, Limits, Absolute, Relative and Polar Coordinates, zoom Text, Multiline Text, Creating Title Block – Title, Drawing Number, Drawn, Checked, Approved, Angle of Projection, Scale, Basic Toolbars and commands - Format, View, Draw, Dimension, Modify Tool bars, Draw tool bar options - line, Circle, Rectangle, Ellipse, Spline and Arc , Modify tool bar options - Trim, Extend, Offset, Fillet, Chamfer, Mirror, Break, Array, Polar, Rectangular, Move, Copy, Stretch, Rotate ESNAP, SNAP, Grid, Ortho, Dimension Tool bar –aligned, angular, linear and annotations, leader line. Setting Dimension Style. View Tool bar - Orbit, Render, 3D Views (SW, SE, NE, NW Isometric Views).

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2. **EXERCISES FOR PRACTICE:**
Square headed spanner, circular, rectangular components, concentric squares, circle inscribed in a square and rectangle. Fork, Depth Stop, Pump Housing, Geneva Wheel. Importance of Layer - Layer and object properties; construction line, object line, hidden line, centre line, hatching, dimensioning, leader, Options like - Region, Extrude.

3. **EXERCISES FOR PRACTICE:** 2D drawings and sectional views - Shaft support, Sliding Block, Bearing Bracket, Shaft bracket, Anchor bracket, Piston of Petrol Engine, Petrol Engine Connecting Rod.

4. **EXERCISES FOR PRACTICE:** 2D drawings of Components of Screw Jack, and Components of Plummer Block.

Text Books:

1. Machine Drawing, K L Narayana.
2. Solidworks Drawing and Training Manual.
3. Autocad Command Reference manual.

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16ME C14

KINEMATICS OF MACHINES

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives: Student will acquire knowledge in

1. analysis of mechanisms.
2. drawing displacement diagrams for followers with various types of motions.
3. cam profile drawing for various followers.
4. estimation of transmission of power by belts and application of various gears and gear trains.

Course Outcomes: Student will demonstrate knowledge in

1. Understanding basic elements of machinery and their motion characteristics.
2. Designing a suitable mechanism depending on application.
3. Drawing displacement diagrams and cam profile diagram for followers.
   Executing different types of motions and various configurations of followers.
4. Drawing velocity and acceleration diagrams for different mechanisms.
5. Selecting gear and gear train depending on application.
6. Selection of suitable clutch, brake.

UNIT–I

Introduction: Definition of link, element, pair, kinematic chain, mechanism and machine, Grubler's criterion, single and double slider chains, inversions of quadratic cycle chain, inversions of single and double slider crank chains. Mechanism with lower pairs and straight line motion mechanism, Pantograph and Geneva mechanisms. Ackerman and Davis steering gear mechanisms and Hooke's Joint. Peaucellier, Hart, Scott-Russel, Watt and Tchebicheff mechanisms.

UNIT–II

Analysis of mechanisms: Graphical methods to find velocities of mechanisms, instantaneous centre, body centre and space centre, Kennedy's theorem, graphical determination of acceleration of different mechanisms including Coriolis component of acceleration, analytical method to find the velocity and acceleration, analysis of four bar mechanism with turning pairs, Freudenstein's method for four bar linkage synthesis.

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UNIT–III

Laws of Friction: Friction in screw threads, pivots, collars, Clutches - Single and Multi plate, Cone and centrifugal clutches. Friction circle and friction axis of a link.

Brakes and Dynamometers: Block or shoe, band and block, internal expanding shoe brake, Prony, rope brake, belt transmission, torsion dynamometers.

UNIT–IV

Cams: Types of cams and followers, displacement diagrams for followers, uniform motion, parabolic motion, simple harmonic motion, cycloidal motion, drawing cam profile with knife–edge follower, translating roller follower and translating flat follower. cams of specified contour. Cams of specified contours, tangent cam with roller follower, circular arc (convex) cam with roller follower.

UNIT–V

Gears: Classification of gears, spur gears, nomenclature, law of gear tooth action, involute as gear tooth profile, interference of involute gears, minimum number of teeth to avoid interference, contact ratio, cycloidal tooth profile, comparison of involute and cycliodal tooth profile.

Helical Gears: Helical gear tooth relations, contact of helical gear teeth,

Gear trains: Gear trains–simple and compound, reverted and epicyclic gear trains. Differential of an Automobile.

Text Books:

1. Thomas Bevan, Theory of Machines, CBS Publishers, 2009.
2. S.S. Rattan, Theory of Machines, Tata McGraw Hill Publishers, 4th Edition, 2013.
3. J.E.Shigley, Theory of Machines, Tata Mc.Graw Hill Publishers, New Delhi, 3rd Edition, 2005.

Suggested Reading:

1. C.S. Sharma and Kamlesh Purohit, Theory of Mechanisms and Machines PHI Learning Pvt. Limited, 2006.
2. Amitabh Ghosh and A.K.Mallik, Theory of Machines, East West Publications, 3rd Edition, 2009.

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16ME C15

THERMODYNAMICS

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives: Student will understand
1. Basic definitions of thermodynamics and significance of Zeroth law of thermodynamics.
2. The importance and application of first law of thermodynamics.
3. The various laws associated with second law of thermodynamics.
4. Properties of pure substances and use of Molier diagram.
5. Various air standard cycles, their importance and their comparison.
6. Calculation procedures of the air-fuel ratio.

Course Outcomes: Student will be able to
1. Estimate the temperature of different scales of thermometers.
2. Apply the first law of thermodynamics process to various thermodynamics processes.
3. Understand the meaning of perpetual motion of machine of second kind and its significance.
4. Read data from the chart of Mollier diagram and its applications.
5. Distinguish working principles of various IC engines like diesel engine, petrol engine.
6. Calculate theoretical air–fuel ratios required for combustion of fuels and also convert from gravimetric analysis to volumetric analysis and vice versa.

UNIT–I

Introduction: Thermodynamics, Macroscopic and Microscopic approaches, thermodynamic systems, properties, processes and cycles, thermodynamic equilibrium, quasi – static process, measurement of pressure, Zeroth law of thermodynamics and its significance, measurement of temperature, reference points, ideal gas equation.

UNIT–II

First Law of Thermodynamics: Concept of heat and work, first law of thermodynamics for closed system, energy- a property of the system, application of first law to various thermodynamic processes like isobaric, isochoric, isothermal, adiabatic and polytropic, definition of enthalpy, PMM1, first law applied to flow processes, application of SFEE to nozzle and diffuser, throttling device, turbine and compressor.

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UNIT–III

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Kelvin–Planck and Clausius statements of second law of thermodynamics, PMM2, equivalence of Kelvin-Planck and Clausius statement, reversible and irreversible processes, Carnot theorem, Clausius inequality, calculation of entropy change during various thermodynamic processes, principle of entropy increase, T–S diagrams, application of entropy principle for mixing of two fluids. Helmholtz and Gibb's functions.

UNIT–IV

Thermodynamic Properties of Fluids: Properties of pure substances, p–v diagram, p–T diagram, p–v–T surface, T–s diagram, h–s diagram, dryness fraction, use of steam tables, Maxwell relations.

UNIT–V

Air Standard Cycles: Air standard cycles - Otto, Diesel, Dual Combustion Cycles, working principle, derivation of expression for air standard efficiency, comparison of otto, diesel and dual cycles-for the same compression ratio, for the same maximum pressure and temperature.
Vapour Power Cycles: Vapour power cycles - Carnot cycle, Simple Rankine cycle.
Fuels and Combustion: Characteristics of an ideal fuel, classification of fuels, Stoichiometric air-fuel ratio, equivalence ratio, relation between volumetric and gravimetric analysis.

Text Books:

1. P.K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publishers, 5th edition, 2013.
2. D.S. Kumar, Thermal science and Engineering, S.K.Kataria and Sons, 4th edition, 2013.
3. D.P.Mishra, Engineering Thermodynamics, Cengage Learning, 2012.
4. Y.A. Cengel and M.A. Boles, Thermodynamics: An Engineering Approach, Tata McGraw Hill Publishers, 7th edition, 2014.

Suggested Reading:

1. R.K. Rajput, Thermal Engineering, Laxmi Publications (P) Ltd, 8th edition, 2011.
2. Mahesh M Rathor, Thermal Engineering, Tata McGraw-Hill Publishers, 2013.

16PE C01

METAL CASTING AND WELDING

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives: To enable the students to

1. select the suitable manufacturing process for a given component.
2. design the pattern, gating system and rises for a simple casting.
3. identify the defect and suggest remedy for the same.
4. describe various welding processes.
5. illustrate the terminology of welding, the characteristics of power sources used for welding and the consumables required.
6. compare various arc, resistance, solid state and other welding processes.

Course Outcomes: Student will be able to

1. select the suitable manufacturing process for a given component.
2. design the pattern, gating system and rises for a simple casting.
3. identify the defect and suggest remedy for the same.
4. describe various welding processes.
5. illustrate the terminology of welding, the characteristics of power sources used for welding and the consumables required.
6. compare various arc, resistance, solid state and other welding processes.

UNIT–I

Pattern design and methoding: Introduction, classification, pattern design: types of patterns pattern materials, pattern allowances, gating system, propose, elements, requirements, types of gates, choke, gating ratio, types of gating systems, gating system design, Risering: purpose, requirements, chvorinov's rule, optimum shape and dimensions of riser, riser design by Caine's method, modules method and NRL method.

UNIT–II

Moulding, melting, defect analysis and inspection techniques: Moulding sand: ingredients, types of sand clays, additives, moulding sand preparation, required properties, Core: purpose, core prints, core sand preparation, core preparation, chaplets, types of cores, net force on the core Melting furnaces: Cupola, Inductionand Arc furnace, casting defects and remedies, inspection and testing of castings.

UNIT–III

Special casting processes: Gravity die casting pressure die casting, centrifugal casting, shell moulding, investment casing, continuous casting, slush casting, lost foam process, squeeze casting, vacuum moulding CO_2 moulding and ceramic moulding.

UNIT–IV

Arc welding: Introduction, classification of welding processes, physics of arc, DCSP, DCRP, AC, arc initiation, arc stability, parts of arc, arc length characteristics, static V-I characteristics of power sources arc, duty cycle, shielded metal arc welding, submerged arc welding, Gas tungsten arc welding, Plasma arc welding, Atomic Hydrogen welding.

UNIT–V

Other welding processes: Resistance welding: spot, projection, seam, butt and percussion welding, Oxy-Acetylene welding, Thermit welding, laser beam welding, electron beam welding, Soldering and Brazing, weld defects, solid state welding, forge welding, friction welding, ultrasonic welding, explosive welding, weldability, effect of various parameters on weldability and weld defects.

Text Books:

1. P.N. Rao, Manufacturing Technology, Vol. 1, Tata McGraw Hill Publishers, 3rd edition, 2011.
2. Amitabh Ghosh and Mallick, Manufacturing science, Assoc. East West Press Pvt. Ltd.,, 4th edition, 2011.
3. Schey, Introduction to Manufacturing Processes, McGraw Hill Education, 2nd edition.

Suggested Reading:

1. Roy A. Lindberg, Materials and Process of Manufacturing, Prentice Hall of India, 5th editin, 1992.
2. Serope Kalpak Jian, Manufacturing Engineering and Technology, Addision, Wesley Publishing company, 2006.
3. Mikeli P. Grover, Fundamentals of Modern Manufacturing Materials, Processes and Systems, 3rd edition, Wiley A.

16PE C02

METAL FORMING TECHNOLOGY

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Objectives:

1. To introduce students to metal forming technology while understanding the fundamentals of theory of plastic deformation and stress strain relations.
2. To explain the working principle of various operations like sheet metal operations, extrusion, drawing, rolling, forging etc with their applications, merits and demerits.
3. To explain different deformation mechanisms and effect of the process variables on different process and product quality.
4. To enable the students to determine loading and energy required for metal forming tools and machines.
5. To enable the students to understand different defects that occurring forming operations with remedial measures.

Outcomes: After learning this course, students will be able to

1. Define what is meant by metal forming and its specific advantages over other manufacturing processes.
2. Apply theory of plasticity to analyze metal forming processes.
3. Understand the basic principles and practical aspects of metal forming operations.
4. Understand various process parameters that affect product quality in various processes under different conditions.
5. Determine load, energy and power required for various processes and machines.
6. Propose suitable metal forming processes for making different products.

UNIT-I

Theory of Plasticity: Plastic deformation, work hardening, cold, warm and hot working with their advantages and disadvantages, true stress and true strain, flow curve, effect of strain-rate and temperature on flow stress. yield criterion: von-Mises and Tresca.

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UNIT-II

Forging: Open and closed die forging, Drop, Press and Machine forging operations, types of hammers and presses, their principles of operation and applications, Forging load calculation with slab method and empirical methods, forge ability , forging defects, Methods of heating and types of furnaces, Isothermal forging Hot Isostatic Pressing.

UNIT-III

Extrusion and Drawing: Types of extrusion, Tube extrusion Rod/wire/tube drawing ,load calculation of extrusion and drawing using uniform deformation energy method and slab method. maximum reduction in drawing, effect of friction, die angles, deformation speeds on extrusion/drawing forces, die materials and lubrication in these operations, extrusion and drawing defects.

UNIT-IV

Rolling: Principles of Metal rolling, roll load, torque and mill power calculation for homogenous deformation, classification and description of rolling mills, their applications, rolling defects, shape rolling, ring rolling thread rolling, roll bending and powder rolling.

UNIT-V

Sheet Metal Working: Sheet Metal working operations-shearing, blanking, piercing, bending, drawing and squeezing operations, estimation of loads and energy required for these operations, Formability, FLD, types of presses, specifications and their applications, comparison of simple, compound, progressive and combination dies. Other sheet metal forming operations like Embossing, Stretch forming, Spinning and Flow forming.

Text Books:

1. Serope Kalpakjian, Manufacturing Engineering and Technology, Pearson education INC., 4th Edn, 2015.
2. George.E. Dieter, Mechanical Metallurgy, SI Metric Edition, McGraw –Hill, 1988.
3. P.N. Rao, Manufacturing Technology, TMH, 4th Edn., 2015.

Suggested Readings:

1. Jan R.K. and Gupta S.C, Production Technology, Khanna Publications,17th Edn, 2012.
3. Roy A lindberg, Materials and Process of manufacturing, PHI, 4th edn, 2004.
4. John A Schey, Introduction To Manufacturing Processes Mcgraw Hill education, 3rd Edn, 2012.

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16EE C14

ELECTRICAL MACHINES AND MICROCONTROLLER APPLICATIONS
(Common to BE-Mech. and Prod.)

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives:
1. To understand the concepts of transformers.
2. To comprehend the need of DC and AC machines and their control aspects.
3. To know the features of 3-phase induction motors.
4. To understand the concepts of 8051 of microcontrollers.
5. To understand the basics of interfacing with 8051.

Course Outcomes: The student will be able to
1. Identify the compatibility of DC machines for a given application.
2. Identify the applications of 3-phase induction motor.
3. Know the calculation of Efficiency and regulation of transformer.
4. Program using 8051.
5. Use 8051 for basic applications.

UNIT- I

D.C. Generators: Constructional details, Principle of operation, EMF equation, Classification of generators, Armature reaction, Characteristics of shunt, series and compound generators.

DC Motors: Working Principle, back EMF, Classification of motors, Torque developed in motors, Characteristics of shunt, series and compound motors, Three point starter, Speed control of DC motors.

UNIT- II

Transformers: Construction, Working principle, EMF equation, Ideal transformer, Practical transformer on no load and load conditions, Equivalent circuit of transformer, Efficiency and regulation of transformer, OC and SC tests.

UNIT-III

Three Phase Induction Motors: Production of rotating magnetic field, construction and principle of operation, Torque Calculation, speed-torque characteristics, Speed control of 3-phase induction motors.

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UNIT-IV

8051 Microcontrollers: Introduction to microprocessor, microcontroller classification, Internal architecture of 8051 and its pin configuration, Memory organization and expansion. **SFR's:** Counter and timers, serial data I/O, Interrupts.

8051 Instruction set: Addressing modes and Instruction set. Assembly Language Programming with 8051.

UNIT-V

8051 Interfacing: Expansion of I/O ports, A/D converter, D/A converter, Stepper motor interfacing with 8051, DC motor interfacing with 8051.

Text Books:

1. D.P. Kothari and Nagrath, Basic Electrical Engineering, Tata McGraw Hill Publications, 2nd edition, 2007.
2. V.K.Mehta, Principles of Electrical Engineering, S.Chand and Co, 1st edition, 2003.
3. Muhammad Ali Mazidi, Jainice Gilispie Mazidi and Rolin D. MCkinlay, The Microcontroller and Embedded Systems using Assembly and 'C', 2/e Pearson Education, 2007.
4. Ayala K.J, The 8051 Micro Controller Architecture, Programming and Application, Penram International, 2007.

Suggested Reading:

1. B. L.Theraja and A.K. TherajaA Text book of Electrical Technology, S.Chand and Co, 24th revised edition, 2007.
2. P. V. Prasad, S. Sivanagaraju, Electrical Engineering: Concepts and Applications, Cengage Learning, 1st Edition, 2012.

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16PE C03

METAL CASTING AND WELDING LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: To enable the students to

1. Prepare the mould for a single piece and split patterns.
2. Test the moulding sand and anlalyse the same.
3. Test the bead geometry and correlate the results to the input parameters.
4. Able construct the cooling curves and analyse the same.
5. Able to distinguish the type of the flame and recommend for different materials.
6. Able use TIG, MIG and Spot welding machines and experiment with them.

Course Out comes: Students are able to

1. Prepare the mould for a single piece and split patterns.
2. Test the moulding sand and anlalyse the same.
3. Test the bead geometry and correlate the results to the input parameters.
4. Construct the cooling curves and analyse the same.
5. Distinguish the type of the flame and recommend for different materials.
6. Use TIG, MIG and Spot welding machines and experiment with them.

EXPERIMENTS

Casting:

1. Design and manufacturing of a simple pattern with various allowances.
2. Green sand moulding practice for a single piece pattern.
3. Green sand moulding practice for a split pattern with a horizontal core.
4. Moulding sand testing: GCS, GSS, DCS and DSS Permeability and shatter index.
5. Finding out the GFN, Moisture content and clay content for a given sand sample.
6. Melting and Pouring of Aluminum.
7. Dimensional inspection and visual inspection of the casting and analysis of dimensional variation and defects.

Welding:

1. Study of gas welding equipment and process. Identification of flames, making Butt joint with gas welding.
2. Study of Arc welding process, comparison of the bead geometry with DCSP, DCRP and A.C.
3. Study of resistance welding process and plot the variation of spot area with time and current variation.
4. Study of TIG welding process and plotting cooling curve in TIG welding process.
5. Study of SAW Welding process and finding out deposition efficiency of the process.
6. Study of MIG welding process and testing of weld bead formed by MIG welding.

Note: Minimum 4 Experiments need to be conducted.

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16PE C03

METAL FORMING TECHNOLOGY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Objectives:

1. To demonstrate various operations like sheet metal operations- blanking, punching, deep drawing, extrusion etc with their applications, merits and demerits.
2. To explain different deformation mechanisms and effect of the process variables on process or bustness and product quality.
3. To enable the students to determine loading and energy required for metal forming tools and machines.
4. To enable the students to understand different defects that occurring forming operations with remedial measures.
5. To make the students understand working principle, types, and applications of forging process.
6. To make students understand working principle, parameters, types and applications of extrusion 1process.

Outcomes: The students will be able to:

1. Understand the practical aspects of metal forming operations.
2. Understand various process parameters that affect product quality under different conditions.
3. Work independently with various presses and dies to produce different components.
4. Determine load, energy and power required for various processes and machines.
5. Propose suitable metal forming processes for making different products.
6. Design and Fabricate various types of dies for sheets metal operations.

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List of Experiments:

1. Evaluation of Formability of a given sheet material using Erichsen cupping test.
2. Study of Simple Diedesign for Blanking/ Piercing operations in sheet metal forming and manufacturing of circular blanks using a mechanical press(capacity30Tons) and measurement of forces and comparing with the oretical loads.
3. Study of Progressive die design and manufacturing of washer components using the same on a fly press (capacity6Tons)and estimation of forces.
4. Studyof Compound diedesign and manufacturing of washer components using the same on double body fly press (capacity8 Tons)and estimation of forces.
5. Study of Combination diedesign and manufacturing of cylindricalcup susing the same on a Hydraulic power press(capacity 50Tons) and estimation of drawing force.
6. Study of deep drawing die design and measuring forces with/without blank holder for cylindrical/square cups using 10 T load cell on a Hydraulic power Press and comparing them with theoretical values.
7. Measurement of cutting forcef or Blanking operation using 10T load cell on Mechanical power Press for different materials and comparing the oretical and practical values.
8. Estimation of True stress and True strain for ferrous/ non ferrous materials encounter edin metal forming operations using Universal Testing Machine.
9. Study of extrusion dies and demonstration of extruding lead material.
10. Demonstration of Simulation software for metal forming operations.

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16EG C03

SOFT SKILLS AND EMPLOYABILITY ENHANCEMENT LAB

Instruction	2 hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
CIE	15 Marks
Credits	1

Course Objectives: To help the students

1. Participate in group discussions and case studies with confidence and to make effective presentations. Also to learn the art of communication.
2. With- resume packaging, preparing and facing interviews.
3. Build an impressive personality through effective time management & goal setting, self confidence and assertiveness.
4. Understand what constitutes proper grooming and etiquette in a professional environment. Also to understand academic ethics and value systems.
5. To understand the elements of research and hone their soft skills through a live, mini project.

Course Outcomes: The students will be able to

1. Be effective communicators and participate in group discussions and case studies with confidence. Also be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals. Also learn to mange time effectively and deal with stress.
4. Make the transition smoothly from Campus to Corporate. Also use media with etiquette and know what academic ethics are.
5. To do a live, mini project by collecting and analyzing data and making oral and written presentation of the same.

Exercise 1

Group Discussion and Case studies: Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.

Elements of effective presentation, Structure of presentation, Presentation tools, Body language, Creating an effective PPT.

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Exercise 2

Interview Skills: Resume writing, structure and presentation, planning, defining the career objective, projecting ones strengths and skill-sets.

Interview Skills, concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews.

Exercise 3

Personality Development: Effective Time Management, setting realistic goals, self confidence and assertiveness, stress management, moral values.

Exercise 4

Corporate Culture: Grooming and etiquette, communication media etiquette,

Academic ethics and integrity.

Exercise 5

Mini Project: General/Technical. Research, developing a questionnaire, data collection, analysis, written report and project seminar.

Suggested Reading:

1. Dr. Shalini Verma, *Body Language- Your Success Mantra*, S Chand, 2006.
2. Ramesh, Gopalswamy, and Mahadevan Ramesh, *The ACE of Soft Skills*, New Delhi: Pearson, 2010.
3. Covey and Stephen R, *The Habits of Highly Effective People*, New York: Free Press, 1989.

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ME 311 **DYNAMICS OF MACHINES**

Instruction	4 Periods + 1 Tutorial per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To find static and dynamic forces on planar mechanisms.
2. To know the causes and effects of unbalanced forces in machine members.
3. To determine natural frequencies of undamped, damped and forced vibrating systems of one, two and multi degree freedom systems.

Outcomes:

1. Graduates are expected to demonstrate the ability of the analysis of foces in mechanism which provide them the required inputs to design the systems which withstand operating conditions
2. Graduates are expected to understand gyroscopic and centrifugal actions of vehicles and will be able to reckon additional bearings reactions due to gyroscopic and centrifugal effects
3. Graduates are expected to understand the turning moment diagram, cyclic fluctuation in speed, fluctuation in energy and get the ability of designing flywheel.
4. Graduates will have ability to control speed using governors
5. Graduates will have the ability to identify the unbalance in rotors and engines and will get the knowledge of balancing.
6. Graduates will understand concepts of vibration thereby they are able to design the systems free from ill effects of vibration.

Unit-I

Static and Dynamic analysis of planar mechanisms: Graphical and analytical methods, Free body diagrams, Method of superposition, Equivalent offset inertia force, Inertia force in reciprocating engines, Flywheels.

Unit-II

Force analysis of space mechanisms, Inertia matrix, Lagrangian and Newton-Euler formulation. Gyroscopic effect in shafts, Aero planes, Naval ships, Two & Four wheel automobiles.

Unit-III

Forces on bearings due to rotating shaft carrying several eccentric rotors, Balancing of shafts carrying several rotors, Determination of balancing masses from the forces on the bearings, Shaking forces in a single cylinders engine, Partial balancing of reciprocating engine. Balancing of a two cylinder locomotive engine, Determination of unbalanced forces and couples.

Unit-IV

The role of a centrifugal governor in speed control, Porter and Hartnell type governors, Speed vs Lift curves, Power and Stability. Undamped free vibration of a single degree of freedom linear system (axial and torisonal), Determination of natural frequencies, Equivalent system of combination of springs, Stepped shafts, Gears and rotors. Free response of single degree of freedom damped linear systems, Damped natural frequencies, Relative damping.

Vibration of harmonically forced single degree of freedom systems. Resonance, vibration isolation with coupled damper --- Partial differential equation: Governing equation of free vibration of a simply supported uniform beam. Derivation of natural frequencies.

Unit-V

Natural frequencies of two degree freedom linear systems. Nodes in three rotor systems. Modes of vibration, Determining natural frequencies by Holzer's method for multi-rotor systems. Dunkerley's method, Raleigh's method.

Text Books:

1. S.S. Rathan, *Theory of Machines*, Tata-Mc Graw Hill, 1995.
2. John.J.Vicker, Gordon R. Pennock, Joseph E. Shigley, *Theory of Machines & Mechanisms*, Oxford University Press, 2003.

Suggested Reading

3. A. Ghosh and Mallick, *Theory of mechanisms and machines*, Affiliated to E-W Press, 1988.
4. Ashok G Ambedkar, Mechanism and Machine Theory, PHI, 2013.
5. Benson H. Tangue, Principles of Vibration, 2nd Edn., Oxford University Press, 2007
6. Robert L. Norton, *Design of Machinery*, Tata Mc Graw Hill, 2005.
7. Charles E Wilson, J. Peter Sadler *Kinematics and Dynamics of Machinery* Pearson Education, 2008.
8. Banal, R.K. Brar, J.S, 'Theory of Machines', Laxmi Publications, 3rd Edition., 2004

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PE 313

APPLIED THERMODYNAMICS & HEAT TRANSFER

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To demonstrate basic knowledge by understanding the basic working principles of reciprocating air compressor and its applications in engineering.
2. Students will come to know the working principle of diesel and petrol engines and their combustion phenomena and problems pertaining to abnormal combustion
3. To demonstrate basic knowledge by understanding different modes of heat transfer
4. Students will acquire the basic knowledge in understanding the principles of radiation and also the application of heat exchangers

Outcomes:

1. Students will be able to estimate power required for reciprocating air compressor, used for many engineering applications.
2. Students will be able to evaluate the performance of diesel and petrol engines and suggest some suitable methods for remedy of abnormal combustion
3. Students will acquire knowledge in estimating the relationship between various dimensionless numbers for free convection and forced convection
4. Students will acquire the basic knowledge in understanding the principles of radiation and also the application of heat exchangers
5.
6.

UNIT-I

Reciprocating Air Compressors: Single stage and multi stage compressors, work done, Efficiency of multi stage compression. Effect of clearance volume on work done and efficiency. After cooling and inter cooling. Uses of compressed air.

UNIT-II

Internal Combustion Engines: Classification, Working principles of. Deviation of actual cycles from air standard cycles, Index of compression and expansion for variable specific heats, Performance of I.C. engines- Determination of Indicated power, brake power, frictional power, brake thermal efficiency, mechanical efficiency, indicated thermal efficiency, relative efficiency, volumetric efficiency, specific fuel consumption based on brake power and indicated power, air intake- Heat balance sheet .

UNIT-III

Combustion Phenomena: Fuel systems in IC engines, Combustion Phenomena in Spark ignition and compression ignition engines, Types of carburetors, Injection pumps and injectors, Cooling and Lubrication of Internal Combustion Engines, Detonation, Knocking, Types of combustion chambers.

UNIT-IV

Modes of heat transfer: Laws of heat transfer - Fourier, Newton, Stefan-Boltzmann General conduction equation in cartesian, cylindrical coordinates, One dimensional steady state conduction through slabs, hollow cylinders and spheres with and without heat generation, Effects of variable thermal conductivity in heat transfer of one dimensional steady state conduction of plates, cylinders Steady state heat transfer through composite slabs and cylinders, Critical radius of insulation.

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UNIT-V

Convection: Dimensional analysis and its use in free and forced convection, Buckingham theorem, Physical significance of different dimensionless numbers.

Radiation: Definition of absorptivity, reflectivity and transmissivity, Concept of black-body and emissivity. Kirchoff's law, Planck's black body spectral distribution, Wien's and Steffan Boltzmann law.

Heat Exchangers: Classification, Simple problems on parallel flow and Counter-flow heat exchangers.

Text Books

1. Rajput, R. K.,"*Thermal Engineering*", Laxmi Publishers, New Delhi, 2004
2. Sachdeva,R.C., "*Fundamentals of Engineering Heat and Mass Transfer*", New Age International (P) Ltd Publishers, New Delhi, 2004

Suggested Reading

3. Ganeshan, V., " *Internal Combustion Engines*", Tata Mcgraw Hill Publishing, New Delhi, 2004
4. Mahesh M. Rathore, "Thermal Engineering," TMH, New Delhi, 2010
5. Holman, J.P., "*Heat Transfer*", McGraw Hill Publication, New Delhi, 2004
6. Som S.K, Introduction to Heat Transfer,PHI 2013

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PE 311 **MACHINE TOOL ENGINEERING**

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75
Sessionals	25
Credits	3

Objectives:

1. To provide the basic understanding of cutting tools, geometry in machining process
2. To make students familiar with cutting forces in turning drilling, milling operations.
3. To make the students to understand various machine tools, like lathe, drilling, milling shaper, planner,
4. To make a knowledge of Thread manufacturing and gear manufacturing

Outcomes:

1. Students are able to select tool geometry for various materials
2. Students are able to calculate forces in turning, drilling and milling processes
3. Students capable of identifying the machine tools for manufacturing various components.
4. Students are able to understand thread cutting and fear cutting operations
5.
6.

UNIT-I

Orthogonal and oblique cutting: Cutting forces in turning, drilling milling and grinding, Merchant's analysis, Shear angle, friction angles. Experimental methods for estimation of shear angle, cutting forces and power of chips. Built up edge phenomena and its effects. Chip breakers. Sources of heat, its distribution and measurement. Different types of cutting fluids.

UNIT-II

Tool wear and tool life: Criteria for tool wear, flank and crater wear theories, criteria for tool life in roughing and fininshing, Measurement of tool wear, Taylor's tool life equation, factors effecting tool life, Machiniability. Single point cutting tool design; Geometry, tool nomenclature, American, DIN, max. rake system. Interrelation between normal rake and orthogonal rake, tool signature, effect of basic tool angles on its performance. Selection of size and angles of S.I. Tools, from tools. Design feature of umlti point cutting tools.

UNIT-III

Lathes: Types constructional features, size of lathe, various operations that can be performed on lathes types o lathes, capstan and turret lathes, bar work and chuck work and tool holding devices. Taper turning methods. Automats – single spindle and multiple spindle automats, swiss type of automats, constructions and features of these machines.

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UNIT-IV

Drilling Machines: Types and constructional features and applications, Radial drilling machine, drilling operations
Milling Machines: Classifications and types various operations on milling machines, Up and down milling. Types of milling cutters and bars. Dividing head, plain, compound and differential indexing.

Boring machines-Horizontal, Vertical and Jig boring machines and constructional features.

Thread production – Thread rolling, thread chasing , thread milling and thread grinding

UNIT-V

Shaping, Planning & Slotting Machines: Types, Constructional features, Types of work done on it. Quick return motion, manipulation of cutting speeds and feeds, work and tool holding devices, comparison of these machines.

Gear Cutting Machines: Methods of gear cutting, types and classification of gear hobbing, gear shaping machines Bevel gear cutting

Grinding Machines: Types, Classification Abrasives and bonds used for grinding wheel, Selection of grinding wheel, cylindrical grinding and center less grinding

Text Books:

1. B.L. JuneJa and Shekon, *"Fundamentals of Metal Cutting & Machines Tools"*, Wiley Eastern Ltd. 1987.
2. P.N. Rao, *"Manufacturing Technology – Metal Culling & Machine Tools"*, Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.

Suggested Reading:

3. M.C. Shaw, "Metal Cutting Principles", Clarendon Press, Oxford 1984
4. Hazara Choudary, "Workshop Technology", Vol. II, Media Pub., New Delhi.
5. Kibbe Richand R, Meyer, R.D, Neely etal, 'Machine Tool Practices, 9th Edition, PHI, 2014.
6. Jain & Chitale, Text Book of Production Engineering, 2nd Edition, PHI, 2014.

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DESIGN OF MACHINE ELEMENTS
(USAGE OF DATA BOOK IS COMPULSORY)

Instruction	4 Periods + 1 Tutorial per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessional	25 Marks
Credits	3

Objectives:

1. To understand the basics of mechanics of materials and design of a machine for static and fatigue strength, rigidity and wear criterions, use of codes and standards.
2. To know the principles of ergonomic design.
3. To learn the principles to design shafts, keys, belt drives, joints and couplings.
4. To Develop, set-up, and solve mechanical component design problems based upon given data and requirements

Outcomes:

1. Students will be able to design machine elements and systems of machine elements to Successfully satisfy the function of the machine.
2. Student will develop corrective action (define the cause for a problem and the design fixes) for field problems.

Unit-I

Introduction, Materials used in machine design and their specifications to Indian standards. Important mechanical properties of materials used in design. Codes and standards used in design. Reliability, Principles of good Ergonomic Design, Manufacturing considerations. Preferred numbers. Value analysis. Analysis of Stress and Strain : Definition of stress and strain, Types of loading, Direct normal stress, bending stress, Torisonal stress, crushing and bearing stresses, Biaxial stress and Triaxial stress. Theories of elastic failure, Stress concentration factor, factor of safety, Design of components for static loads.

Unit-II

Design for Fatigue and Impact loads; Importance of fatigue in design, Fluctuating stresses, fatigue strength and endurance limit. Factors affecting fatigue strength. S-N Diagram, Soderberg and Modified Goodman's diagrams for fatigue design. Cumulative fatigue, Miner's rule, Design of components for fatigue. Design of components for impact loading.

Unit-III

Design of keys, shafts – solid hollow stepped shafts and splined shafts under torsion and bending loads. Design of belt drive systems, selection of belts and design of pulleys.

Unit-IV

Design of cotter and knuckle joints, riveted and welded joints under direct and eccentric loading. Design of couplings – Muff and Split Couplings, Flange, Flexible and Marine type of couplings.

Unit-V

Design of bolts and nuts, locking devices, bolt of uniform strength, design of gasket joints, design of power screws and screw jack.

Text Books:

1. V.B. Bhandari, *Machine Design*, Tata Mc Graw Hill Publication, 2010.
2. J.E. Shigley, C.R. Mischne, *Mechanical Engineering Design*, Tata Mc Graw Hill Publications, 2011.
3. Siraj Ahmed, 'Mechanical Engineering Design, PHI, 2014.

Suggested Reading

4. Robert L. Norton, *Machine Design: An Integrated Approach*,2/e Pearson Education, 2013
5. P. Kannaiah, *Machine Design*, Science-Tech Publications, 2010
6. M.F. Spotts, *Design of Machine Elements*, Prentice Hall of India, 2013.

Machine Design Data Books:

1. Design Data Hand book for Mechanical Engineers, K. Mahadevan, K. Balaveera Reddy, CBS Publisher 3rd Edition.
2. Design Data bok by PSG College – 2012

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PE 312 **COMPUTER AIDED MANUFACRUFING**

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To provide the basic understanding of computer aided manufacturing
2. To make students familiar with CNC,DNC, Part Programming
3. To make the students to understand APT language
4. To impart knowledge of Group technology, Computer aided process Planning

Outcomes:

1. Students are able to understand NC machines used in computer aided manufacturing
2. Students are able to understand machine centers and controllers used in CNC machines
3. Students are able to write part programmes with G codes and M codes for typical components
4. Students are capable of write part programmes with APT language
5. Students are able to understand Group technology and CAPP
6. Students are able to understand Computer aided process planning

UNIT-I

Numerical Control Machine Tools: Features and elements of NC, Positional, paraxial and contouring type. Numerical control modes, Machine control unit, Part Program, NC tooling, NC Machine tool applications, Advantages of NC, Practical NC machines

Computer Numerical Control: Structure of CNC machine tools, Spindle design, Spindle drives, Feed Drives, Feedback devices, Open Loop and Closed Loop Control in CNC machine tools, Axes-Standards

UNIT-II

CNC Control Systems: CNC Machining Centers, Vertical Axis Machining Centers

Horizontal axis machining centers, CNC turn centers, CNC turn mill centers, multiple spindle Turning Centers, Multiple axis turning centers

Adaptive Control, Adaptive control Optimization. Introduction to FANUC, SINUMERIC controllers.DNC and typical configurations

UNIT-III

CNC Programming: Part programming fundamentals; Process planning, Axes selection, Tool selection, Steps involved in Development of Part Program, Job and Tool Set up Planning.

Machining path planning

Manual Part- Programming: Manual part programming Methods, Preparatory functions, G- Codes, Miscellaneous Functions M Codes, Writing Part programmes for typical components, Tool length compensation, Canned cycles, Cutter radius compensation,

UNIT-IV

Computer Aided Part Programming: Concept of CAP, APT Language, Geometry Commands, Motion Commands like point to point Continuous path commands, Post processor commands, Compilation of control commands, Writing complete Part Programme for typical components with APT.

Group Technology: Part families, Layout, Part classification and coding system. Opitz, MICLASS Coding system, Production flow analysis

UNIT-V

Computer Aided Process planning: Approaches to CAPP, Variant and generative process planning. Flexible manufacturing system and their control, Elements of Computer Integrated Manufacturing system (CIM)

Computer aided Inspection and Quality Control: Inspection and testing Coordinate Measuring Machine, Non Contact Inspection, and Machine Vision

CAD/CAM Integration: Turnkey CAD/CAM Systems, Introduction to Rapid Prototyping Technique, Reverse Engineering

Text Books;

1. Grover, MP and Zimmers E.W. "CAD/CAM" Printice Hall of India, 1989.
2. P.N. Rao, " CAD/CAM Principles and Applications" 3 rd Edition Tata McGraw Hill, New delhi, 2010.

Suggested Reading:

3. Yoram Koren, "Computer Control of Manufacturing Systems" McGraw Hill Int, Newyork1994
4. Elanchezhian. C.Sunder Selwyn. T.Shanmuga Sunder, G. "Computer Aided Manufacturing", Laxmi Publications(p) Ltd. 2nd Edition, New Delhi,2007
5. Stenreson & Curran, 'Computer Numerical Control: Operation and Programming', 3rd Edition, 2009,
6. Chang, 'Computer Aided Manufacturing, 3rd Edition, Pearson

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PE 324

ADDITIVE MANUFACTURING

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End Examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives:

1. To make students understand the basic concepts of various rapid prototyping technologies.
2. To understand and apply criterion for selecting appropriate RPT technique for any given application.
3. To competently use tools to explore digital manufacturing techniques and CAD modeling software

Outcomes: Students will be able to

1. Identify different process and key characteristics of RP technologies and commonly used RP systems
2. Describe various CAD issues for rapid prototyping and related operations for STL model manipulation, formulate and solve typical problems on reverse engineering
3. Explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts
4. Critically explore technologies used for rapid prototyping in terms of their parameters, application, limitations, cost, materials, equipment, outcomes and implications
5. distinguish the types of additive manufacturing capabilities based on part geometry customer demands CNC machine capabilities
6. Identify different post processing techniques involved after rapid prototyping

UNIT-I

Introduction to rapid manufacturing, customization and mass customization, classification of rapid manufacturing processes (additive,/subtractive/formative), process chain for additive and other rapid manufacturing processes. Classification of additive (layered) prototyping/ tooling/ manufacturing processes.

UNIT-II

Extruder deposition system, laminated object manufacturing and laminated tooling systems, shaped deposition manufacturing and modular configuration, stereolithography and other liquid based systems. Laser sintering based technologies and their related details

UNIT-III

Construction and basic AM machines: construction of CNC machine – axes, linear motion guide ways, ball screws, motors, bearings, encoders/glass scales, process chamber, safety interlocks, sensors

UNIT-IV

Pre-processing in AM: Pre-processing of CAD model- STL conversion, STL error diagnostics, support generation, transformations, slicing, surface preparation of materials, pre-heating of powders.

UNIT-V

Post processing in AM: Post processing equipment – support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non – thermal and thermal techniques.

Text Books:

1. Gibson I, Rosen DW and Stucker B; Additive manufacturing methodologies : Rapid prototyping to direct digital manufacturing , Springer , 2010
2. Venuvinod, PK; Ma, W; Rapid prototyping – Laser based and other technologies, Kluwer , 2004

Suggested Reading:

3. Chee Kai Chua, Kah Fai Leong , 3D printing and additive manufacturing : principles and application: fourth edition of rapid prototyping
4. Rapid tooling : Technologies and industrial applications by Jacob, Paul F
5. Andreas Gebhanrdt, Understanding Additive Manufacturing,Hanses,2012
6. Alain Brnard, Georges Talliander, Additive Manufacturing,Wiley,2014

ME 316

DYNAMICS AND VIBRATIONS LAB

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives:

1. To demonstrate basic principle and exposure to evaluate CAM Follower Motion and Gyroscopic.
2. Students will understand the importance of static and dynamic balancing
3. Students will acquire the knowledge in evaluating the stability of dynamic systems.

Outcomes:

1. Students will be able to evaluate the effect of gyroscopic couple and CAM Follower Motions in machines.
2. Students will be able to estimate the performance of governers
3. Students will be able to evaluate the static and dynamic balancing of rotating and reciprocating machines.
4. Students will be able to evaluate the stability of systems under dynamic loading.
5.
6.

List of experiments:

(1) To study the motion of follower with the given profile of the cam. (To plot the n-q (Follower displacement Vs Angle of rotation) curves for different cam follower pairs.

(2) To study the gyroscopic effect on a rotating disc.

(3) Determination of the frequency of torsional vibration.

(4) Static and Dynamic balancing in a Rotating mass system.

(5) Study the effect of varying mass on the centre of sleeve in porter governor.

(6) Study the effect of varying the initial spring compression in Hartnell governor.

(7) Undamped torsional vibrations of single rotor system.

(8) Undamped torsional vibrations of double rotor system.

(9) To study the longitudinal vibrations of helical coiled spring.

(10) To study the undamped forced vibration of spring mass system.

(11)To study the force damped vibration of spring mass system.

(12)Determination of critical speed of the given shaft with the given end conditions. (Whirling of Shafts)

(13)Frequency response of spring mass system with and without damping.

(14)Frequency response with random excitations (Seismic response).

Note: Any 12 experiments need to be conducted

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PE 314

MACHINE TOOL ENGINEERING & CAM LAB

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives

1. To grind single point cutting tool using HSS as cutting tool
2. To have work shop practice on lathe drilling and milling machines
3. To understand gear cutting and to cut gear on milling machine
4. To have an hand experience on 'CNC' lathe and milling machine

Out comes:

1. Student is able to grind single point cutting tool with various angles
2. Student is able to produce various components on lathe, milling machines
3. Student is able to manufacture a gear using milling machine
4. Student is able to write part programme and manufacture some components on CNC lathe, milling
5.
6.

Experiments:

1. Introduction to Machine Tools, like Lathe, Drilling, Milling and Shaper.
2. Plain and step turning operations on Lathe
3. Step turning and Knurling on Lathe machine
4. Taper turning on Lathe
5. Drilling and Boring on Lathe
6. Thread Cutting on Lathe
7. Grinding of Single Point Cutting Tool
8. Gear Cutting using (a) Plain Indexing (b) Compound Indexing
9. Measurement of Cutting forces during machining on Lathe machine and Milling machine
10. Finding Shear angle experimentally in turning operation
11. Step turning and facing on CNC Lathe
12. Taper turning on CNC Lathe
13. Multiple turning in ball shape on CNC Lathe
14. Contouring on CNC milling machine
15. Pocketing (rectangular and circular)
16. Drilling Cycles on Milling machine

Note: Any **Twelve** Experiments need to be conducted

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PE 315

APPLIED THERMODYNAMICS & HEAT TRANSFER LAB

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessional	25 Marks
Credits	2

Course Objectives

1. To demonstrate basic knowledge and exposure to evaluate the performance of the internal combustion engines of petrol engine and diesel engine along with heat distribution
2. Students will acquire knowledge in evaluating the performance of multi-stage reciprocating compressor
3. To demonstrate knowledge in evaluating thermal conductivity and heat transfer coefficient under natural convection phenomena and forced convection phenomena
4. Students will acquire knowledge in evaluating characteristics of radiation and also heat exchangers

Course Outcomes:

1. Students will be able to evaluate the performance of petrol and diesel engine
2. Students will be able to evaluate the performance of multi stage reciprocating air compressor and its importance over single stage air compressor
3. Students will able to estimate the effect of insulation on conduction heat transfer and also estimate the value of convection heat transfer coefficients under different scenario
4. Students will be able to estimate the properties of radiating body and effectivenss of heat exchangers.
5.
6.

Applied Thermodynamics

1. Determination of Valve diagram of four stroke diesel engine
2. Determination of Performance characteristics of a multi-cylinder petrol engine
3. To conduct Morse test on multi cylinder petrol engine
4. Determination of Performance characteristics of two-stroke petrol engine
5. To conduct performance test on a variable compression ratio petrol engine
6. To conduct performance test on diesel engine
7. To determine volumetric efficiency, isothermal efficiency of multi-stage reciprocating air compressor

Heat Transfer

8. Determination of Thermal conductivity of insulating powder
9. Determination of thermal conductivity of composite wall
10. Determination of Thermal conductivity of lagged pipe
11. Determination of convective heat transfer coefficient under Natural/Forced convection phenomena
12. Determination of Heat transfer coefficient in parallel and counter flow heat exchanger.
13. Determination of Emissivity of a given plate.
14. Determination of the value of Stefan-Boltzman constant.

Note: Minimum 12 Experiments taking 6 from each section

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PE 321

METAL FORMING TECHNOLOGY

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessional	25 Marks
Credits	3

Objectives:

1. To introduce students to metal forming technology while understanding the fundamentals of theory of plastic deformation & stress strain relations.
2. To demonstrate various operations like sheet metal operations, extrusion, drawing, rolling, forging etc with their applications, merits and demerits.
3. To explain different deformation mechanisms and effect of the process variables on process robustness and product quality.
4. To enable the students to determine loading and energy required for metal forming tools and machines.
5. To enable the students to understand different defects that occur in forming operations with remedial measures.

Outcomes:

After learning this course, students will be able to:

1. Define what is meant by metal forming and its specific advantages over other manufacturing processes.
2. Apply theory of plasticity to analyze metal forming processes
3. Understand the practical aspects of metal forming operations.
4. Understand various process parameters that affect product quality under different conditions
5. Work independently with various presses and dies to produce different components
6. Determine load, energy and power required for various presses and machines
7. Propose suitable metal forming processes for making different products

UNIT-I

Theory of Plasticity: Plastic deformation, work hardening, plasticity cycle, cold, warm & hot working with their advantages & disadvantages, true stress and true strain, flow curve, effect of strain-rate & temperature on flow stress. yield criterion: von-Mise's and Tresca.

UNIT-II

Forging: Open and closed die forging, Drop, Press and Machine forging operations, types of hammers and presses, their principles of operation and applications, Forging load calculation with slab method, forgeability tests, forging defects, Methods of heating and types of furnaces, Isothermal forging and Hot Isostatic Pressing.

UNIT-III

Extrusion & Drawing: Types of extrusion, Tube extrusion Rod/wire/tube drawing , load calculation of for extrusion & drawing using uniform deformation energy method and slab method. maximum reduction in drawing, effect of friction, die angles, deformation speeds on extrusion/drawing forces, die materials and lubrication in these operations, extrusion and drawing defects.

UNIT-IV

Rolling: Principles of Metal rolling, roll load, torque and mill power for homogenous deformation, classification and description of rolling mills, their applications, rolling defects, shape rolling, ring rolling thread rolling, roll bending & powder rolling

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UNIT-V

Sheet Metal Working: Sheet Metal working operations-shearing, blanking, piercing, bending, drawing & squeezing operations, estimation of loads and energy required for these operations, Formability, FLD, classification of presses, specifications & their applications, simple, compound, progressive and combination dies, Embossing, Stretch forming, Spinning & Flow forming.

Text Books:

1. Serope Kalpakjian, "Manufacturing Engineering & Technology", Addision-Wesley Pub.,
2. George.E. Dieter, "Mechanical Metallurgy", SI Metric Edition, McGraw-Hill.

Suggested Readings:

3. P.N. Rao, "Manufacturing Technology",TMH, Pub.,
4. Jani R.K. and Gupta S.C, "Production Technology", Khanna Publications
5. Roy A lindberg, "Materials and Process of manufacturing", PHI.
6. John Schey "Introduction To Manufacturing Processes" Tata Mcgraw Hill

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PE 322

CAD and FEM

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Acquire fundamental understanding of the principles of CAD, Design Analysis, wire frame, surface and solid modeling techniques.
2. Able to understand the 2D and 3D transformations and their mathematics.
3. Able to learn use of mass properties and mechanical tolerencing in design
4. Understand the basic finite element formulation and be able to derive equations in finite element Methods for 1D, 2D and 3D problems
5. Able to formulate and solve basic problems in dynamic analysis

Outcomes:

1. Demonstrate basic concepts of CAD tools and software
2. Apply basic concepts of curves, surfaces and solids to design applications
3. Become familiar with solid modeling concepts and techniques
4. To demonstrate a basic understanding of the concepts, mathematical formulation and numerical implementation underlying the FEM as applied to solid mechanics and dynamic analysis
5. To create his/her own FEM computer programs to solve simple static and dynamic problems;
6. To analyze more complex mechanical problems using commercial FEA software ANSYS.

UNIT-I

Design Process: Design criteria, Alternative solutions, Alternative design Computer Aided Design and Review, Drafting Techniques-Basic geometric elements and their creation.
Geometric Modeling: Wire frame entities and their definition, interpolation and approximation curves. Concept of parametric and non-parametric representation of a circle and helix curves properties of splines
Synthetic curves: Parametric representation of cubic spline, Bezier and B-spline curves, continuity, properties and characteristics. Concept of NURBS.

UNIT-II

Surface Modeling: Analytic surfaces: definitions of planar, surface of revolution, Tabulated cylinder, synthetic surfaces: Cubic and Bezier survaces,
Solid Modeling: C-rep and B-rep approaches, Design Applications: Mass property calculations, Mechanical tolerancing, Finite Element Analysis, Design Review.
2D Transformations and their Mathematics:Translation, Scaling and Rotation about arbitrary points , shearing and Reflection, Homogeneous representations, concatenation.

UNIT-III

Introduction to Finite Element Method for solving field problems, stress and equilibrium, Boundary condtions, Strain-Displacement, Stress-Strain relations.
One dimensional problems: Finite element modeling coordinates and shape functions, potential energy approach: Assembly of Global stiffness matrix and load vector, Finite element equations, Treatment of boundary conditions, Quadratic shape functions, analysis of trusses with 2D of and per node.

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UNIT-IV

Analysis of frames: Analysis of frames with two translations and a rotational degree of freedom at each node, analysis of Beams: Element stiffness matrix for two nodes. (Two degrees of freedom per node). Finite element modeling og two dimensional stress analysis with constant strain triangle.

UNIT-V

Finite element modeling: Finite element modeling of axi-symmetric solids subjected to axi-symmetric loading with triangular elements. Two dimensional four nodded iso-parametric elements and numerical integration and Gaussian Quadrature. Dynamic Analysis: Formulation of finite element model, element matrices, Evaluation of Eigen Values and Eigen vectors for a stepped bar. Convergence requirements. Introduction to Finite Element Analysis Software.

Text Books:

1. Ibrahim Zeid, CAD/CAM, "Theory and Practice", McGraw Hill Inc. Newyork, 1991
2. Tirupathi R, Chandraputla and Ashok D Belagundu, 'Introduction to Finite Elemets in Engineering", PHI, 1997.

Suggested Reading

3. Arivid, R.Eide, Toland D. Jenison, Lane H. Mashaw, Larry L.Northup, "Introduction to Engineering Design, McGraw Hill, 1998.
4. G. Ramamurthy, "Applied Finite Element Analysis", I.K. International Pub., House Pvt. Ltd., New Delhi, 2009.
5. Ramamurthy, V. 'Finite Element Method in Machine Design', Revised Edition, Narosa Publishing House, 2012.
6. Daryl L. Logan, 'A First Course in the Finite Element Method, 3rd Edition, Cengage Learning, 2012.

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PE 323 **METAL CASTING & WELDING**

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To provide the basic understanding of casting, welding and forming processes along with their relative merits, limitations and their applications.
2. To make the students familiar with design aspects and calculations of pattern, gating system and riser.
3. To make the students to understand the defects, their causes and remedies in castings and weldments
4. To impart the ability to students to carry out load calculations for forming of simple shapes.

Outcomes:

1. Students are able to select the suitable manufacturing process for a given component.
2. Students are able to design pattern, gating system and rises for a simple casting.
3. Students are capable of indentifying defect and suggest the remedy for the same
4. Students can suggest minimum capacity of the machine for a given forming operation
5.
6.

UNIT-I

Casting: Introduction, classification, pattern design: Types of patterns, pattern materials, pattern allowances; gating system: purpose, elements, requirements, types of gates, choke, gating ratio, types of gating systems, gating system design, risering: purpose, requirements, chvorinov's rule, optimum shape and dimensions of riser, riser design by Caine's method, Modules method and NRL method.

UNIT-II

Casting: Moulding sand: ingredients, required properties; melting furnaces:cupola, induction & arc furnace; casting defects and remedies, inspection & testing of castings, Special casting processes: die casting, shell moulding, investment casting and CO_2 moulding.

UNIT-III

Welding: Introduction, Classification, Arc Welding: Physics of arc, DCSP, DCRP, AC, arc initiation, arc stability , parts of arc, arc-length characteristics, static V-I characteristics of power source arc welding processes such as SMAW, SAW, GTAW, GMAW, PAW; Resistance welding: spot, projection, seam, butt and percussion welding.

UNIT-IV

Welding: Oxy-acetylene welding, Thermit welding, laser beam welding, Electron beam welding. Soldering & brazing, weld defects, solid state welding: forge welding, friction welding, ultrasonic welding and explosive welding. Weldability, effect of various parameters on weldability.

UNIT-V

Processing of Plastics glasses ceramics and metal matrix composites : thermoplastics and thermo setting plastics, Extrusion, injection moulding, blow moulding, thermoforming, Compression moulding and transfer moulding. Forming and shaping of glass, Design, processing of metal matrix and ceramic matrix composites.

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Processing of metal powders: preparation of metal powders, compaction, sintering and secondary finishing operations.

Fabrication of Microelectronic, Micromechanical, and Microelectromechanical Devices: Semiconductors and Silicon, Crystal Growing and Wafer Preparation, Films and Film Deposition, Oxidation, Lithography, Etching Diffusion and Ion Implantation

Text Books:

1. P.N.Rao "Manufacturing Technology", Vol.1, Tata McGraw Hill Publ., 3rd Edn., 2011.
2. Amitabh Ghosh & Mallick. "Manufacturing Science", Assoc. East West Press Pvt. Ltd., 4th Edn., 2011

Suggested Reading:

3. Schey, " Introduction To Manufacturing Processes" 2nd , Ed Mcgraw-hill Education,.
4. Roy A.Lindberg, " Materials & Process of Manufacturing", Prentice Hall of India 5th Edn., 1992.
5. Serope Kalpakjian, "Manufacturing Engineering and Technology", Addision, Wesley Publishing Company, 2006.
6. Mikell P.Grover "Fundamentals of Modern Manufacturing : Materials, Processes And Systems" 3rd Edition, Willey Asia.

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ME 325

MACHINE DESIGN
(USAGE OF DATA BOOK IS COMPULSORY)

Instruction	4 Periods + 1 Tutorial per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To learn design criteria of machine components, selection of materials and manufacturing process.
2. To learn application of principles to design helical coiled and leaf springs, gears, curved beams, sliding contact and rolling element bearings and IC engine components.
3. To provide the design concepts of helical and leaf springs.
4. To provide the students the knowledge of design of IC engine parts.

Outcomes:

1. Graduates demonstrate the ability of design helical, leaf springs for static and fluctuating loads
2. Are expected to have ability to design gears for power transmission considering beam strength, dynamic factors and wear life
3. Graduates demonstrate the ability designing sliding contact bearings, considering power lost in friction, heat dissipation heat balance
4. Graduates are expected to have the ability of selection of rolling contact bearings based on load –life relationship
5. Graduates demonstrate the ability designing IC engine parts such as piston, connecting rod, crank shaft considering gases impulse and thermal aspects.
6. Graduates demonstrate the ability designing curved beams like C-clamp, crane hooks and selection of chains

Unit-I

Mechanical springs: Introduction. Different types of springs. Materials used for springs.

Helical Springs: Whal factor, calculation of stress, Deflection and energy stored in spring. Design for static and fluctuating loads.

Leaf Springs: Stress and Deflection. Nipping of Leaf springs. Design for static and fluctuating loads.

Unit-II

Gears: Introduction of gear drives, different types of gears, Materials used for gears. Standards for gears and specifications.

Spur Gear Design: Lewis equation, Beam strength of gear tooth and static design. Wear load and design for Wear. Dynamic loads on gear tooth. Design of Helical, Bevel and Worm gears, concepts of Design for manufacturability.

Unit-III

Bearings: Introduction. Materials used for Bearings. Classification of bearings and mounting of bearings.

Design of sliding contact bearings: Properties and types of Lubricants, Design of Hydrostatic and Hydrodynamic sliding contact bearings.

Design of Rolling Contact Bearings: Different types of rolling element bearings and their constructional details, static load carrying capacity. Dynamic load carrying capacity. Load-life relationship, selection of bearing life. Design for cyclic loads and speeds. Design of Ball and Roller bearings.

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Unit-IV

I.C. Engine parts: Introduction. Materials used. Design of piston, connecting rod and crank for I.C. Engines.

Unit-V

Design of curved beams: Introduction stresses in curved beams, expression for radius of curvature of neutral axis for rectangular, circular, trapezoidal and T-sections. Design of crane Hook, C-clamp.

Design of chain drives: Power rating of roller chains. Strength of roller chains.

Text Books:

1. Bhandari V.B. *Machine Design*, Tata Mc Graw Hill Publications, 2010.
2. J.E. Shigley , C.R. Misckhe, *Mechanical Engineering Design*, Tata Mc Graw Hill Publication, 2010.

Suggested Reading:

3. P. Kannaiah, *Machine Design*, Science-Tech Publications, 2010.
4. M.F. Spotts, *Design of Machine Elements*, Prentice Hall, 2013.
5. Robert L. Norton, *Machine Design: An Integrated Approach*,2/e Pearson Education, 2013.
6. Siraj Ahmed, 'Mechanical Engineering Design, PHI, 2014.

Machine Design Data Books:

7. Design Data book by PSG College – 2012
8. Mahadevn .K, Balaveera Reddy. K, 'Design Data Hand Book, 4th Edn., CBS Publishers & Distributors, 2013.

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PE 351 **TURBO MACHINERY (Elective-I)**

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. The purpose of this course is to learn the Fluid properties and fundamentals of Fluid statics and fluid flow
2. To introduce the concepts of flow measurements and flow through pipes
3. To introduce the concepts of momentum principles
4. To impart the knowledge on pumps and turbines

Outcomes:

1. Graduates will become familiar with the impact force of jet on different types of vanes.
2. Graduates demonstrate the ability of servicing of reciprocating and centrifugal pumps.
3. Graduates are expected to have ability to design the turbines for power generation.
4. Graduate demonstrate the ability of designing steam nozzles, steam & gas turbines.
5.
6.

UNIT-I

Turbo Machines- Classification- Impulse-momentum equation- Lay-out of hydraulic power plant-working principle- Impact jet on vanes- Force exerted by a jet striking (i) a fixed flat vertical vane held normal to the jet flow (ii) at the centre of a fixed symmetrical curved vane (iii) at one end of fixed symmetrical and unsymmetrical curved vanes (iv) flat vertical vane moving in the direction of jet (v) a series of flat vertical moving vanes (vi) at the centre of symmetrical moving curved vanes (vii) symmetrical curved vanes moving in the same direction as that of jet at inlet (viii) at one end of a series of un-symmetrical moving curved vanes

UNIT-II

Centrifugal pumps: Classification- Working principle- Comparison over reciprocating pumps-Velocity triangles- Manometric head- work done per second- Head equivalent of work done- Manometric, mechanical and overall efficiencies- Pressure rise in the impeller- Minimum starting speed- Specific speed- Physical significance of specific speed- Model testing- Conditions of similarity of CF pumps-Priming- Performance characteristic curves- Troubles (operational difficulties), reasons and remedies in CF pumps- Cavitation- effects of Cavitation- Precautions against Cavitation

UNIT-III

Hydraulic Turbines: Classification- Impulse and reaction turbines- Construction and working of Pelton wheel, Francis turbine and Kaplan turbine- Velocity triangles- Work done (power developed)- Hydraulic, Mechanical and Overall efficiencies- Maximum efficiency- Comparison between Impulse and reaction turbines- Comparison between Francis and Kaplan turbines- Specific speed- Physical significance of specific speed- Unit quantities- Model testing of turbines- Conditions for similarity of turbines- Draft tubes (functions and types only)- Surge tanks(functions and types only) - Performance characteristic curves

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UNIT-IV

Steam Nozzles: Classification- friction in the nozzle (Nozzle efficiency)- Exit velocity of steam- Mass rate of steam flow through the nozzle- Condition for maximum discharge (Critical pressure ratio) and its significance- Diameter of throat and exit for maximum discharge

Steam Turbines: Classification- Working of Impulse and Reaction steam turbines- Velocity triangles- Work done- Nozzle efficiency- Blading or diagram efficiency- Gross or stage efficiency- Condition for maximum efficiency- Compounding of steam turbines- Velocity compounding, Pressure compounding and Pressure-velocity compounding of Impulse steam turbines

UNIT-V

Gas Turbines: Classification- Analysis of Joule (ideal) cycle / Brayton (actual) cycle- Net work done and thermal efficiency of gas turbines working on ideal and actual cycles- Optimum pressure ratio for Maximum power output and maximum thermal efficiency- Maximum power output and maximum thermal efficiency- mass of air circulated- Methods for improving the cycle efficiency- Calculation of net work done and thermal efficiency of gas turbines with (i) Intercooling (ii) Reheating (iii) Regeneration (iv) Intercooling and reheating (v) Intercooling and regeneration (vi) Reheating and regeneration (vii) Intercooling, reheating and regeneration.

Text Books:

1. Bansal, R.K., *"A Text Book of Fluid Mechanics and Hydraulic Machines"*, Laxmi Publication (P) Ltd., New Delhi, 2004
2. P.L Ballaney., "Thermal Engineering (Including Basic Thermodynamics)(Heat Engines): Mechanical engineering, Volume 1"., Khanna Publishers, New Delhi, 1985

Suggested Readings:

3. Madan Mohan Das., "Fluid Mechanics and Turbomachines", PHI Learning Private Limited, New Delhi, 2009
4. Ramamrutham, S., *"Hydraulics, Fluid Mechanics and Fluid Machines"*, Dhanpat Rai & Sons, New Delhi,2004
5. Rajput, R. K.,*"Thermal Engineering"*, Laxmi Publishers, New Delhi, 2004
6. Dr. R. Yadav., "Steam & Gas Turbines and Power Plant Engineering"., Central Publishing House, Allahabad, 2014

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HUMAN RIGHTS AND LEGISLATIVE PROCEDURE (Elective-I)

Instruction	4 Periods per week
Duration of End Examination	3 Hrs
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: To help students

1. To understand the value of human rights
2. To understand the Lawful rights available to him and others
3. To create understanding the rights of under privileged and respect them
4. To understand role of an individual in the Civil Society

Course Outcomes: At the end of the course student

1. will understand the process of evolution of human rights
2. Will understand constitutional protection available
3. Will understand the conditions of under privileged persons and will adopt a positive attitude towards.
4. Will understand the role of Law in protecting environment and will recognize right to life.
5. Awareness of human rights will create the need for transparency
6. Understanding enforcement mechanism will enable us to know the mechanism for exercising rights

Unit-I

Meaning and concept of Human Rights: Notion and classification of Rights, Moral and Legal Rights, Three generations of rights (Civil, and Political Rights, Economic Social and Cultural Rights, Collective/Solidarity Rights). Indian Bill of Rights and Sarodaya. Preamble of Indian Constitution, Fundamental Rights-Directive Principles-Fundamental Duties

Unit-II

Human Rights enforcement mechanism Human Rights Act, 1993, Judicial organs-Supreme Court (Art 32) and High Court (Art 226), Human Rights Commission, National and State Commission of Women/Children/Minority/SC/ST

Unit-III

A Right to development, Socio-Economic and Cultural Effects of Globalization, Right to Education, Transparency in Governance and Right to Information, Consumer Protection act.

Unit-IV

Environment Rights such as right to clean environment and public safety: Issues of Industrial Pollution, Prevention, Rehabilitation: Safety aspects of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment.

Unit-V

Role of Advocacy Groups: (a) Professional bodies: Press, media role of Lawyers – Legal Aid., (b) Educational Institutions (c) Role of Corporate Sector (d) N.G.Os

Text Books:

1. The history of Human rights by M.r. Ishay, Orient Longman, Newdelhi, 2004.
2. S.N. Chaudhary, Human Rights and Poverty in India: Theoretical Issues, Delhi: Concepts, 2005.
3. Anuradha Kumar, Encyclopedia of Human Rights Development of under Privilege, New Delhi: Sarup, 2002.
4. P.M. Katare and B.C. Barik, Development, Deprivation and Human Rights, Violation, New Delhi: Rawat, 2002.

Reference Books:

5. Venket Iyer, (ed.), Democracy, Human Rights and the Rule of Law: Essays in Honour of Nani Palkhivala, New Delhi: Butterworth's, 2000.
6. R.J. Cook and C.G. Ngwena (ed.), Health and Human Rights, OUP, Clarendon, 2007.
7. UNESCO, Ethics of Science and Technology: Explorations of the Frontiers of Science and Ethics, OUP, Clarendon, 2006.
8. K.P. Saksena, (ed.), Human Rights and the Constitution: Vision and the Reality, New Delhi: Gyan Pub., 2003

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PE 353

VALUE ENGINEERING (Elective-I)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To enable students to understand the concepts & applications of Value Engineering.
2. To know various alterations processing techniques & materials used in manufacturing.

Outcomes: students will be able

1. apply the concepts of Value Engineering in the context of engineering
2. apply the concepts of value engineering to various products to be manufactured in industries and in turn to minimize the cost
3. understand the decision environment its effect on work understand the decision environment its effect on work basic steps in using the systems value analysis
4. understand the decision environment its effect on work
5. Construction Management Contracts
6. Work any local industry where Value Engineering is applied

UNIT-I

An overview of value engineering (VE)-Definition, concepts and approaches of value analysis, concepts and approaches of value analysis and engineering-evaluation of VE. Evaluation of function, problem setting system, problem solving system, setting and solving management decision.

UNIT-II

Type and Services problem, evaluation of value. Results accelerators, basic steps in using the systems value analysis.

UNIT-III

Understanding the decision environment, effect of value analysis on other work in the business. VE Team, coordinate, designer, different services, definitions.

UNIT-IV

Construction Management Contracts Value Engineering Case studies, effective organization for value work, function analysis system techniques- FAST diagram.

UNIT-V

Case Studies: A student is expected to associate with any local industry where Value Engineering is applied and submit a report (or) a question may be set involving a case study where a student has to apply creative idea to reduce the cost without compromise to the end use of the product.

Text Books:

1. Value Engineering by L.D. Miles, Mc-Grawhills
2. Value Engineering Theory by D.E. Parker, Sundarm Publications

Suggested Readings:

3. Value Engineering – practical applications for design, construction and operations by ALPHONSE DELL'LSOLA
4. Value Engineering Practical applications by Dr. John N. Parrigin
5. Value Engineering Mastermind Concept to Value Engineering certification by Anil Kumar Mukhopadhyaya
6. Value Engineering A plan for invention by Richard Park

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ME 353 **MECHANICAL VIBRATIONS (Elective-I)**

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To gain the knowledge of mathematical modeling of a physical system and applying the principles of Newton's Second Law and conservation of energy to derive the equations of motion.
2. To study the response of a vibrating system with periodic excitation and understand the principle of vibration isolation.
3. To develop the equations of motion for a continuous system in elongation, bending and torsion to find the natural frequencies and mode shapes.

Outcomes:

1. Develop a mathematical model for a physical system and derive the governing differential equations.
2. Determine the natural frequencies of single and two degrees of freedom systems without and with damping.
3. Determine and analyze the response of machine members or structures in forced vibration with different excitation frequencies.
4. Determine the natural frequencies and mode shapes of bars in elongation and torsion and beams in bending.
5. Find torsional vibration of one, two and three rotor system
6. Identify the node and mode shapes

UNIT-I

Fundamentals of Vibrations Analysis- Introduction; Elements of vibration; vibration analysis procedure; spring elements-equivalent stiffness; Mass or inertia elements; Damping elements-equivalent damping-Types of damping, Definitions and Terminology, Simple harmonic motion.
Free Vibration Analysis-Single Degree of Freedom Systems Undamped Vibrations: Different methods for equation of motion-Newton's Second Law, D'Alembert's Principle of Virtual displacement, Principle of Conservation of Energy, Rayleigh's method.
Damped Vibrations: Differential equation of motion, critical damping coefficient and damping ratio; Damped natural frequency; Logarithmic decrement; Energy dissipated in viscous damping.

UNIT-II

Forced Vibration Analysis (Single Degree of Freedom System): Response of damped and undamped systems to harmonic excitation; frequency response curve; magnification factor; Harmonic excitation of the base, vibration isolation, transmissibility, force transmission to foundation; response of a damped system under rotating unbalance.

Vibration measuring instruments-working principle of Seismic mass, Vibrometer, Accelerometer.

UNIT-III

Damped and Undamped Vibrations: Free and forced vibration analysis of two degree of freedom system-different methods for the formulation of equation equations of motion, natural frequencies, Principal modes-physical interpretation and orthogonality, General method, Eigen value method, Influence coefficients.

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UNIT-IV

Torsional Vibrations: Torsional vibration of one, two and three rotor system, Equivalent shafting, Torsional vibration of a geared system, Coordinate coupling-static and dynamic coupling, whirling of rotating shafts.

UNIT-V

Vibrations of Continuous Systems: Vibrations of strings, bars and beams, formulation of equation of motion, characteristic equation, Eigen values, identification of node and mode shape

Text Books:

1. G.S. Grover & Nigam ,Mechanical Vibrations,Nem Chand & Bros, 6th edn,1998
2. S.S. Rao ,Mechanical vibration, 4th edn, Pearson, 2009

Suggested Readings:

3. Thomson , William T, Theory of Vibration with Application,4th edn, Pearson Education,2007
4. V.P. Singh , Mechanical vibration, Dhanpath Rai &Co.,3rd edn,2006
5. Graham Kelley,S., Mechanical vibration – Schaums Outline Series, TMH
6. F.S. Tse, Morse & Hinkle ,Mechanical vibration, Allyn and Bacon, 1978

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ME 324

REFRIGERATION AND AIR CONDITIONING

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. Students will acquire the basic knowledge about the importance of refrigeration and its applications in engineering practice
2. To demonstrate basic knowledge of various types of refrigeration processes like air refrigeration, simple vapor compression refrigeration and absorption refrigeration, steam jet refrigeration and un-convectional refrigeration
3. Students will acquire the basic knowledge on various psychrometric processes
4. Students will acquire knowledge in estimating air conditioning loads

Course Outcomes : Students will be able to

1. differentiate refrigeration from air conditioning
2. understand merits and demerits of various refrigeration processes
3. understand merits and demerits of various non-conventional refrigeration processes over conventional refrigeration systems
4. apply a suitable psychrometric process depending on requirement or application
5. understand the importance of thermodynamics of human body
6. design air conditioning system for a particular application

UNIT-I

Introduction to Refrigeration: Definition of Refrigeration and Air-conditioning, Necessity of Refrigeration and its applications, Methods of Refrigeration, Unit of Refrigeration and C.O.P. Reversed Carnot cycle, Limitations, Effect of operating temperatures,

Properties of Refrigerants: Survey, Designation, Desirable properties of refrigerants, Thermodynamic, Chemical and Physical properties, Classification of Refrigerants, Alternative refrigerants, Substitute for CFC Refrigerants, Global warming, Green House Effect and Future of Refrigerants.

Air Refrigeration Systems: Analysis of Bell-Coleman Cycle, Reversed Brayton cycle, Open and Dense air system, Application to aircraft refrigeration, Simple cooling system, Bootstrap simple evaporating system, Regenerative cooling system and Reduced ambient cooling system.

UNIT-II

Vapour compression system: Working principle and essential components of Simple vapor compression Refrigeration cycle, Compressor, condenser, evaporator, and expansion devices, Analysis of cycle, C.O.P, Representation of the cycle on T-S, P-H and H-S charts

Dry and wet compression, Effect of operating conditions like evaporating pressure, condenser pressure, Liquid sub-cooling and Vapor super heating, Performance of the system. Low temperature refrigeration system (with single load system), Compound compression with water inter cooler and Flash intercooler, Cascade refrigeration system-Analysis and advantages

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UNIT-III

Vapour Absorption Refrigeration System; Simple absorption systems, COP, Practical ammonia absorption refrigeration system, Lithium bromide absorption system, Electrolux refrigerator, Common refrigerants and absorbents properties, Comparison with vapor compression refrigeration system

Steam Jet Refrigeration: Principle of working, Analysis of the system, Advantages, limitations and applications.

Non-Conventional Refrigeration Systems: Principle and operation of Thermoelectric Refrigeration Systems, Seebeck effect - Peltier effect - Thomson effect, Analysis, Pulse tube refrigeration system.

Introduction to Cryogenics- Advantages, Limitations and applications

UNIT-IV

Psychrometry- Psychrometric properties, Psychrometric chart, construction, Representation of Psychrometric processes on the chart, Heating and Cooling with Humidification and Dehumidification, Adiabatic dehumidification, Adiabatic chemical dehumidification and mixing processes

Introduction to Air Conditioning Requirements of comfort air conditioning, Thermodynamics of human body, Body temperature, Metabolism, Body defense and Human tolerance, Effect of heat on performance, ASHRE comfort chart, Effective temperature.

UNIT-V

Cooling Load Calculations in Air Conditioning: Concept of by pass factor, Sensible heat factor, Apparatus Dew Point, Room Sensible Heat Factor (RSHF), Gross Sensible Heat Factor (GSHF), Different heating and cooling loads, Problems.

Design of air conditioning systems: All fresh air, Re-circulated air with bypassed air, Design of Summer, Winter and Year round air conditioning systems, Energy conservation in air conditioned building,

Air Conditioning Systems: Types, Components of air conditioner equipments, Humidifier, Dehumidifier, Filter. **Applications of Refrigeration and Air conditioning** Food Preservation, Transport air conditioning, and Industrial applications

Text Books

1. Arora C.P., " *Refrigeration and Air conditioning*", Tata McGraw Hill, New Delhi, 2004.
2. Stocker, W.S., "*Refrigeration and Air conditioning*", McGraw Hill, New Delhi, 2004.

Suggested Reading

3. Jain, V.K., "*Refrigeration and Air Conditioning*", S Chand & Company, New Delhi, 2004.
4. Manohar Prasad, "*Refrigeration and Air Conditioning*", New Age International, Allahabad, 2007.
5. Rajput, R.K., "*Refrigeration and Air Conditioning*" Laxmi Publications, New Delhi, 2007
6. Edward G Pita, Air conditioning Principles and Sytems: An Energy Approach,4th edn,PHI,2012

ME 351

CONTROL SYSTEMS THEORY (Elective-I)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To introduce students to the fundamental of feedback control system theory.
2. Use of analytical design methods in designing, analyzing various physical systems and to apply the gained knowledge in developing solutions for real world systems.
3. To develop the ability of formulating mathematical models and designing feedback control systems.
4. To provide students with necessary tools to analyze linear feedback control systems.

Outcomes: Students should be able to

1. Differentiate mechanical, electrical, hydraulic, pneumatic, thermal systems
2. Draw Signal flow graphs
3. Find error coefficients sensitivity and Performance indices.
4. Correlation between transient and frequency response, Bandwidth
5. Design Lead. Lag and Lead-lag compensator
6. Derive state model from transfer functions and differential equations

Unit-I

Control Systems Classification: Open Loop & Closed Loop Systems. Mathematical models and Transfer functions from governing equations of mechanical, electrical, hydraulic, pneumatic, thermal systems. AC, DC servomotors & Electromechanical servo systems.

Unit-II

Block diagrams, Block diagram reduction. Signal flow graphs, Mason's gain formula. Transient response. Time domain specifications of 1st and 2nd order systems. Steady state error, Error coefficients, sensitivity and Performance indices.

Unit-III

Routh criteria, Root Locus method. Frequency Response: Bode, Polar plots. Correlation between transient and frequency response, Bandwidth, Experimental determination of transfer functions.

Unit-IV

Nyquist criteria. Gain and phase margins, Lead. Lag and Lead-lag compensator design, PID controller, linearization of Non linear systems.

Unit- V

State space representation: Concept of state, State variable, state models of linear time invariant systems, derivation of state model from transfer functions and differential equations. State transition matrix, solution of state equations by time domain method. Concept of controllability and observability.

Text Books:

1. Ogata, K., *"Modern Control Engineering"*, Prentice Hall, 2004
2. M. Gopal, *"Control Systems"*, Tata McGraw Hill, 2004.

Suggested Reading:

3.Anand kumar.A "control systems", Prentice Hall of India,2014
4. Norman S. Nise, *"Control Systems Engineering"*, John Wiley & Sons, Inc., 2001
5. M. Gopal, 'Modern Control System Theory', New Age International, 1993
6. K.R. VARMAH, 'Control Systems' McGraw Hill, June, 2010

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PE 325 **METAL FORMING TECHNOLOGY LAB**

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End Examination	75 Marks
Sessionals	25 Marks
Credits	2

Objectives:

1. To demonstrate various operations like sheet metal operations-blanking, punching, deep drawing, extrusion etc with their applications, merits and demerits.
2. To explain different deformation mechanisms and effect of the process variables on process robustness and product quality.
3. To enable the students to determine loading and energy required for metal forming tools and machines.
4. To enable the students to understand different defects that occur in forming operations with remedial measures.

Outcomes:

1. After practicing this lab, students will be able to:
2. Apply theory of plasticity to analyze metal forming processes
3. Understand the practical aspects of metal forming operations.
4. Understand various process parameters that affect product quality under different conditions
5. Work independently with various presses and dies to produce different components
6. Determine load, energy and power required for various presses and machines
7. Propose suitable metal forming processes for making different products.

List of Experiments:

1. Evaluation of Formability of a given sheet material using Erichsen cupping test.
2. Study of Simple Die design for Blanking/Piercing operations in sheet metal forming and manufacturing of circular blanks using a mechanical press (capacity 30 Tons) and measurement of forces and comparing with theoretical loads.
3. Study of Progressive die design and manufacturing of washer components using the same on a fly press (capacity 6 Tons) and estimation of forces.
4. Study of Compound die design and manufacturing of washer components using the same on double body fly press (capacity 8 Tons) and estimation of forces.
5. Study of Combination die design and manufacturing of cylindrical cups using the same on a Hydraulic power press (capacity 50 Tons) and estimation of drawing force.
6. Study of deep drawing die design and measuring forces with/without blank holder for cylindrical/square cups using 10T load cell on a Hydraulic power Press and comparing them with the theoretical values.
7. Measurement of cutting force for Blanking operation using 10T load cell on Mechanical power Press for different materials and comparing theoretical and practical values.
8. Estimation of True stress and True strain for ferrous/non ferrous materials encountered in metal forming operations using Universal Testing Machine.
9. Study of extrusion dies and demonstration of extruding lead material
10. Demonstration of Spinning Process
11. Design and manufacturing of a forming die (tool) to produce a typical component.
12. Demonstration of Simulation software for metal forming operations.

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PE 326

CAD and FEM LAB

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives:

1. Able to understand the usage of solid modeling software
2. Able to learn 2D & 3D modeling with CAD Software
3. Able to understand FEA Software for static & dynamic applications

Outcomes:

1. Able to demonstrate and apply CAD software to engineering designs
2. Able to solve static, dynamic and thermal problems with FEA software
3.
4.
5.
6.

List of Experiments:

1. Geometric modeling of simple parts using sketcher tools.
2. Part modeling and Assembly of simple parts using CAD Packages.
3. Mass properties and Sectional properties of a part and Assembly.
4. Tolerancing of Drawings from part (or) assembly modeling - Static Analysis of plane Truss and 2D beam for different type of loads ANSYS / NASTRAN/ADINA etc.,
5. Analysis of plate with a hole to determine the SCF deformations and the Stresses to study the failure behavior.
6. Static Analysis of curved shell due to internal pressure and moments.
7. Model analysis of beam with different cross sections and end conditions.
8. Harmonic analysis of a shaft subjected to a periodic force
9. Steady state heat transfer Analysis of Cross section of chimney.
10. Transient heat transfer analysis of a solidification of casting.
11. Buckling analysis of shells for critical loads.
12. Transient analysis of spring mass beam system with a transient load.
13. Non-linear static analysis of cantilever beam with non-linear materials
14. Coupled field analysis.

Note: 1. Use of solid works/CATIA & ANSYS Software
2. Practice any 12 exercises

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PE 327

METAL CASTING AND WELDING LAB

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives:

1. To make the students acquaint with the welding equipment and the sand casting process.
2. To give the students a feel of working with their hands in the areas of welding and casting.

Outcomes:

1. Students can select the welding processes for a given fabrication.
2. Students are able to suggest the various testing methods required for the moulding sand
3.
4.
5.
6.

Casting

1. Design and manufacturing a simple pattern with various allowances
2. Green sand moulding practice for a single piece pattern.
3. Green sand moulding practice for a split pattern with a horizontal core.
4. Moulding sand testing: GCS, GSS, DCS and DSS Permeability and shatter index.
5. Testing of Bentonite: gel index and swell index.
6. Finding out the GFN, Moisture content and clay content for a given sand sample
7. Melting & Pouring of Aluminum
8. Dimensional inspection & visual inspection of the casting and analysis of dimensional variation & defects.

Welding

1. Study of gas welding equipment and process. Identification of flames, making Butt joint with gas welding.
2. Study of Arc welding process, comparison of the bead geometry with DCSP, DCRP and A.C.
3. Study of resistance welding process and plot the variation of spot area with time and current variation
4. Study of TIG welding process and plotting cooling curve in TIG welding process.
5. Study of SAW Welding process and finding out deposition efficiency of the process.
6. Study of MIG welding process and testing of weld bead formed by MIG welding.

Note: Minimum 12 Experiments need to be conducted

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PE 328

INDUSTRY VISIT

At least 3 days in a semester	3 x 8 = 24 Hours
Sessionals	Grade*

A minimum of two industrial visits will be arranged by department and students have to attend the visits and prepare a data report of their visits to the industries and submit to the department. Students are required to present a seminar based on their report which is evaluated by Head of the Department and two senior faculty to award the grade.

* Excellent / Very Good / Satisfactory / Unsatisfactory

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PE 411

Production Drawing Practice

Instruction	1	Lecture + 3 Drawing Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Student will understand
1. The need and the importance of production drawing
2. How to make part drawing from given assembly drawings.
3. Indication of size, form and positional tolerances on the drawing sheets
4. Surface finish and heat treatment process on the drawing sheets.
5. Writing process sheets
6. Notations, symbols and abbreviations on production drawings

Outcomes: On completion of the course the students will develop abilities to
1. Draw part drawings from given assembly drawings of machine parts.
2. Indicate tolerance values on the parts drawn on sheet as per alpha numeric codes for given assembly drawings
3. Indicate form tolerances and position tolerances on the parts drawn on the sheet as per universally accepted norms for a given assembly drawing
4. Indicate values of surface finished and heat treatment process on the parts drawn for a given assembly drawings.
5. Write process sheet for every part that is drawn from given assembly drawings
6. Interpret a production drawing and process sheet.

UNIT-I

Introduction to Production Drawing: Types of Drawings and their uses, Format of drawing sheet, title block - Machine tools elements, methods of indicating notes on drawing

UNIT-II

Limits and Fits: Basic definition of terms, alpha numeric designation of limits/fits, calculation of limits and tolerances - Types of fits, interchangeability and selective assembly - Exercises involving selection/interpretation of fits and calculation of limits.

UNIT-III

Production Drawing: Conventional practices of indicating tolerances on size and geometrical form, Position - Surface finish, surface treatments

UNIT-IV

Part drawings: Part drawings from assembled drawings (10 No's - out of which student should draw a minimum of 8 drawings) – (Specification and indication of the above features on the drawings) - Stuffing box, Screw jack, I.C engine connecting rod, Revolving center, Square tool post, Single tool post, Steam engine cross head, Drill jig (plate type), Non return valve, Blow off cock

UNIT-V

Writing Process sheets, tolerances and surface finish for different components such as Bevel Gear, Flange & Pinion shaft.

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Text Books:

1. K.L. Narayana, P. Kannaiah and K. Venkat Reddy, *Production Drawing*, New Age Intl., (P) Ltd., Revised Edition, 1997.
2. P. Narasimha Reddy, T.A. Janardhan Reddy and C. Srinivasa Rao, *Production Drawing Practice*, Hitech Publishers, 2001

Suggested Reading:

1. R.L. Murthy, *Precision Engineering in Manufacturing*, New Age International Private Ltd., 1996
2. R.K. Jain, *Engineering Metrology*, Khanna Publishers, 8^{th} edition, 1985
3. IC Gupta, *Engineering Metrology*, Dhanpat Rai Pub., New Delhi, 1984.
4. Rega Rajendra, *Principles of Engineering Metrology*, Jaico Publishing House, Mumbai, 2008.
5. Doeblin, *Measurement Systems Application and Design*, TMH, 5 th Edn., 2004.

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ME 412

Metrology and Instrumentation

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Student will understand the need for measurement and fundamental concepts of measurement.
2. Student will get familiarize with limits, Fits& tolerances and the instruments used to measure these limits.
3. Student will able to have knowledge of various precision linear and angular measuring instruments.
4. Student will learn the importance of Geometric form and how to measure form errors.
5. Equip the student to have knowledge in the concepts of classification of instrument errors and their characteristics.
6. Student will enable to understand the working principles of various instruments used for the measurement of strain, forces, pressure, and temperature.

Outcomes: At the end of the course, students are able to

1. Learn and understand the need for measurement and fundamental concepts of measurement.
2. Demonstrate sound knowledge in gauges design and gauge selection for inspection.
3. Acquire the knowledge about fundamentals of linear and angular measurements and various instruments used for measuring the different parameters.
4. Demonstrate an ability to select and use the appropriate measuring instruments to measure surface roughness and other geometric form errors.
5. Recognize the concepts of errors, classification and instrument characteristics.
6. Apply the skills in measuring various quantities like strain, force, pressure & temperature.

UNIT-I

Limits, Fits and Tolerances: Types of fits, Selective assembly and interchangeability, Taylor's Principle for plain limit gauges, Use of Plug, Ring and Snap gauges, Introduction to Linear and Angular measurements, Slip gauges and End bars, Gauge material and manufacturing methods, Different types of Micrometers, Height gauges, Tomlinson gauges, Sine bar.

UNIT-II

Comparators: Dial indicator, Sigma Mechanical comparator, Back pressure type Pneumatic comparator. Optical projector and its Principle and Applications, Tool maker's Microscope and its Principle and applications, measurement of straightness and flatness, Auto collimator, Roundness measurement with bench centers and talyround, Coordinate Measuring Machine.

UNIT-III

Surface Roughness Measurements: Profilometer, Taylor Hobson Talysurf, Application of screw Thread metrology - 2 wire and 3 wire methods, Best wire size, Spur Gear nomenclature, Gear tooth thickness measurement by gear tooth vernier, Parkinson gear tester.
Introduction to Interferometry and its applications, The N.P.L. flatness Interferometer.

UNIT-IV

Elements of instrumentation system: Static and Dynamic characteristics of instruments, Types of errors, Strain measurement, Wire and foil type resistance strain gauges, Rosette Gauges, Bonding procedure, Strain Gauge Factor, Application of strain gauges, Strain gauge load cells, measurement of axial load and torsion by strain gauges, Piezo electric load cell.

UNIT-V

Introduction to Transducers: Displacement and acceleration measurement, L.V.D.T, Pressure measurement by Bourdon pressure gauge, Bulk modulus pressure gauge and Pirani gauge, Temperature measurement by thermo couples, Laws of thermo electricity, Types of materials used in thermocouples, Series and parallel circuits.

Text Books:

1. R.K. Jain, *Engineering Metrology*, Khanna Publications, 1996.
2. Doeblin, *Measurement Systems Application and Design*, TMH, 5th Edn., 2004.
3. Anand Bewoore & Vinay Kulkarni, *Metrology & Management*, McGrawhill Education India, 2014.
4. I B.C. Nakra & K.K. Chaudhary , *Instrumentation Measurement and Analysis* , 3rd Edn., McGrawhill, 2014

Suggested Reading:

1. IC Gupta., *Engineering Metrology*, Dhanpat Rai Pub. New Delhi, 1984.
2. Rega Rajendra, *Principles of Engineering Metrology*, Jaico Publishing House, Mumbai, 2008.

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ME 414

Operations Research
(for Mech, Prod and I.T)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Students will understand the significance of Operations Research concept and techniques
2. Students will come to know the formulation of LPP models
3. Students will understand the Algorithms of Graphical and Simplex Methods
4. Students will understand the Transportation and Assignment techniques
5. Students will come to know the procedure of Project Management along with CPM and PERT techniques
6. Students will understand the concepts of sequencing and queuing theory

Outcomes: At the end of the course, the students were able to

1. Recognize the importance and value of Operations Research and mathematical formulation in solving practical problems in industry;
2. Formulate a managerial decision problem into a mathematical model;
3. Apply Operations Research models to real time industry problems;
4. Build and solve Transportation Models and Assignment Models.
5. Apply project management techniques like CPM and PERT to plan and execute project successfully
6. Apply sequencing and queuing theory concepts in industry applications

UNIT-I

Introduction: Definition and Scope of Operations Research.

Linear Programming: Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method, Degeneracy in Simplex, Duality in Simplex.

UNIT-II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

UNIT-III

Assignment Techniques: Introduction, Hungarian technique of Assignment techniques, unbalanced problems, problems with restrictions, Maximization in Assignment problems, Travelling salesman problems

UNIT-IV

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, duration of the project, Free float, Independent float and Total float, Crashing of network.

UNIT-V

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two machines, processing 'n' jobs through three machines.

Queuing Theory: Introduction, Kendal's Notation, single channel - poisson arrivals - exponential service times

Text Books:

1. Hamdy, A. Taha, *Operations Research-An Introduction*, Sixth Edition, Prentice Hall of India Pvt. Ltd., 1997.
2. S.D. Sharma, *Operations Research*, Kedarnath, Ramnath & Co., Meerut,2009
3. V.K. Kapoor, *Operations Research*, S. Chand Publishers, New Delhi, 2004

Suggested Reading:

1. Harvey M. Wagner, *Principles of Operations Research*, Second Edition, Prentice Hall of India Ltd., 1980.
2. R. Paneer Selvam, *Operations Research*, Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008.
3. Nita H. Shah, Ravi M. Gor, Hardik Soni, *Operations Research*, PHI Learning Private Limited, 2013

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PE 412

Modern Machining and Forming Methods

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Student will learn

1. The importance of non-conventional machining processes
2. Various non-conventional machining processes and their process parameters
3. The relative merits, limitations and applications of various non-conventional machining processes
4. The knowledge regarding working media and its functions of non-conventional machining processes
5. The concepts of non-conventional forming processes such as rubber pad forming, hydro forming, stretch forming, etc.,
6. The concepts of HERF and to provide the description of HERF process

Outcomes: At the end of the course, the students are able to

1. Select the non-conventional machining process for a particular application
2. Demonstrate the capability of comparison of various non-conventional machining methods
3. Describe the various non-conventional machining processes
4. Exhibit the proficiency of selecting working media for various non-conventional machining processes
5. Exhibit the basic understanding of non-conventional forming processes
6. Compare various non-conventional forming processes based on their merits, limitations and applicability

UNIT-I

Mechanical Energy Methods:

Ultrasonic Machining (USM): Introduction, Process description, abrasive slurry, Abrasive materials and their characteristics, Functions of liquid medium in slurry, Types of transducers, effect of process parameters, applications and limitations

Abrasive Jet Machining (AJM): Principle of operation, process details, process variables and their effect on MRR and accuracy, equation for MRR, advantages, disadvantages and applications

Water Jet Machining (WJM): Schematic diagram, equipment used, advantages and applications

Abrasive Water Jet Machining (AWJM): Process, advantages, limitations and applications

UNIT-II

Thermal methods: Electro Discharge Machining (EDM): Process description with schematic diagram, process parameters, functions and characteristics of dielectric medium, dielectric fluids, over cut and side taper, flushing, mechanism of metal removal, crater volume, types of power supply circuits, mathematical analysis of metal removal rate (MRR), equations for surface finish, characteristics of spark eroded surfaces, advantages, disadvantages and applications

Wire EDM: Process description and applications

LASER Beam Machining (LBM): Principle of LASER beam production, materials used, process parameters, advantages, limitations and applications,

Plasma Arc Machining (PAM): Introduction, equipment used, process description and parameters, types of plasma arc: transferred arc and non transferred arc and process applications, **Electron Beam Machining (EBM):** Schematic of the process, process parameters, principle of production of electron beam, equipment used, advantages, disadvantages and applications,

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UNIT-III

Electro chemical, Chemical and other machining processes: Electro-chemical machining (ECM): Schematic of process parameters, function and characteristics of electrolyte, chemistry of the process, MRR for pure metal and alloys, electrode feed rate (EFR), advantages, limitations and applications

Chemical Machining: Chemical blanking and chemical milling, advantages, limitations and applications

ION Etching: Process description, merits, limitations and applications, hot machining, high speed machining, process parameters, advantages and applications

UNIT-IV

High Energy Rate Forming Processes (HERF): Introduction, applications, advantages, **Explosive Forming:** Principles, explosive materials, Equipment, types of explosive forming, standoff operation and contact operation, the pressure pulse, gas bubble and the process applications

Electro-Hydraulic Forming (EHF): Schematic of process, description and its applications, **Electro-Magnetic Forming (EMF):** Process description, merits, limitations and applications

UNIT-V

Other Forming Processes:

Rubber Pad Forming: Principle of the process, process details and its types, Guerin, wheelon, Mar forming and Hydro forming processes and applications,

Stretch Forming: Introduction, types of stretch forming, stretch draw forming, rotary stretch forming or stretch wrapping, compression forming, radial draw forming.

Tube spinning: introduction, methods of tube spinning, backward spinning, forward spinning, machines and tools used, machine variables, speeds and feeds, effect of tube spinning on work metal properties and applications.

Text Books:

1. P.C. Pandey and H.S. Shah, *Modern Machining Process* Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1980
2. J Paulo Davim, *Modern Machining Technology, A Practical Guide*, 1st Edition, Woodhead Publishing in Mechanical Engineering

Suggested Reading:

1. Hassan Abdel-Gawad El-Hofy, *Advanced Machining Processes, Nontraditional and Hybrid Machining Processes*, McGraw Hill Publishing Co. Ltd.,
2. Davies and Austin, *Developments in High Speed Metal Forming*, The Machinery Publishing Co. Ltd., 1985
3. *Production Technology*, HMT
4. A. Bhattacharya, *New Technology*, The Institution of Engineers (India), 1984

With Effect from the Academic Year 2016 - 2017

PE 461

Robotics (Elective – II)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Students will understand
1. The configuration, work envelop and motion controls and applications
2. Familiarities with the kinematics of robots.
3. Robot end effectors and their design.
4. Familiarities with the dynamics of robots.
5. Robot Programming methods & Languages of robot.
6. Various Sensors and drives and their applications in robots

Outcomes: At the end of the course, the students will be
1. Equipped with robot anatomy, work volume and robot applications
2. Familiarized with the kinematic motions of robot
3. Having good knowledge about robot end effectors and their design concepts
4. Familiarized with the robot dynamics
5. Equipped with the Programming methods & drives used in robots
6. Equipped with the principles of various Sensors and their applications in robots.

Unit I
Robots: History and evolution of robots, Laws of Robotics, basic configuration, degree of freedom, work envelope, motion control methods, Application in industry, material handling, loading & unloading, processing, welding & painting applications, assembly and inspection, Robot specification requirements

Unit II
Rotation matrix: Homogenous transformation matrix, Denavit-Hartenberg convention, Euler angles, RPY reprensation, Direct and inverse kinematics for industrial robots for position and orientation, Redundancy

Unit III
Manipulator Jacobian: Joint, End effector velocity, direct and inverse velocity nalysis, Trajectory Planning, interpolation, cubic polynomial, linear segments with with parabolic blending, static force and moment transformation, solvability, stiffness, singularities

Unit IV
Robot dynamics: Lagrangian formulation, link inertia tensor and manipulator inertia tensor, Newton-Euler formulation for RR & RP manipulators, Control: Individual joint, computed torque

Unit V
End effectors: position and velocity measurement, Sensors: Proximity and range, tactile, force and torque, Drives for Robots: Electrical, Hydraulic and Pneumatic, Robot vision: Introduction to technique, image acquisition and processing, introduction to robot programming languages

Text Books:

1. Spong and Vidyasagar, *Robot Dynamics and Control*, John Wile and Sons, 1990
2. R.K. Mittal, I.J. Nagrath, *Robotics and control*, Tata Mcgraw-Hill Publishing Company Ltd. 2003
3. Groover, *Industrial Robotics*, Mcgraw-Hill Publishing Company Ltd. 2003

Suggested Reading:

1. Asada and Siotine, *Robot analysis and Intelligence*, Wiley Interscience, 1986
2. K.S. Fu Gon ZalezRC., IEEc.S.G., *Robotics, Control Sensing Vision and Intelligence*, McGraw Hill, Int. Ed., 1987
3. Richard S. Paul, *Robot Manipulators: Mathematics, Programming, and Control*, MIT Press (MA)

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With Effect from the Academic Year 2016 - 2017

ME 461

Renewable Energy Sources (Elective – II)

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Student will learn the

1. Need and importance of non-conventional energy resources
2. Extent of solar energy which can be utilized as energy resource
3. Concept of wind energy and its merits and demerits
4. Operating principles of ocean and geothermal energy
5. Advantages and disadvantages of bio-energy over conventional energy
6. Merits and demerits of tidal energy, wave energy and OTEC

Outcomes: At the end of the course, the students are able to

1. Understand the depletion and of environmental impact conventional sources of energy and will suggest suitable and alternative renewable energies in place of fossil energies
2. Know the absorption, conversion and utilization of solar energy
3. Understand the problems associated with utilizing the wind energy
4. Describe the physics of geothermal resources and describe how biomass is currently used as a source of energy
5. Explain the physical principles of wave energy, the generation of tides and how to harness their power
6. Understand the environmental impact of OTEC plants

Unit-I

Statistics on conventional energy sources and supply in developing countries, Definition-Concepts of RES, Limitations of RES, Classification of NCES-Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources, comparison of these energy sources.

Unit-II

Solar Energy- Solar Radiation – Energy available from Sun, Solar Thermal Collectors – Flat Plate and Concentrating Collectors –Solar Applications, Solar engines-Stirling, Brayton engines, fundamentals of photo Voltaic Conversion – p-n junction – PV solar cells and its materials-solar satellite system

Unit-III

Wind energy- merits and demerits-Wind power plant-site selection-classification of wind power plants-Windmill rotors- Horizontal axis and vertical axis rotors-.working principle-New developments.

Unit-IV

Geothermal energy- Layers in earth-Definition and classification of resources.

Biomass energy-Biomass- Source, Composition, Conversion technologies – Direct combustion-Pyrolysis–Gasification, Biomass gasifier –float and fixed dome types

Unit V

Wave, Tidal and OTEC energy- Difference between tidal and wave power generation-single basin and double basin tidal plants-progressive wave.

OTEC power plants- Open and closed OTEC Cycles- Environmental impacts of OTEC.

Text Books:

1. S. Hasan Saeed and D.K. Sharma, *Non Conventional Energy Resources*, S.K. Kataria & Sons, New Delhi, 2014
2. Dr. R.K. Singal, *Non Conventional Energy Resources*, S.K. Kataria & Sons, New Delhi, 2005
3. G.D. Rai, *Non Conventional Energy Sources*, Khanna Publishers, New Delhi, 2011

Suggested Reading:

1. Mittal K M, *Non-Conventional Energy Systems*,Wheeler Publishing Co. Ltd, New Delhi, 2003.
2. Ramesh R & Kumar K U, *Renewable Energy Technologies*, Narosa Publishing House, New Delhi, 2004
3. Shali Habibulla, *Non-Conventional Energy Sources*, State Institute of Vocational Education, Hyderabad, 2005
4. Ashok V Desai, *Non-Conventional Energy*, Wiley Eastern Ltd, New Delhi, 2003
5. R.K. Hegde, *Power Plant Engineering*, Pearson Education India, 2015

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With Effect from the Academic Year 2016 - 2017

ME 462

Computational Fluid Dynamics (Elective – II)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Understanding of governing equations of fluid flow.
2. Student understand finite difference and finite volume methods to solve fluid flow equations.
3. Issues that arise in the solution of such equations.
4. Various methods to overcome those issues and modern trends in CFD.
5. Get exposure to grid generation.
6. Various boundary conditions and their implementation.

Outcomes: At the end of the course, the students were able to

1. Classify basic equations of fluid flow
2. Choose appropriate boundary conditions
3. Choose proper numerical technique to solve equations.
4. Critically analyze different mathematical models and computational methods for flow simulations
5. Interpret computational results.
6. Acquire the required knowledge to take advanced courses in CFD.

UNIT-I

Basic Equations: Continuity, momentum and energy equations, navier-stokes equations, Heat transfer conduction equations for steady and unsteady flows, steady convection-diffusion equation.

UNIT-II

Models: Reynolds and Favre averaged N-S equations, Mixing length model, k-epsilon turbulence model

Classifications of partial differential equations: Elliptic, parabolic and hyperbolic equations, Initial and boundary value problems

UNIT-III

Finite Difference Method: Forward, backward and central difference

Parabolic partial differential equations: Euler, implicit and crank Nicholson methods, ADI models, Errors, consistency, stability analysis, Vonnumen analysis, Convergence criteria.

UNIT-IV

Elliptic partial differential equations - Jacobi, Gauss seidel methods, Viscous incompressible flow, Stream-function-vorticity method

Introduction to grid generation- types of grids O, H, C

UNIT – V

Finite Volume Method: Finite volume formulation for diffusion equation, convection diffusion equation, Solution algorithm for pressure velocity coupling in steady flows, staggered grid, SIMPLE algorithm.

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Text Books:

1. J.D. Anderson, Jr., *Computational Fluid Dynamics: The Basic with Applications* McGraw Hill, Inc., 2012
2. H. Versteeg and W. Malalasekra, *An Introduction to Computational Fluid Dynamics*: The Finite Volume Method, Pearson,2nd edn. 2011

Suggested Reading:

1. John F. Wendt (Editor), *Computational Fluid Dynamics - An Introduction*, Springer – Verlag, Berlin, 1992
2. Charles Hirsch, *Numerical Computation of Internal and External Flows*, Vols. I and II. John Wiley & Sons, New York, 1988.
3. K. Muralidhar and T. Sundarajan.. *Computational Fluid Flow and Heat Transfer*, Narosa Publishing House. 2008
4. C.J.Date , *Introduction to CFD*, Dorling Kindersley Pvt Ltd, 2007

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With Effect from the Academic Year 2016 - 2017

ME 463

Automobile Engineering (Elective – II)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: The student will learn
1. The anatomy of the automobile in general
2. The location and importance of each part
3. The functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels
4. Suspension, frame, springs and other connections
5. ignition, controls, electrical systems and ventilation
6. Emissions, pollution regulations, EURO and BHARATH stages

Outcomes: At the end of the course, the student will be able to
1. Identify the different parts of the automobile
2. Explain the working of various parts like engine, transmission, clutch, brakes
3. Describe how the steering and the suspension systems operate.
4. Understand the environmental implications of automobile emissions
5. Develop a strong base for understanding future developments in the automobile industry

Unit I

Types of automobiles: Normal, Hybrid and Hydrogen Fuel vehicles. Engine location and its components, chassis layout; crank shaft proportion, firing order, piston and piston rings, cylinder liners, valves and operation mechanism, inlet and exhaust manifolds, carburetion and fuel injection system, Mechanical Fuel Injection system & Electronic Fuel Injection System.

Unit II

Lubricating Systems: Wet sump, dry sump and petroil systems - Cooling systems: Water pumps, radiators, thermostat control anti freezing compounds - Types of Ignition Systems, Modern Ignition systems, Types of Batteries and charging systems, starting motors, lighting and electrical accessories, automobile air-conditioning.

Unit III

Steering systems: Linkage arrangements and its components modified Ackerman linkage, wheel alignment, caster and camber. Rack and pinion assembly, recent trends, Wheel and tyres: Tyre construction, specification. Tyre wear and causes, wheel balancing, Types q/' Suspension system, Independent suspension, coil and leaf springs, torsion bar, shock absorbers.

Unit IV

Power Train: Clutches, gear and gearbox manual, semi-automatic and automatic gearboxes. Torque converter, propeller shaft, universal coupling differential, four-wheel drive system

Brakes Systems: Description and operation of hydraulic brake, leading and trailing shoe layout, disc brakes, master cylinder and hand brake linkage, Recent Trends.

Unit V

Maintenance: Pollution control, trouble shooting and servicing procedure overhauling, engine tune up, tools and equipment for repair and overhaul testing equipment, pollution control technologies used for petrol and diesel engines. Types and study of catalytic converters, Euro norms 2 & 3 and Bharat Norms – Recent Trends.

Text Books:

1. *Crouse & Anglin, Automotive Mechanics*, TataMcGraw Hill. Publishing Co. Ltd., New Delhi, Tenth Edition – 2004
2. Kirpal singh., *Automobile Engineering Vol. I & II* Standard Publishers, Delhi.

Suggested Reading:

1. Joseph Heitner, *Automotive Mechanics*, Affiliated East West Pvt. Ltd.
2. C.P Nakra, *Basic Automobile Engineering*, Dhanpat Rai Publishing Co(P) Ltd., New Delhi, 2003.
3. G.B.S. Narang, *Automobile Engineering*, Khanna Publishers, New Delhi, 2014
4. R.K. Rajput, *A Textbook of Automobile Engineering*, Laxmi Publications, New Delhi, 2012

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ME 464

Entrepreneurship (Elective – II)
(for Mech, Prod, Civil, EEE, ECE, I.T, Chemical, BioTech and CSE)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. The essence of Entrepreneurship
2. The environment of industry and related opportunities and challenges
3. Concept a procedure of idea generation
4. Elements of business plan and its procedure
5. Project management and its techniques
6. Behavioral issues and Time management

Outcomes: After completing this course, students will be able to:

1. Apply the entrepreneurial process
2. Analyze the feasibility of a new business plan and preparation of Business plan
3. Evaluate entrepreneurial tendency and attitude
4. Brainstorm ideas for new and innovative products or services
5. Use project management techniques like PERT and CPM
6. Analyze behavioural aspects and use time management matrix

UNIT-I

Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries, Types of enterprises, Corporate Social Responsibility.

UNIT-II

Identification and characteristics of entrepreneurs: First generation entrepreneurs, environmental influence and women entrepreneurs, Conception and evaluation of ideas and their sources, Selection of Technology, Collaborative interaction for Technology development.

UNIT-III

Business plan: Introduction, Elements of Business Plan and its salient features, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary.

UNIT-IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden

UNIT-V

Behavioral aspects of entrepreneurs: Personality, determinants, attributes and models, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, *Dynamics of Entrepreneurial Development and Management*, Himalaya Publishing House, 1997.
2. Prasanna Chandra, *Project-Planning, Analysis, Selection, Implementation and Review*, Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, *Entrepreneurial Development*, S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, *Entrepreneurship*, Tata Me Graw Hill Publishing Company Ltd., 5lh Ed., 2005
2. Stephen R. Covey and A. Roger Merrill, *First Things First*, Simon and Schuster Publication, 1994.
3. Sudha G.S., *Organizational Behavior*, National Publishing House, 1996.

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With Effect from the Academic Year 2016 - 2017

CE 461

Disaster Mitigation and Management (Elective – II)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: Students will understand

1. The basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts.
2. The nature, mechanism causes, consequences and mitigation measures of the various natural disasters including hydro metrological and geological based disasters.
3. Risks, vulnerabilities and human errors associated with human induced disasters including chemical, biological and nuclear warfare agents.
4. The knowledge of various chronological phases in the disaster management cycle.
5. The disaster management framework and legislations in the context of national and global conventions.
6. The applications of geospatial technologies like remote sensing and geographical information systems in disaster management.

Course Outcomes:

1. Ability to analyse and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at local level
2. Ability to choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan.
3. Ability to understand various mechanisms and consequences of natural and human induced disasters for the participatory role of engineers in disaster management.
4. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans
5. Ability to understand various participatory approaches/strategies and their application in disaster management
6. Ability to understand the concepts of remote sensing and geographical information systems for their effective application in disaster management.

UNIT-I:

Introduction to Natural, human induced and human made disasters – Meaning, nature, types and effects; International decade of natural disaster reduction (IDNDR); International strategy of natural disaster reduction (ISDR)

UNIT-II:

Natural Disasters– Hydro meteorological disasters: Causes, impacts, Early warning systems, structural and non-structural measures for floods, drought and cyclones; Tropical cyclones: Overview, cyclogenesis, drought monitoring and management.; Geographical based disasters: Earthquakes and Tsunami- Overview, causes, impacts, zoning, structural and non-structural mitigation measures; Tsunami generation; Landslides and avalanches: Overview, causes, impacts, zoning and mitigation measures. Case studies related to various hydro meteorological and geographical based disasters.

UNIT III:

Human induced hazards: Risks and control measures in a chemical industry, Causes, impacts and mitigation measures for chemical accidents, chemical disaster management, current status and perspectives; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents and traffic accidents .

UNIT IV:

Use of remote sensing and GIS in disaster mitigation and management; Scope of application of ICST (Information, communication and space technologies in disaster management, Critical applications& Infrastructure; Potential application of Remote sensing and GIS in disaster management and in various disastrous conditions like earthquakes, drought, Floods, landslides etc.

UNIT V:

Concept of Disaster Management: Introduction to disaster management, Relationship between Risk, vulnerability and a disaster, Disaster management cycle, Principles of disaster mitigation: Hazard identification and vulnerability analysis, Early warning systems and forecasting; Infrastructure and development in disaster management; Disaster management in India: National disaster management framework at central, state, district and local levels. Community based disaster management.

Text Books :

1. Rajib, S and Krishna Murthy, R.R, *Disaster Management Global Challenges and Local Solutions,* Universities Press Hyderabad, 2012
2. *Notes / Reading material published by National Disaster Management Institute*, Ministry of Home Affairs, Govt. of India.

Suggested Reading:

1. Navele, P & Raja, C.K., *Earth and Atmospheric Disasters Management, Natural and Manmade.* B.S. Publications, Hyderabad, 2009
2. Fearn-Banks, K, *Crises computations approach: A case book approach*. Route ledge Publishers, Special Indian Education, New York & London, 2011
3. Battacharya, T., *Disaster Science and Management*. Tata McGraw Hill Company, New Delhi., 2012

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PE 413

Computer Aided Production Drawing Lab

Instruction	3	Periods per week
Duration of End Examination	3	Hours
End examination	50	Marks
Sessionals	25	Marks
Credits	2	

Objectives: Students will learn

1. Construct production drawings to meet final design requirements.
2. Creation drawings for visualization using Modeling Packages Solid works, CATIA
3. The Fits, limits and Tolerances of parts
4. The Conventions like surface finish, roughness, concentricity
5. Preparation of Bill of materials for assembly
6. The process sheet in industrial terminology

Outcomes: At the end of the course, students will be able to

1. Read the working drawing of various components
2. Identify the different parts of the object with dimensional tolerances
3. Create the various part drawings using solid modeling package
4. Use the various functions of modeling soft ware: annotations, sheet making
5. Define the bill of materials with mass properties
6. Understand and read the industrial blueprint readings

Part Drawings:

Prepare the Part Drawings with production drawing details of the following assemblies using modeling softwares, like, solid works/solid edge/CATIA/ProE/Auto CAD-MDT/ Nx

Exercise No: 1	Stuffing box
Exercise No: 2	Screw jack
Exercise No: 3	I.C engine connecting rod
Exercise No: 4	Revolving center
Exercise No: 5	Square tool post
Exercise No: 6	Single tool post
Exercise No: 7	Universal coupling
Exercise No: 8	Flange coupling
Exercise No: 9	Steam Engine Cross Head
Exercise No: 10	Drill Jig (Plate Type)
Exercise No: 11	Non Return Valve
Exercise No: 12	Blow off Cock

Note: Student should prepare a minimum of 10 production drawings

Suggested Reading:

1. K.L. Narayana, P. Kannaiah and K. Venkat Reddy, *Production Drawing*, New Age Intl., (P) Ltd., Revised Edition, 1997.
2. P. Narasimha Reddy, T.A. Janardhan Reddy and C. Srinivasa Rao, *Production Drawing Practice*, Hitech Publishers, 2001

With Effect from the Academic Year 2016 - 2017

ME 416

Metrology and Instrumentation Lab

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives:

1. Student will choose the proper measuring instrument for the precise measurement of Length, Height and diameter
2. Student will able to select the proper measuring instrument for the angular measurement.
3. Student will indentify gear & screw thread parameters using optical projector and tool makers microscope.
4. Student will get familiarize with limits & fits, gauge selection and design.
5. Student will enable to understand the working principles in the measurement of Flatness, Roundness and Surface roughness.
6. Student will equip with various aspects regarding displacement.

Outcomes: At the end of the course, the students were able to

1. Identify methods and devices for measurement of length, height and diameter.
2. Acquire the knowledge about angular measurement and various measuring instruments.
3. Recognize & measure the gear and screw thread parameters using profile projector and tool maker microscope.
4. Demonstrate the sound knowledge in gauges selection and design.
5. Acquire adequate knowledge in the measurement of flatness, roundness and surface roughness.
6. Demonstrate the measurement of displacement.

Experiments:

1. Measurement with inside, outside and depth micrometers.
2. Measurement with height gauges, height masters, etc.
3. Measurement of Linear and Angular dimensions with Tool Maker's Microscope – Diameter of a thin wire and single point cutting tool angle.
4. Measurement with Dial Indicator and its calibration.
5. Measurement of angles with Sine bar and Bevel protractor.
6. Measurement of roundness errors with bench centers.
7. Measurement of flatness errors (surface plate) with precision level.
8. Measurement with optical projector.
9. Checking machined components with plug gauges and adjustable snap gauges.
10. Surface roughness measurement by Taylor Hobson -Talysurf.
11. Measurement of Gear tooth thickness.
12. Displacement measurement with LVDT.

Note: Student should complete a minimum of 10 experiments.

Suggested Reading:

1. IC Gupta, *Engineering Metrology*, Dhanpat Rai Pub., New Delhi, 1984.
2. B.C. Nakra & K.K. Chaudhary , *Instrumentation Measurement and Analysis*, , 3rd Edn. McGrawhill, 2014

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PE 414

Manufacturing Engineering Lab

Instruction	3 Periods per week
Duration of End Examination	3 Hours
End examination	50 Marks
Sessionals	25 Marks
Credits	2

Objectives: Students will learn

1 Various concepts of Manufacturing Processes
2 The process of choosing right manufacturing process and materials
3 The concepts of process sheets
4 Various CAD packages
5 The Bill of Materials and MRP concepts
6 Limits, tolerances and fits in manufacturing

Outcomes: Students able to

1 Apply right manufacturing techniques
2 Choose the right material
3 Operate different machine tools
4 Prepare process sheets and Bill of Material
5 Apply limits, fits and tolerances while manufacturing components
6 Prepare CAD drawings

Part-1: **Manufacturing Mini Product**: Study of all manufacturing facilities available in various manufacturing related laboratories, manufacturing canon.

Part-2: **Manufacturing Major Product:** One/two of the following items have to be manufactured by a group of maximum two members using all the production facilities and processes as far possible and assembly techniques with fits and tolerances using CAD system, various exercises have to be allotted to different groups of students by the lab faculty

1. V block with U clamp
2. Dia test indicator stand
3. Simple Jig
4. Simple fixture
5. Simple die set
6. Simple tail stock mechanism
7. Lathe tool post
8. Milling Machine Arbor
9. Pipe vice
10. Paper Punch (double punch)
11. Hydraulic Cylinder
12. Gear box (Spur, Helical or Worm)

Suggested Reading:

1. P.N. Rao, *Manufacturing Technology – Metal Culling & Machine Tool*, Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
2. Jain K.C Chitale, A.K., *Production Engineering*, 2nd Edn., PHI, 2014.

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PE 415

Project Seminar

Instruction	3 Periods per week
Sessionals	25 Marks
Credits	1

The objective of the project seminar is to actively involve the student in the initial work required to undertake the final year project. Dealing with a real time problem should be the focus of the under graduate project.

It may comprise of

- Problem definition and specifications.
- A broad understanding of the available techniques to solve a problem of interest.
- Presentation (Oral & written) of the project.

The department should appoint a project coordinator who will coordinate the following.

- Grouping of students as project batch(a maximum of 3 in group)
- Allotment of projects and project guides
- Project monitoring at regular intervals.

Each project group/batch is required to

1. Submit a one page synopsis of the seminar to be delivered for display on notice board.
2. Give a 30-40 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write up on the talk delivered.

Three (3) teachers will be associated with the evaluation of the project seminar for the award of the sessional marks which should be on the basis of performance on all the three items stated above.

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With Effect from the Academic Year 2016 - 2017

ME 421

Production and Operations Management

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. Understand plant layout design to facilitate material flow and processing of a product in the most efficient manner
2. Understand work study methods to improve the performance of workers
3. Gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management and strategy.
4. Understand how Materials Requirement Planning and MRPII systems are used in managing operations
5. Recognize the importance of Inventory control to ensure their availability with minimum capital lock up.
6. Evaluate the quality processes in manufacturing and service sector to improve the operational performance

Outcomes: At the end of the course, the student will be able to

1. Identify and evaluate the processes, tools and principles of production and operations management to better understand the logistics and supply chain operations
2. Demonstrate the ability to apply mathematical forecasting techniques
3. Identify future challenges and directions that relate to production and operations management to effectively and efficiently respond to market changes
4. Apply the tasks, tools and underlying principles of operations management in the manufacturing an d service sectors to improve organizational performance
5. Explain and evaluate the quality process in manufacturing and service sector to improve the operational performance

UNIT-I

Production & Operations Management: Introduction: Types of Production Systems, job shop, batch, flow shop

Plant location and layout: Factors affecting plant location, plant layout objectives, types of layouts, merits and demerits.

Work Study: Introduction to method study and work measurement, standard time calculations, methods of rating, work sampling, wages and incentives, types of incentive plans.

UNIT-II

Forecasting: Introduction, forecasting objectives and uses, demand patterns, qualitative models, market survey, Delphi, quantitative models, moving average, weighted moving average, simple exponential smoothing, trend adjusted exponential smoothing, least square method, simple regression, multiple regression.

Forecast Errors: Mean Absolute Deviation (MAD), Mean Square Error (MSE), Mean Forecast Error (MFE), Mean Absolute Percentage Error (MAPE)

UNIT-III

Aggregate planning and master scheduling: Introduction, objectives of aggregate planning, cost in aggregate planning, strategies in aggregate planning, master production scheduling

Materials Requirement Planning (MRP): Importance of MRP, MRP system inputs and outputs, MRP calculations, bill of materials.

UNIT-IV

Inventory Control: Importance of inventory control, types of inventory models, inventory costs deterministic inventory models, basic EOQ model, production model without shortages, purchase model with instantaneous replenishment and with shortages, production model with shortages, inventory model with price breaks, fixed order quality system, periodic review system and inventory model with probabilistic demand.

UNIT-V

Quality Control: Introduction, history and early contributions by quality gurus, quality tools, process capability, quality control by control charts, control charts for variables and attributes, sampling plans, operating characteristic curves, introduction to total quality management

Text Books:

1. Stevenson, *Production operation Management*, Mc-Graw Hill International
2. Joseph Monks, *Operations Management*, TMH Publishers, New Delhi, 2004.
3. Buffa Elwood S, *Modern Production /Operations Management* , John Wiley Publishers, Singapore, 2002

Suggested Reading:

1. Everrete E. Adama & Ronald J. Ebert, *Production & Operations Management*, Prentice Hall of India, 5th Edition, 2005
2. Panneer Selvam R, *Production and Operations Management*, Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2006.
3. S.D. Sharma, *Operations Research*, Kedarnath, Ramnath & Co., Meerut,2009
4. S.N. Chary, *Production and Operations Management*, Tata McGraw Hill, 3rd Edition, 2006.

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PE 421

Tool Engineering

Instruction	4	Periods per week
Duration of End Examination	3	Hours
End examination	75	Marks
Sessionals	25	Marks
Credits	3	

Objectives: Students will understand

1. The fundamentals of Tool Design that apply to different areas of manufacturing.
2. How to design simple tools independently as required by the industry
3. Various tool materials available including new materials like plastics
4. Significant technological advancement in this field
5. The fundamental concepts of Jigs and fixtures along with design principles
6. Common tools used in manufacturing practices

Outcomes: At the end of the course, the students will be able to

1. Understand the definition of tool design, its importance and application in various fields.
2. Suggest appropriate tool geometry, tool material, locating and clamping methods and manufacturing process for various tools.
3. Design simple tools independently
4. Design jigs and fixtures based on requirements.
5. Understand importance of plastics as tooling material
6. Design the tools for various operations like blanking, piercing, drawing, broaching, milling etc.

Unit-I

Introduction to Tool Engineering: Role and importance of tool engineering in industries, tool engineering functions, duties of a tool engineer.

Tools : Types, classification, features and applications, Properties of Cutting tool materials, types of cutting tool material -- Major constituents , relative characteristics and their applications, ISO classification and coding of carbide tools, coated tools, modern cutting tool materials and their applications, cutting tools for machining composites. Introduction to plastics, their properties and commonly used plastics as tooling materials and their applications.

Unit-II

Design of tools: Design of single point cutting tools, Design of flat and circular form tools, Design elements of a milling cutter, types of milling cutters, forces and power estimation, grinding of milling cutters, Design of milling cutters.

Introduction to broaching operation: Types of broaches - pull, push broach, geometry of broach, and design of broaching tool and manufacturing of broaches.

Unit-III

Twist drill geometry: Design and manufacturing of twist drill, effect of variation of angles on torque and thrust forces and sharpening of twist drills.

Reamers: Types of reamers, geometry of a reamer, reaming allowance, tolerance disposition, design and manufacture of reamers

Taps and Dies: Types, geometry, calculation of tapping drill diameters, design and manufacturing of taps and dies.

Unit-IV

Introduction to press tools and various sheet metal forming operations: Design of die set for blanking and piercing operations, design of bending dies, design of die set for deep drawing operation, design of die set for forging operation, design of dies for metal spinning operation.

Unit-V

Jigs & Fixtures: Design principles and construction features, locating methods associated with flat, cylindrical, internal and external surfaces, type of locating pins, requirements and choice of locating systems, redundant location, fool proofing, setting blocks, types of clamping devices and their basic elements, quick action clamps and nuts, equalizing and multiple clamping pneumatics, hydraulic, magnetic, electrical and vacuum clamping, types of drill jigs and their classification, drilling bushings, indexing jigs, design of fixtures for turning, grinding, welding and milling, economic analysis of jigs and fixtures.

Text Books:

1. Cyril Donaldson, George H LeCain, V C Goold and Joyjeet Ghose, *Tool Design*, 4th edition, Tata Mc Graw Hill Education Private Limited, New Delhi, 2012
2. David Spitler, Jeff Lantrip, John Nee and David A Smith, *Fundamentals of Tool Design*, 5th edition, Society of Manufacturing Engineers, 2003

Suggested Reading:

1. P.C Sharma, *A Textbook of Machine Tools and Tool Design*, S.Chand (G/L) & Company Ltd, 2005
2. AmitabhaBattacharya and Inyong Ham, *Design of Cutting Tools Use of Metal Cutting Theory*, ASTME Pub., Michigan, USA
3. Surender Keshav & Umesh Chandra, *Production Engineering Design (Tool Design)*, Satya Prakashan, New Delhi-1994.
4. P.C Sharma, *Production Engineering*, New Age India Pub.,

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ME 471

Power Plant Engineering (Elective – III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will learn

1. Different types of power plants and their site selection criteria
2. Operation of thermal power plant
3. About hydraulic power plant, dams and spillways
4. Different types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
5. The power plant economics
6. The environmental and safety aspects of power plant operation.

Outcomes: At the end of the course, the student will be able to

1. Select the suitability of site for a power plant.
2. Propose ash handling, coal handling method in a thermal power plant
3. Understand the flow-sheet of hydro-power plant
4. Explain working principle of different types of nuclear power plant.
5. Know the various factors of plant load and economy
6. Indicate safety aspects of power plants

Unit - I

Introduction: Power plant, classification of power plants, conventional and non-conventional power plants

Steam power plant: Plant Layout, types of coals, coal handling equipment, Ash handling systems

UNIT II

Steam power plant: Combustion Process - Overfeed and Underfeed stokers-traveling grate stokers, spreader stokers, retort stokers- Pulverized fuel burning system-cyclone furnace-Fluidized bed combustion (FBC).

UNIT III

Hydro electric power plant: Hydrological cycle, flow measurement, Hydrographs - drainage area characteristics, Types of hydroelectric power plants- storage and pondage - classification of dams and spill ways.

UNIT - IV

Nuclear power plant: Nuclear fuel - breeding and fertile materials - types of reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Gas cooled Reactor-Radioactive waste disposal.

UNIT - V

Power plant economics and environmental considerations:

Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor - related exercises-Fixed cost and variable cost-methods to find depreciation cost, Effluents from power plants and Impact on environment – pollutants - Pollution control.

Text Books:

1. R.K. Rajput, *A Text Book of Power Plant Engineering* 4th edition, Laxmi Publications (P) Ltd., New Delhi, 2015
2. P.K. Nag, *Power Plant Engineering* 4th edition, McGraHill Education(India) Private Limited, New Delhi, 2014
3. S.C. Arora and S. Domukundwar, *A Course in Power Plant Engineering*, Dhanpat Rai & Sons, New Delhi, 2005

Suggested Reading:

1. R. Yadav, *Fundamentals of Power Plant Engineering*, Central Publishing House, Allahabad, 2012
2. R.K. Hegde, *Power Plant Engineering*, Pearson Education India, 2015
3. P.C. Sharma, *A Text Book of Power Plant Engineering*, S.K. Kataria & sons, New Delhi, 2016

ME 472

Intellectual Property Rights (Elective – III)

(for Mech, Prod, Civil, ECE, EEE, CSE, IT)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will learn

1. Fundamental aspects of IP
2. Aspects of IPR acts.
3. Awareness of multi disciplinary audience
4. Awareness for innovation and its importance
5. The changes in IPR culture
6. About techno-business aspects of IPR

Outcomes: At the end of the course, a student

1. Will respect intellectual property of others
2. Learn the art of understanding IPR
3. Develop the capability of searching the stage of innovations.
4. Capable of filing a patent document independently.
5. Completely understand the techno-legal business angle of IP. .
6. Capable of converting creativity into IP and effectively protect it.

UNIT-I

Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR), IPR in India – Genesis and Development, IPR abroad, Some important examples of IPR. Importance of WTO, TRIPS agreement, International Conventions and PCT

Patents: Macro economic impact of the patent system, Patent and kind of inventions protected by a patent, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Why protect inventions by patents. Searching a patent, Drafting of a patent, Filing of a patent, the different layers of the international patent system, (national, regional and international options), compulsory licensing and licensers of right & revocation, Utility models, Differences between a utility model and a patent. Trade secrets and know-how agreements

UNIT-II

Industrial Designs: What is an industrial design. How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?

UNIT-III

Trademarks: What is a trademark, Rights of trademark? What kind of signs can be used as trademarks. Types of trademark, function does a trademark perform, How is a trademark protected? How is a trademark registered. How long is a registered trademark protected for? How extensive is trademark protection. What are well-known marks and how are they protected? Domain name and how does it relate to trademarks? Trademark infringement and passing off.

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UNIT-IV

Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights covered by copyright? Copy rights in computer programming.

UNIT-V

Enforcement of Intellectual Property Rights: Infringement of intellectual property rights Enforcement Measures Emerging issues in Intellectual property protection. Case studies of patents and IP Protection.

Unfair Competition: What is unfair competition. Relationship between unfair competition and intellectual property laws.

Text Books:

1. Ajit Parulekar and Sarita D' Souza, *Indian Patents Law – Legal & Business Implications*; Macmillan India ltd , 2006
2. B. L.Wadehra; *Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications*; Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan; *Law of Copyright and Industrial Designs*; Eastern law House, Delhi 2010

Suggested Reading:

1. Cronish W.R1 *Intellectual Property; Patents, copyright, Trad and Allied rights*, Sweet & Maxwell, 1993.
2. P. Narayanan, *Intellectual Property Law*, Eastern Law Edn., 1997.
3. Robin Jacob and Daniel Alexander, *A Guide Book to Intellectual Property Patents, Trademarks, Copy rights and designs*, Sweet, Maxwell 4th Edition.

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ME 473

Mechatronics (ELECTIVE - III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. How to identify, formulate, and solve engineering problems
2. The design a system, component, or process to meet desired needs within realistic constraints
3. The how to use the techniques, skills, and modern engineering tools necessary for engineering practice
4. The use of drive mechanisms and fluid power systems
5. The use of industrial electronic devices
6. The demonstrate the design of modern CNC machines, and Mechatronics elements

Outcomes: At the end of the course, the students will be able to

1. Model and analyze electrical and mechanical systems and their interconnection
2. Integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems
3. Do the complete design, building, interfacing and actuation of a mechatronics system for a set of specifications
4. Be proficient in the use of fluid power systems in various mechatronics applications
5. Demonstrate the use of industrial electronic devices
6. Demonstrate the design of modern CNC machines, and mechatronics elements

UNIT-I

Introduction to mechanization & automation: Need of interface of electrical & electronic devices with mechanical elements, the concept of Mechatronics, Flow chart of Mechatronics system, elements of Mechatronics system, drive mechanisms, actuators, feedback devices and control system, application in industries and systems development

UNIT-II

Drive mechanisms: Feeding and indexing, orientation, escapement and sorting devices, conveyor systems

Introduction to electrical actuators: A.C. servomotors, D.C. servomotors, stepper motors

UNIT-III

Introduction to fluid power systems: Industrial Pneumatics and hydraulics, merits of fluid power, pneumatic & hydraulic elements symbols, study of hydraulic control valves, pumps & accessories, hydraulic circuits & mechanical servo control circuits, Electro-hydraulic and Hydro-pneumatic circuits

UNIT-IV

Introduction to industrial electronic devices: Diodes, Transistors, Silicon Controlled Rectifiers (SCR), Integrated Circuits (IC), Digital Circuits, Measurement systems & Data acquisition systems: sensors, digital to analog and analog-to-digital conversion, signal processing using operational amplifiers, introduction to micro processor & micro controller, Temperature measurement interface and LVDT interface, Systems response

UNIT-V

Design of modern CNC machines and Mechatronics elements: machine structures, guide ways, spindles, tool monitoring systems, adaptive control systems, Flexible manufacturing systems, Multipurpose control machines, PLC programming

Text Books:

1. William Bolton, *Mechatronics: Electronic control systems in mechanical and electrical engineering*, 6th edition, Pearson Education
2. HMT Ltd, *Mechatronics*, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1998

Suggested Reading:

1. Michaels Histand & David G, Alciatore, *Introduction to Mechatronics and Measurement Systems*, Tata McGraw-Hill International Edition
2. Devdas Shetty, Richard A. Kolk, *Mechatronics System Design*, Cengage Learning
3. S.R. Majumdar, *Oil Hydraulic Systems – Principles & Maintenance*, McGraw-Hill Publishing Company Limited, New Delhi
4. Godfrey Onwubolu, *Mechatronics: Principles and Applications*, Butterworth-Heinemann

ME 474

Mechanics of Composite Materials (ELECTIVE - III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand the

1. Properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
2. How to predict the elastic properties of long fiber composites based on the constituent properties. An ability to rotate stress, strain and stiffness tensors using ideas from matrix algebra.
3. Linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior. An ability to analyze a laminated plate in bending using classical lamination theory.
4. How to predict the failure strength of a laminated composite plate. A knowledge of issues in fracture of composites.
5. Exposure to recent developments in composites, including metal and ceramic matrix composites.
6. How to use the ideas developed in the analysis of composites towards using in industrial application.

Outcomes: At the end of the course, a student should be able to

1. Understand the various fabrication methods of composite materials.
2. Understand the specifics of mechanical behavior of layered composites compared to isotropic materials.
3. Determine stresses and strains in composites.
4. Apply constitutive equations of composite materials and understand mechanical behavior at micro and macro level.
5. Understand the failure of composites including fracture.
6. Understand the theory of plate and shell; understand the bending analysis of composite beams.

Unit-I

Introduction: Fibers, matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites and carbon composites.

Unit-II

Micromechanics of lamina and mechanical properties: Prediction of elastic constants, micromechanical approach, Halpin-Tsai equations, thermal properties, hygro properties, mechanics of load transfer from matrix to fibre.

Unit-III

Macro-mechanics of lamina: Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects, simplified composite beam solutions, bending of laminated beams.

Unit-IV

Strength, fracture, fatigue and design: Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: single and multiple fractures, de-bonding, fibre pullout and de-lamination.

Strength of an orthotropic lamina: Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria, designing with composite materials

Unit-V

Manufacturing processes: Hand lay-up, prepregs, bag molding, autoclave processing, RTM, pultrusion, filament winding, gel time test for resins, curing cycle,

Measurement of basic composite properties: Fiber and matrix tests, tensile test, compressive test, in-plane shear test, inter-laminar shear test, flexure test.

Text Books:

1. Jones, R.M., *Mechanics of Composite Materials*, Mc Graw Hill Co., 1967
2. B.D. Agarwal et.al, *Analysis and performance of fiber composites*, 3rd edition, Wiley sons., 2013
3. P.K. Mallick, *Fiber Reinforced Composites Materials*, Manufacturing, and Design, Taylor & Francis, Third Edition 2007 ,

Suggested Reading:

1. Ever J Barbero, *Introduction to composite materials design*, Taylor &Francis, 1999.
2. Hyer, M.W., *Stress Analysis of Fibre Reinforced Composite Materials*, McGraw Hill Co., 1998.
3. Carl. T. Herakovich, *Mechanics of Fibrous Composites*, John Wiley Sons Inc., 1998.

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ME 475

Supply Chain Management (Elective – III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. The significance of supply chain management in engineering.
2. The awareness about transportation and warehouse management systems.
3. The designing supply chain networks.
4. The concept of demand and supply and integrating it with supply chain management.
5. The acquainted with planning and managing inventories.
6. The pricing and revenue management

Outcomes: At the end of the course, the student is able to

1. Apply supply chain management concepts in engineering applications
2. Plan an effective transportation and warehouse management systems
3. Design an effective supply chain networks
4. Integrate and optimize demand and supply gaps
5. Apply inventory management techniques
6. Understand and design a pricing and revenue management systems

UNIT-I

Concept of SCM, Concept of Logistics Management, Supply Chain, Types of supply chain, functions in SCM, Transportation Management, Warehousing Management, Warehouse management systems.

UNIT-II

Designing the supply chain Network, Designing the distribution network, Network Design, Network Design in an uncertain environment.

UNIT-III

Planning and Demand:Planning demand & supply in a supply chain, demand forecasting, aggregate planning, planning supply & demand.

UNIT-IV

Planning & managing inventories in a supply chain, managing economies of scale, cycle inventory, and managing uncertainty safety inventory optimal level of product availability

UNIT-V

Sourcing, Transporting & Pricing Products, sourcing decisions, transportation, pricing & revenue management. Coordination & technology in the supply chains, coordination in supply chain, information technology and supply chain.

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Text Books:

1. N. J. Kumar & Mukesh Bhatia, *Supply Chain Management*, Neha publishers & Distributors,2010
2. Michael H. Hugos, *Essentials of Supply Chain Management*, 3rd edition, John Wiley & Sons, Inc, Hoboken, New Jersy,2011
3. Sunil Chopra & Peter Meindl, *Supply Chain Management* – Strategy, Planning and Operation, Pearson Education, Inc., Upper Saddle River, New Jersey, 2003

Suggested Reading:

1. Martin Christopher, *Logistics & Supply Chain Management*, 5th edition, Financial Times Series,2010
2. Dobler Donald. W, David.N.Burt, *Purchasing & supply Management Text & Cases*. McGraw-Hill, 1996
3. Chitale A.K. Gupta R.C, *Materials Management-Text and Cases*, Prentice-Hall Of India Pvt. Limited, 2007

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PE 471

Manufacturing Systems and Simulation (Elective – III)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. The systems, subsystems for manufacturing techniques
2. The information technologies relevant to manufacturing systems
3. The discrete and continuous systems
4. The system simulation and associated concepts
5. The queuing theory concepts applied to system simulation
6. The awareness about programming with GPSS and SIMSCRIPT

Outcomes:

1. Student is able to have overall view of various manufacturing processes
2. Capable of applying information systems and automation to manufacturing
3. Ability to build various models suitable for appropriate manufacturing facility
4. Able to understand and conceptualize systems simulations
5. Ability to simulate discrete and continuous systems
6. Capable of programming with GPSS and SIMSCRIPT

UNIT-I

Manufacturing Systems: Definition of systems, basic concepts and problems concerning systems, systems design, decision making procedures, Structural, transformational and procedural aspects of manufacturing, modes of production, process systems for manufacturing, logistic systems, material flow & technological information flow, management & information systems for manufacturing, managerial information flow in manufacturing systems

UNIT-II

Information Systems: Fundamentals of information technology, information systems, information networking, parts oriented production information systems and computerized production scheduling, online production control systems, Computer based production management systems, Automation systems for manufacturing, Industrial automation, Kinds of automation, principles of CIM, effectiveness of CIM, factory automation, automatic machine tools for mass production, NC machine tools, computer controlled manufacturing systems, FMS, automated assembly, automatic material handling, automatic inspection & testing, computer integrated automation systems- unmanned factory

UNIT-III

System Models: Concepts, continuous and discrete systems, systems modeling, type of models, subsystems, corporate model and system study

System simulation: Techniques, comparison of simulation and analytical methods, types of simulation, distributed log model, cobweb models

UNIT-IV

Continuous system Simulation: Numerical solution of differential equation, analog computers, hybrid computers, continuous system simulation languages CSMP, system dynamic growth models, logistic curves

Discrete systems simulation: Events generation of arrival patterns, simulation programming tasks, analysis of simulation output

Queuing theory: Arrival pattern distribution, service times, queuing disciplines and measure of queues

UNIT-V

GPSS and SIMSCRIPT: General description of GPSS and SIMSCRIPT, programming in GPSS simulation programming techniques: Data structures, implementation of activities, event and queues, event scanning, simulation algorithms in GPSS and SIMSCRIPT

Text Books:

1. Geofery Gordan, *Systems Simulation*, Prentice Hall, 1980
2. Allan Carrie, *Simulation of Manufacturing Systems*, John Wiley & Sons Ltd,1998

Suggested Reading:

1. Adelaide Marzano, *Manufacturing system simulation*, VDM Verlag
2. Davi Bedworth & James Bailey, *Integrated Production Control system Management, analysis & design*, 2nd edition, John Wiley & Sons Ltd.,2010
3. Ronald Zskin & Charles Standridge, *Modeling and Analysis of Manufacturing Systems*, John Wiley & Sons Ltd.,2011
4. Deo. N., '*ystem simulation with Digital Computers*, Prentice Hall, 1980

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PE 481

Micro Manufacturing (ELECTIVE - IV)

Instruction week	4 Periods per
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. The importance of micromachining, Nano polishing, Micro forming and Micro welding.
2. Micromachining processes
3. The Nano polishing methods
4. The micro forming processes
5. The concepts of micro welding to the students
6. The recent trends and applications of micro manufacturing

Outcomes: At the end of the course, the students are able to

1. Suggest suitable micromachining process to a particular application.
2. Select the process parameters of particular micro machining process
3. Describe the various micro, machining, welding and forming processes
4. Compare various micro machining / forming/ welding processes based on relative merits and demerits.
5. Demonstrate the understanding of various nano machining operations.
6. Exhibit the knowledge regarding the recent trends in micro-manufacturing processes

UNIT I

Micro Machining I: Introduction, scaling laws, mechanical micro machining, ultra sonic micro machining, abrasive jet micro machining, water jet micro machining, abrasive water jet micro machining, micro turning, chemical and electro chemical micro machining, electric discharge micro machining, electro discharge grinding.

UNIT II

Micro Machining II: Beam energy based micro machining, electron beam micro machining, laser beam micro machining, ion beam micro machining, plasma beam micro machining, hybrid micro machining, electro chemical spark micro machining, electrolytic in process dressing.

UNIT III

Nano Polishing: Abrasive flow finishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing, magnetic float polishing, elastic emission machining, chemo-mechanical polishing

UNIT IV

Micro Forming and Welding: Micro extrusion, micro and nano structured surface development by nano plastic forming and roller imprinting, micro bending with laser, laser micro welding, electron beam for micro welding.

UNIT V

Recent Trends and Applications: Metrology for micro machined components, ductile regime machining, AE based tool wear compensation, machining of micro gear, micro nozzle, micro pins and applications.

Text Books:

1. Jain V. K., *Micro Manufacturing Processes*, CRC Press, Taylor & Francis Group, 2012
2. Janocha H., *Actuators – Basics and applications*, Springer publishers, 2012
3. Jain V.K., Introduction to Micro machining, Narosa Publishing House, 2011

Suggested Reading:

1. Bharat Bhushan, *Handbook of nanotechnology*, springer, Germany, 2010.
2. Bandyopadhyay. A.K., *Nano Materials*, New age international publishers, New Delhi, 2008, ISBN:8122422578.
3. Jain V.K., *Advanced Machining Processes*, Allied Publishers, Delhi, 2002
4. Mcgeoug.J.A., *Micromachining of Engineering Materials*, CRC press 2001, ISBN-10:0824706447.

PE 482

Non - Destructive Testing and Evaluation (ELECTIVE - IV)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student has to understand the

1. Need, basic concepts and technologies of Non Destructive Testing (NDT)
2. Security precautions from Radiography, protection from radiation and measurement of radiation received by personnel.
3. Technology of acoustic emission (AE), the associated instrumentation and applications
4. Technologies like neutron radiography; laser induced ultrasonics, surface analysis and thermography
5. Merits and demerits of the different NDT Technologies
6. Latest research and developments in NDT

Outcomes: At the end of the course, the students will be able to demonstrate

1. the knowledge of different NDT techniques.
2. clear understanding of liquid penetrant inspection and magnetic particle inspection.
3. view and interpret radiographs, utilize the various principles of radiography for different components of different shapes.
4. the knowledge of acoustic emission for NDT and the instrumentation used for NDT.
5. the ability to analyze and prepare a technical report.
6. the knowledge of latest research, developments and trends in NDT.

UNIT-I

Liquid penetrate inspection: Principles of penetrate inspection, characteristics of a penetrate, water washable system, post emulsification system , solvent removable system, surface preparation and cleaning, penetrate application, development, advantages limitations, and applications.

Magnetic particle instruction: Principle, magnetization methods, continuous and residual methods, sensitivities, demagnetization, magnetic particles, applications advantages and limitations.

UNIT-II

Eddy current testing: Principle, lift-off factor, and edge effect, skin effect, inspection frequency, coil arrangements, inspection probes, types of circuit, reference pieces, phase analysis, display methods and applications.

UNIT-III

Ultrasonic testing: Generation of ultra sound, characteristics of an ultrasonic beam, sound waves at interfaces, sound attenuation, display systems, probe construction, type of display, inspection techniques, identification of defects, Immersion testing , sensitivity and calibration. Reference standards. Surface condition, Applications.

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UNIT-IV

Radiography: Principle and uses of radiography, limitation principle, radiation sources, production of X-Rays, x-ray spectra, attenuation of radiation, radiographic equivalence, shadow formation enlargement and distortion, radio graphic film and paper, Xeroradiography, fluoroscopy, exposure factors, radiographic screens, identification markers and image quality indicators, inspection of simple shapes, inspection of complex shapes, viewing and interpretation of radiographs, radiation hazard, protection against radiation, measurement of radiation received by personnel.

UNIT-V

Acoustic Emission: Physical Principles, Sources of emission, instrumentation and applications, Other NDT Techniques: Neuron radiography, Laser induced ultrasonics, surface analysis, and thermography.

Text Books:

1. Barry Hull & Vernon John, *Non Destructive Testing*, 1988.
2. H J Frissell (Editorial Coordinator), Non-*Destructive Evaluation and quality control*, ASM handbook-International Publication USA, 1989..
3. Dove and Adams, *Experimental Stress analysis and Motion Measurement*, Prentice Hall of India, Delhi

Suggested Reading:

1. *Non-Destructive Examination and Quality Control*, ASM International, Vol.17, 9th edition (1989)
2. J. Prasad and C. G. K. Nair, *Non-Destructive Test and Evaluation of Materials*, Tata McGraw-Hill Education, 2nd edition (2011).
3. B. Raj, T. Jayakumar and M. Thavasimuthu, Practical *Non Destructive Testing*, Alpha Science International Limited, 3 rd edition (2002).
4. T. Rangachari, J. Prasad and B.N.S. Murthy, *Treatise on non-destructive testing and evaluation*, Navbharath Enterprises, Vol.3, (1983

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PE 483

Product Design and Process Planning (ELECTIVE – IV)

Instruction week	4 Periods per
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. The Product Design and Process Functions
2. The essence of innovation in product development
3. The Human Machine Interactions (ergonomics)
4. The various Intellectual Property Rights
5. The interaction between Design, Manufacturing, Quality and Marketing
6. The awareness about overall view of Process Planning

Outcomes: At the end of the course, the student is able to

1. Have overall view of Product Design and Process Planning
2. Apply creativity techniques in Product Development
3. Applying ergonomically enabled concepts in developing a new product
4. Have awareness and apply Intellectual Property Rights
5. Integrate various stages of developing a new product
6. Develop and execute an effective Process Plan

UNIT-I

Product Design and Process Design functions: selection of right product, systematic procedure of product innovation, factors contributing to successful technological innovation, need for creativity and innovation, techniques of innovation like brain storming and Delphi techniques

UNIT-II

Product Selection and Evaluation: Function of design, design with Human Machine Interaction (HMI) and collection of ideas and purpose of project, selection criteria, screening ideas for new products using evaluation techniques, principles of ergonomics.

UNIT-III

New Product Planning: Interaction between the functions of design, manufacture, quality, testing and marketing, design and material selection, steps for introducing new products after evaluation.

UNIT-IV

New Product Development: Research and new product development, patents, definitions, patent search, patent laws, international code for patents, Intellectual Property Rights (IPR).

UNIT-V

Process Selection and Planning: Process selection, process planning, process sheets, selection of manufacturing process, estimation of machining time in various cutting operations, estimation of costs for manufacture, value engineering in product design, group technology, concepts of concurrent engineering.

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Text Books:

1. Niebel BW & Draper AB, *Production Design & Process Engg*, McGraw Hill, Kogakusha, 1974
2. K. G. Swift & J. D. Booker, *Process Selection*: From Design to Manufacture", Butterworth-Heinemann Ltd; 2nd Revised edition, 2003
3. Bhaskaran Gopalakrishnan, *Product Design and Process Planning in CE (Design & Manufacturing*", Chapman and Hall publishers, 1994

Suggested Reading:

1. Harry Nystrom, *Creativity and Innovation*, John Wiley & Sons,
2. Brain Twiss, *Managing Technological Innovation*, Pittman Publications, 1992
3. Harry, B.Waton, *New Product Planning*, Prentice Hall Inc., 1992
4. Chitale, A. K. & Gupta RC., *Product Design & Manufacturing*, PHI, 1997

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With Effect from the Academic Year 2016 - 2017

PE 484

Nano Materials and Technology (Elective – IV)
(for Mech, Prod and Chemical)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will learn the

1. Nanotechnology approach and challenges
2. Materials of nanotechnology
3. Nano structures
4. Nano fabrication
5. Special nano materials
6. Bio materials

Outcomes: At the end of the course

1. Understand the developments and challenges in nano technology
2. Understand synthesis and properties of nanostructured materials
3. Analyze magnetic and electronic properties of nano materials
4. Analyze nano fabrication methods and their applications
5. Understand the characterization of nano and bio materials and their use
6. Analyze the synthesis and characterization of nano wires and tubes

Unit I

Introduction: Nanoscale, Properties at Nanoscale, advantages and disadvantages, importance of Nanotechnology, Bottom-up and Top-down approaches, challenges in nanotechnology, proximal probe technologies

Unit II

Materials of Nanotechnology: Introduction, Si-based materials, Ge-based materials, Ferroelectric materials, Polymer materials, GaAs& InP (III-V) group materials, Nanotribology and materials, characterization using Scanning Probe Microscope, AFM, FFM

Unit III

Nano Structures: Zero dimensional Nanostructure (Nano particles), synthesis procedure, characterization techniques, properties and applications of Nano particles One dimensional Nanostructures (Nano Wires, Nano Tubes), various Synthesis procedure, characterization procedure and principles involved, properties and applications of Nano Wires, Types of Nano Tubes, Synthesis procedure, characterization properties and applications of Nano Tubes

Unit IV

Nano Fabrication: Introduction, Basic fabrication techniques (Lithography, thin film deposition, and doping), MEMS fabrication techniques, Nano fabrication techniques (E-beam Nano-imprint fabrication, Epitaxy and strain engineering, Scanned probe techniques)

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Unit V

Special Nano Materials: Nano Composites: Introduction, Synthesis procedures, various systems (metal-polymer, metal-ceramics and Polymer-ceramics), Characterization procedures, applications,
Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, principles involved, applications

Text Books:

1. A.K. Banopadyay, *Nano Materials*, New Age Publications
2. T. Pradeep, *Textbook of Nanoscience and Nanotechnology*, McGraw Hill Education (India) Private Limited, New Delhi
3. Dieter Vollath, *Nanomaterials: An Introduction to Synthesis, Properties and Applications*, Wiley, 2013

Suggested Reading:

1. Carl C. Koch, *Nano Materials Synthesis, Properties and Applications*, Jaico Publishing House
2. Willia Tllsey Atkinson, *Nano Technology*, Jaico Publishing House
3. George W. Hanson, *Fundamentals of Nanoelectronics*, Pearson Education, 2009
4. T. Pradeep, *Nano: Essentials-understanding Nano Science and Technology*, TMH, 2007
5. Sabu Thomas, Nandakumar Kalarikkal, A. Manuel Stephan, B. Raneesh, *Advanced Nano-materials*: Synthesis, Properties, and Applications, Apple Academic Press

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Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana

With Effect from the Academic Year 2016 - 2017

PE 485

Total Quality Management (Elective – IV)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand

1. The essence of total quality management in design and manufacturing a product
2. The various principles and concepts of total quality management
3. The functional requirement of quality
4. The various technical tools of quality like control charts and ANOVA etc
5. The quality information system
6. The awareness about measuring and satisfying customer needs

Outcomes: At the end of the course, the student is able to

1. Apply TQM techniques in engineering applications
2. Use various theories and principles related to TQM
3. Using functional requirements of quality
4. Use statistical techniques in TQM
5. Have awareness and use quality information system and innovative systems
6. Deal with customer grievances and satisfying the customers

UNIT-I

Strategic Quality Management: Quality policies, quality goals, obstacle to achieving successful strategic quality management, Organization for quality role of {Top, middle, work force team (Quality Circles)}, Developing a quality work culture, Maslow need theory, Herzberg two factor theory, Theory X, Y & Z methods to create and maintain awareness of quality, provide evidence of management leadership, types of self development and empowerment programmes, methods of participations means of inspiring action, recognition and rewards, Supplier quality rating plans (lot plot plan, OC curve, parent analysis), assignment of supplier capability, methods of evaluating supplier products, contract management (Joint economic plan, joint technological forecasting

UNIT-II

Design for quality: Basic functional requirements of quality, design for (reliability, safety, cost and product performance), concurrent engineering (DFMA) value engineering, support for quality improvement processes (block diagram, brain storming, cause effect analysis, pareto analysis), quality function deployment, reliability analysis, failure rate, failure pattern of complex products (bath tub curve), weibull distribution relationship between part and the system, exponential reliability, availability, FMEA (Fracture Mode and Effect Analysis), Design for experiments: Factorial experiments, construction fractional designs

UNIT-III

Technical tools for Quality: Analysis of variance (ANOVA), 4 factor ANOVA experiment, 2 levels, analysis of means, Techniques for online quality: data collection plan, variable and attribute charts, interpreting the control charts, Techniques for offline quality control: background to Taguchi method (quality loss and loss function, controllable factor, and non controllable factors in parameter performance, tolerance design

Taguchi analysis techniques: net variation and contribution ratio, estimation of process performance, accumulating analysis, performance measures, Taguchi tolerance design and tolerance (re) design

UNIT-IV

Quality Information System: Scope of Quality Information System, differences between QIS and MIS, creating new software (steps, types, defects) reports on quality (operational and executive reports), features of QIS software, software for inspection

Inspection System: Operational sorting and correlation sorting, AQL, LTPD, AOQL, Nondestructive test, Audit systems: (quality improvement planning and implementation, describing quality function, process control system, control of measurement system, material identification and control, drawing and specification control, process corrective action), the concept of POKAYOKE

UNIT-V

Measure of customer needs: The need to measure customer satisfaction, importance of proper packaging, customer processing and installation of product, dealing with customer complaints, using weibull analysis, field feedback, parameter to measure customer (dis)satisfaction, problems with the customer satisfaction system

Beyond TQM: Difficulties in implementing TQM system, rating your quality system, JIT system, the people side of TQM system, system integration, Kansei engineering and flexibility in manufacturing

Text Books:

1. L. Suganthi, Aanand A. Samuel, *Total Quality Management*, PHI Learning Pvt. Ltd., 2004
2. H.G. Menon, *TQM in view Production Manufacturing*, McGraw Hill Publishers

Suggested Reading:

1. Joel E. Ross & Susan Perry, *Total Quality Management: Text, Cases, and Readings*, 3rd edition, CRC Press, 1999
2. John S Oakland, *Total Quality Management: The route to improving performance*, A Butterworth-Heinemann Title, 2nd edition, 1994
3. Jankiraman, *Total Quality Management: Text and Cases*, PHI Learning Private Limited-New Delhi; 1 edition (2006)

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With Effect from the Academic Year 2016 - 2017

CSE 481

Information Security (Elective – IV)

Instruction	4 Periods per week
Duration of End Examination	3 Hours
End examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives: Student will understand the

1. Information assurance as practiced in computer operating systems, distributed systems, networks and representative applications.
2. Several ethical issues in information system
3. Principal concepts, major issues, technologies, and basic approaches in information security.
4. Prevalent network and distributed system attacks, defenses against them, and forensics to investigate the aftermath.
5. Cryptography, how it has evolved, and some key encryption techniques used today.
6. Security policies (such as authentication, integrity and confidentiality), as well as protocols to implement such policies in the form of message exchanges.

Outcomes: At the end of the course, the students are able to understand the

1. Basic concepts and goals of Information security such as Confidentiality, Integrity, Authentication, Non-Repudiation, Authorization, and Availability and their relevance in various Contexts.
2. Classical cryptosystems and techniques used to break them.
3. Ideas of public key cryptosystems and digital signature schemes
4. Different network issues as well as database security issues and the solutions for them through firewall, intrusion detection system
5. Critical evaluation of a range of access control and authentication mechanisms
6. Legal privacy and ethical issues in computer security

Unit I

Introduction: History, critical characteristics of information, NSTISSC SECURITY MODEL, Components of an information system, securing the components, balancing security and access, The SDLC, The Security SDLC

Need for security: Business needs, Threats, Attacks-secure software development

Unit II

Legal, Ethical and Professional Issues: Law and Ethics information security, relevant U.S. laws, international laws and legal bodies, Ethics and information security

Risk Management: Overview, Risk Identification, risk assessment, Risk Control Strategies, selecting a risk control strategy, Quantitative versus qualitative risk control practices, Risk Management discuss points, recommended risk control practices

Unit III

Planning for security: Security policy, standards and practices, security blue print, security education, continuity strategies, Security technology

Firewalls and VONs: Physical design, firewalls, protecting remote connections

Unit IV

Security Technology: Intrusion detection, access control and other security tools, Intrusion detection and prevention systems, scanning and analysis tools, access control devices

Cryptography: Foundations of cryptology, cipher methods, crypryptographic algorithms, cryptographic tools, protocols for secure communications, attacks on cryptosystems

Unit V

Implementing Information Security: Information security project management, technical topics of implementation, Non-technical aspects of implementation, security certification and accreditation,

Security and personnel: Positioning and staffing security function, Employment policies and practices, internal control strategies

Information Security Maintenance: Security management models, the maintenance model, digital forensics

Text Books:

1. Michael E. Whitman and Hebert J. Mattord, *Principles of Information Security*, 4th edition, Ed. Cengage Learning, 2011
2. Thomas R. Peltier, Justing Peltier, John Blackley, *Information Security Fundamentals*, Auerbacj Publications, 2010

Suggested Reading:

1. Detmar W Straub, Seymor Goodman, Richard L Baskerville, *Information Security Policy Processes and Practices*, PHI, 2008
2. Marks Merkow and Jim Breithaupt, *Information Security, Principle and Practices'*, Pearson Education, 2007
3. Mark Rhodes-Ousley, *Information Security, The Complete Reference* McGraw-Hill Education, New York, 2013
4. Alberts, Christopher and Dorofee, Audrey, *Managing Information Security Risks: The OCTAVE Approach* Addision-Wesley Publications, 2003

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PE 422

Seminar

Instruction	3 Periods per week
Sessionals	25 Marks
Credits	1

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of state of the art topics in a broad area of his /her specialization.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to following aspects of seminar presentations.

- Literature survey
- Consolidation of available information
- Power point Preparation
- Technical writing

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.

2. Give twenty(20) minutes presentation through OHP/ PPT/ Slide Projector followed by Ten(10) minutes discussion

3. Submit a report on the seminar topic with list of references and hard copy of the slides.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule should be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar should be from any peer reviewed recent journal publications.

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With Effect from the Academic Year 2016 - 2017

PE 901

Project

Instruction	6 Periods per week
Duration of End Examination	Viva Voce
End Examination	100 Marks
Sessionals	50 Marks
Credits	9

Dealing with a real time problem should be the focus of under graduate project.

All projects will be monitored at least four times in the II-semester through individual presentations (Project batch wise).

Every student should maintain a project dairy, wherein he/she needs to record the progress of his/her work and get it signed at least once in a week by the guide(s). If working outside and college campus, both the external and internal guides should sign the same.

Sessional marks should be based on the marks, awarded by a project monitoring committee of faculty members as well as the marks given by the guide.

Common norms are established for final documentation of the project report, the students are directed to download from the website regarding the guidelines for preparing the project report and the project report format.

The project report shall be evaluated for 100 Marks by the External Examiner.

If the project work found inadequate in the end examination, the candidate should repeat the project work with a new problem or improve the quality of work and report it again.

Break up for 100 Marks in the end examination:

1.	Power point presentation	30 Marks
2.	Thesis/Report preparation	20 Marks
3.	Viva-voce	30 Marks

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 101	**AUTOMATION**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

Student will

1. To learn & understand basic concepts of automation & its significance in manufacturing industries
2. To understand Detroit type automation & flow lines.
3. To conceptualize & design assembly line balancing
4. To learn about automated material handling systems
5. To understand different automated storage/retrieval system
6. To design effective and appropriate testing & inspection systems

Outcome (s)

1. Ability to conceptualize and design automated flow lines
2. Ability to implement line balancing concepts in production and assembly lines
3. Ability to understand and develop automated material handling system suitable for plant operations
4. Ability to design, implement and use and appropriate automated inspection facility
5. Ability to understand and develop automated material handling system suitable for plant operations
6. Ability to design, implement and use and appropriate automated inspection facility

1. Total Hrs 9

Introduction: Definition of automation, Types of production, Functions of Manufacturing, Organization and Information Processing in Manufacturing, Production concepts and Mathematical Models, Automation Strategies, Production Economics: Methods of Evaluating Investment Alternatives, Costs in Manufacturing, Break-Even Analysis, Unit cost of production, Cost of Manufacturing Lead time and Work-in-process.

2. Total Hrs 9

Detroit-Type Automation: Automated Flow lines, Methods of Workpart Transport, Transfer Mechanism, Buffer Storage, Control Functions, Automation for Machining Operations, Design and Fabrication Considerations. *Analysis of Automated Flow Lines*: General Terminology and Analysis, Analysis of Transfer Lines Without Storage, Partial Automation, Automated Flow Lines with Storage Buffers, Computer Simulation of Automated Flow Lines

3. Total Hrs 9

Assembly Systems and Line Balancing: The Assembly Process, Assembly Systems, Manual Assembly Lines, The Line Balancing Problem, Methods of Line Balancing, Computerized Line Balancing Methods, Other ways to improve the Line Balancing, Flexible Manual Assembly Lines. *Automated Assembly Systems*: Design for Automated Assembly, Types of Automated Assembly Systems, Part Feeding Devices, Analysis of Multi-station Assembly Machines, Analysis of a Single Station Assembly Machine

4. Total Hrs 9

Automated Materials Handling: The material handling function, Types of Material Handling Equipment, Analysis for Material Handling Systems, Design of the System, Conveyor Systems, Automated Guided Vehicle Systems. *Automated Storage Systems*: Storage System Performance, Automated Storage/Retrieval Systems, Carousel Storage Systems, Work-in-process Storage, Interfacing Handling and Storage with Manufacturing

5. Total Hrs 9

Automated Inspection and Testing: Inspection and testing, Statistical Quality Control, Automated Inspection Principles and Methods, Sensor Technologies for Automated Inspection, Coordinate Measuring Machines, Other Contact Inspection Methods, Machine Vision, Other optical Inspection Methods. *Modeling Automated Manufacturing Systems*: Role of Performance Modeling, Performance Measures, Performance Modeling Tools: Simulation Models, Analytical Models. *The Future Automated Factory*: Trends in Manufacturing, The Future Automated Factory, Human Workers in the Future Automated Factory, The social impact

Total hours to be taught: 45

Text book (s)

1. Mikell P.Grover, Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education Asia.
2. C.Ray Asfahl, Robots and manufacturing Automation, John Wiley and Sons New York.

References:

1. N.Viswanadham and Y.Narahari, Performance Modeling of Automated Manufacturing Systems, Printice Hall India Pvt. Ltd.,
2. Stephen J. Derby, Design of Automatic Machinary, Special Indian Edition, Marcel Decker, New York Yesdee publishing Pvt. Ltd, Chennai.

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 102	**COMPUTER AIDED MODELING AND DESIGN**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

Student will Understand the

1. Understand the basics of computer aided design
2. To impart knowledge on design process
3. Recognize and explain the uses of wireframe and surface entities
4. Understand and apply various Geometric transformations
5. Understand various advanced modeling concepts

Outcome (s)

Students are able to

1. apply design concepts in design , analysis and can visualize the models through the graphics standards
2. implement Various transformations on geometric models for manipulation
3. recognize various wireframe entities and model them
4. apply surface modeling techniques for the generating various parts and implement
5. differentiate various solid modeling techniques
6. apply various advanced modeling concepts and calculate the interference between mating objects

1. — Total Hrs: 9

Criteria for selection of cad workstations, Shigle design process, Design criteria, Geometric modeling Entities, 2d and 3d primitives, Computer Aided Design , Iterative Design ,CAD process

Geometric Transformations: 2d Translation, Scaling, Rotation, Reflection and shearing, Homogeneous Coordinates , Rotation and Scaling about arbitrary points , 3D transformations

Windowing - View ports -Clipping transformations

Graphics standards: GKS , IGES , PDES and their relevance

2. — Total Hrs: 9

Analytic curves : Lines, Circles, Ellipse, Conics,

Synthetic curves – Cubic, Bezier, B-Splines, NURBS, Curve Manipulations

Wireframe Modeling and its advantages and Limitations

3. — Total Hrs: 9

Analytic Surfaces: Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder.

Synthetic Surface - Cubic, Bezier, B-spline, Coons ,Surface Manipulations , Surface Modeling Techniques

4. — Total Hrs: 9

Boundary Representation (B-rep) & Constructive Solid Geometry (CSG) Modeling

Graph Based Model, Boolean Models, Instances, Cell Decomposition & Spatial – Occupancy Enumeration

5. — Total Hrs: 9

Feature Based Modeling, Assembly Modeling, Conceptual Design and Top down design, Parametric and Variational Modeling Feature recognition, Design by Features

Computer Aided Design of mechanical parts and Interference Detection by Motion analysis

Total hours to be taught: 45

Text book (s)

1. Ibrahim Zeid, ―CAD/CAM, Theory and Practicell, Mc Graw Hill, 1998
2. Foley, Van Dam, Feiner and Hughes, ―Computer Graphics Principles and Practicell, 2nd Ed., Addison Wesley, 2000

Reference (s)

1. E. Micheal, ―Geometric Modellingll, John Wiley & Sons, 1995
2. Hill Jr, F.S., ―Computer Graphics using open GLll, Pearson Education, 2003

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 103	**COMPUTER INTEGRATED MANUFACTURING**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

1. To identify the main elements in computer integrated manufacturing systems
2. To use computer in the area of manufacturing to reduce manual processing and linking computers to all the manufacturing machines and increase the productivity, reduce the unnecessary costs.
3. To study about computer aided planning, artificial intelligence and expert systems
4. To obtain an overview of computer technologies including computers, database and data collection, networks, machine control, as they apply to factory management and factory floor operation
5. To describe the integration of manufacturing activities into a complete system

Outcome (s)

Student are able to understand

1. the basic of CIM, Concurrent engineering, communication matrix, product development cycle, collaborative product development
2. to create the manufacturing database and store and retrieve data from database
3. the product design, design for manufacturability and design for assembly concepts, types of computer aided process planning
4. the CIM technologies such as cellular manufacturing, shop-floor control and flexible manufacturing systems
5. the importance of principles of networking, topology, network devices, selection of network technology, different models of CIM
6. to apply the concepts of lean manufacturing, agile & web based manufacturing to product life cycle and process plan during the development of a product.

1. — **Total Hrs** 9

The meaning of Manufacturing Types of Manufacturing: Basic Concepts of CIM: CIM Definition, Elements of CIM, CIM wheel, concept or technology, Evolution of CIM, Benefits of CIM, Needs of CIM: Hardware and software. Fundamentals of Communication: Communications Matrix. Product Development Cycle, Concurrent Engineering: Definition, Sequential Engineering Versus Concurrent Engineering, Benefits of Concurrent Engineering, Characteristics of concurrent Engineering, Framework for integration of Life-cycle phases in CE, Concurrent Engineering Techniques, Integrated Product Development(IPD), Product Life-Cycle Management (PLM), Collaborative Product Development

2. — **Total Hrs** 9

Introduction, Manufacturing Data: Types, sources; Database Terminology, Database requirements, Database models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL): Basic structure, Data definition Language (Create, Alter, Drop, Truncate, View), Data Manipulation Language (store, retrieve, update, delete). Illustration of Creating and Manipulating a Manufacturing Database. SQL as a Knowledge Base Query Language. Features of commercial DBMS: Oracle, MySQL, SQL Access, Sybase, DB2. Product Data Management (PDM), Advantages of PDM.

3. — **Total Hrs** 9

Product Design: Needs of the market, Design and Engineering, The design Process, Design for Manufacturability (DFM): Component Design, Design for Assembly. Computer-Aided Process Planning: Basic Steps in developing a process plan, Variant and Generative Process Planning, Feature Recognition in Computer-Aided Process Planning. Material Requirements Planning (MRP), Manufacturing Resource Planning (MRP –II), Cellular Manufacturing: Design of Cellular Manufacturing Systems, Cell Formation Approaches: Machine–Component Group Analysis, Similarity Coefficients-Based Approaches. Evaluation of Cell Design. Shop-floor Control: Data Logging and Acquisition, Automated Data Collection, Programmable Logic Controllers, Sensor Technology. Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations: Linear Single Machine Layout, Circular Machine Layout, Cluster Machine Layout, Loop Layout; Operational Problems of FMS. FMS benefits

4. — **Total Hrs** 9

Introduction to Networking, Principles of Networking, Network Terminology, Types of Networks: LAN, MAN, WAN; Selection of Network Technology: Communication medium, Network Topology, Medium access control Methods, Signaling methods; Network Architectures and Protocols: OSI Model, MAP & TOP, TCP/IP, Network Interconnection and Devices, Network Performance. Framework for Enterprise-wide Integration.
CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM

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5.	Total Hrs	9
Lean Manufacturing: Definition, Principles of Lean Manufacturing, Characteristics of Lean Manufacturing, Value of Product, Continuous Improvement, Focus on Waste, Relationship of Waste to Profit, Four Functions of Lean Production, Performance Measures, The Supply Chain, Benefits of Lean Manufacturing. Introduction to Agile and Web Based Manufacturing systems.		
Total hours to be taught		45
Text book (s) 1. S.Kant Vajpayee: Principles of Computer Integrated Manufacturing, Printice-Hall India 2. Singh: Systems Approach to Computer Integrated Design and Manufacturing- John Wiley		
Reference (s) 1. P.Radhakrishnan, S.Subramanyam: CAD/CAM/CIM, New Age International 2. Alavudeen, Venkateshwaran: Computer Integrated Manufacturing, Printice-Hall India		

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BIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE101	**FAILURE ANALYSIS AND DESIGN**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100
Objective (s)	1. To understand importance of design and its morphology 2. To understand buckling phenomenon due to combined external pressure and axial loading							
Outcome (s)	Graduate will be able to understand 1. design methodology and various aspects involved in design process 2. different creative and inventive problem solving techniques 3. different types of design process, concepts of reliable and safe design 4. concept of buckling of cylinders under various loading conditions 5. the fundamentals of fracture, fracture types and concepts of fatigue crack growth, fatigue life prediction and various stress theories of failure vessels 6. basic crack propagation concept, concepts of crack propagation under combined loading, fracture toughness of weld metals.							

1.	Total Hrs	10
Importance of design- The design process-Considerations of Good Design – Morphology of Design – Organization for design– Computer Aided Engineering –Concurrent Engineering – Product and process cycles –Market Identification – Competition Bench marking. Identification of customer needs- customer requirements- Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics		
2.	**Total Hrs**	**10**
Creativity and Problem Solving –Creativity methods-Theory of Inventive Problem Solving(TRIZ)– Conceptual decomposition-Generating design concepts-Axiomatic Design – Evaluation methods-Embodiment Design-Product Architecture-Configuration Design- Parametric Design. Role of models in design-Mathematical Modeling – Simulation – Design for Reliability –Introduction to Robust Design-Failure mode Effect Analysis		
3.	**Total Hrs**	**10**
Buckling phenomenon – Elastic Buckling of circular ring and cylinders under external pressure – collapse of thick walled cylinders or tubes under external pressure – Effect of supports on Elastic Buckling of Cylinders – Buckling under combined External pressure and axial loading		
4.	**Total Hrs**	**10**
Failure analysis and determination of stress patterns from plastic Flow observations – Dynamic loading– Fracture types in tension—Fatigue crack growth– Fatigue life prediction- Cumulative fatigue damage-Stress theory of failure vessels-Thermal stress fatigue		
5.	**Total Hrs**	**10**
Introduction –Through cracks emanating from holes – Corner cracks at holes – Cracks approaching holes-Combined loading-Fatigue crack growth binder- Mixed mode loading-Fracture toughness of weld metals-Service failure analysis		
Total hours to be taught		

Text book (s)

1. Dieter, George E., —Engineering Design - A Materials and Processing Approachll, McGraw Hill, International Editions, Singapore, 2000.
2. Pahl, G, and Beitz, W.,‖ Engineering Designll, Springer – Verlag, NY. 1984

References:

1. David Broek, ‖Elementary Engineering Fracture Mechanics —, Fifthoff and Noerdhoff International Publisher, 1978
2. Preshant Kumar, —Elements of Fracture Mechanicsll, Wheeler Publishing, 1999
3. John F. Harvey, Theory and Design of Pressure Vessels, CBS Publishers and Distributors, 1987
4. Henry H. Bedner, —Pressure Vessels, Design Hand Book, CBS publishers and Distributors, , 1987

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CBIT	*Autonomous Regulation*									
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM & Thermal Engineering				
	Semester-I									
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks				
		L	T	P	C	E	I	Total		
16MEE 107	**ENGINEERING RESEARCH METHODOLOGY**	3	0	0	3	70	30	100		

Objective (s)	1. To motivate the students to choose research as career. 2. To make the students to formulate the research problem. 3. To identify various sources for literature review and data collection. 4. To prepare the research design 5. To equip the students with good methods to analyze the collected data 6. To write a report and interpret the results
Outcome (s)	Students will be able to 1. define research problem 2. review and asses the quality of literature from various sources. 3. understand and develop various research designs. 4. collect the data by various methods: observation, interview, questionnaires. 5. analyze problem by statistical techniques: ANOVA, F-test, Chi-square 6. improve the style and format of writing a report for technical paper/ Journal report

1	**Research Methodology:**	**Total Hrs**	**9**

Research Methodology: Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general.
Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem, Technique involved in Defining a Problem

2	**Literature Survey:**	**Total Hrs**	**9**

Literature Survey: Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet.
Literature Review: Need of Review, Guidelines for Review, Record of Research Review

3	**Research Design:**	**Total Hrs**	**9**

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

4	**Data Collection:**	**Total Hrs**	**9**

Data Collection: Methods of data collection, importance of Parametric test, testing of proportions, testing of variance of two normal population, and Non Parametric test, relation between Spearman's r's and Kendall's W
Data Analysis: Tests for significance: Chi-square, ANOVA, F-test.

5	**Interpretation and report writing:**	**Total Hrs**	**9**

Interpretation and report writing: Meaning of interpretation, layout of research report, Types of reports, Mechanics of writing a report.
Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal

Text Book (s):

1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011

References:

3. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi, 2004
4. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009
5. P. Ramdass and A. Wilson Aruni, Research and Writing across the Disciplines, MJP Publishers

Reddy

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 111	**THEORY OF ELASTICITY AND PLASTICITY**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

Students should able to

1. solve the problems selected to stress-strain tensors and an constitutive relations
2. apply suitable plasticity relations to solve the problems in various metal forming operations

Outcome (s)

Students can

1. demonstrate the understanding of fundamentals stress and its concepts.
2. understanding of concepts of strain
3. solve the problems related to stress & strain and also their relations in isotropic materials
4. to apply the constitutive equations, compatibility equation and equilibrium equations for problem solving
5. apply plasticity relations for simple problems
6. can choose and apply plasticity analysis methods

1. **Total Hrs** **9**

Basic Concepts of Stress : Definition, State of Stress at a point, Stress tensor, invariants of stress tensor, principle stresses, stress ellipsoid, derivation for maximum shear stress and planes of maximum shear stress, octahedral shear stress, Deviatoric and Hydrostatic components of stress, Invariance of Deviatoric stress tensor, plane stress

2. **Total Hrs** **9**

Basic concepts of Strain : Deformation tensor, Strain tensor and rotation tensor; invariants of strain tensor, principle strains, derivation for maximum shear strain and planes of maximum shear strain, octahedral shear strain, Deviatoric and Hydrostatic components of strain tensor, Invariance of Deviatoric strain tensor, plane strain.

3. **Total Hrs** **9**

Generalized Hooke's Law : Stress-strain relationships for an isotropic body for three dimensional stress space, for plane stress and plane strain conditions, differential equations of equilibrium, compatibility equations, Material (D) matrix for Orthotropic Materials

4. **Total Hrs** **9**

True stress and true strain, von-Mise's and Tresca yield criteria, Haigh–Westergard stress space representation of von - Mise's and Tresca yield criteria, effective stress and effective strain, St. Venants theory of plastic flow, Prandtle–Reuss and Levy–Mise's constitutive equations of plastic flow, Strain hardening and work hardening theories, work of plastic deformation.

5. **Total Hrs** **9**

Analysis methods: Slab method, Slip line field method, uniform deformation energy method, upper and lower bound solutions. Application of Slab method to forging, wire drawing, extrusion and rolling processes

Total hours to be taught **Total Hrs** **45**

Text book (s)

1. Timoshenko and Goodieer, *Theory of Elasticity*, Mcgraw Hill Publications 3rd Edition
2. Madleson, *Theory of Plasticity*

Reference(s)

1. J. Chakrabarty, *Theory of Plasticity*, 2nd edition, McGraw Hill Publications 1998
2. George E Dieter, *Mechanical Metallurgy*, McGraw Hill Publications 1988

Preddy

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 102	**INTEGRATED MECHANICAL DESIGN**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To know the importance of limits, fits and tolerances in design of machine and mechanical components
2. To learn design criteria of machine components according to standards and Theories of failures
3. To learn application of principles to design different gears and gear boxes.
4. To provide the design concepts of machine tools, automobiles and mechanical handling equipments for dynamics and thermal aspects.
5. To provide the students the knowledge of design of Mechanical handling equipments like power plants and Construction fields

Outcome (s)

1. Be able to know the importance of limits ,fits and tolerances and Testing standards for design and manufacturing
2. Be able to do the complete design and analysis of shafts, bearings and casings by considering design and machining allowances according to standards and requirements.
3. Be able to do the design and analysis of Different gears and gear boxes.
4. Be able to do the design of brakes of machine tools, automobiles and mechanical handling equipments for dynamics and thermal aspects.
5. Be able to design of Mechanical handling equipments.

1. Total Hrs 9

Phases of design – Standardization and interchangeability of machine elements - Process and Function Tolerances – Individual and group tolerances – Selection of fits for different design situations – Design for assembly and modular constructions – Concepts of integration –BIS, ISO, DIN, BS, ASTM Standards.
Oblique stresses – Transformation Matrix – Principal stresses – Maximum shear stress - Theories of Failure – Ductile vs. brittle component design -
Analysis and Design of shafts for different applications – integrated design of shaft, bearing and casing – Design for rigidity.

2. Total Hrs 9

Principles of gear tooth action – Gear correction – Gear tooth failure modes – Stresses and loads – Component design of spur, helical, bevel and worm gears – Design for sub assembly – Integrated design of speed reducers and multi-speed gear boxes – application of software packages

3. Total Hrs 9

Dynamics and thermal aspects of vehicle braking – Integrated design of brakes for machine tools, automobiles and mechanical handling equipments

4. Total Hrs 9

Integrated Design of systems consisting of shaft, bearings, springs, motor, gears, belt, rope, chain, pulleys, Cam & Follower, flywheel etc. Example - Design of Elevators, Escalators, Gear Box, Valve gear Mechanisms, Machine Tools

Total hours to be taught

Text book (s)

1. L. R., —Machine Design – An Integrated Approach‖ Pearson Education, 2005
2. Newcomb, T.P. and Spur, R.T., —Automobile Brakes and Braking Systems‖, Chapman and Hall, 2nd Edition,1975.
3. Maitra G.M., —Hand Book of Gear Design‖, Tata McGraw Hill, 1985
4. Shigley, J.E., —Mechanical Engineering Design‖, McGraw Hill, 1986
5. Prasad. L. V., —Machine Design‖, Tata McGraw Hill, New Delhi, 1992
6. Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981
7. Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958

Approved Data Books:

1. .S.G. Tech., —Design Data Book‖, Kalaikathir Achchagam, Coimbatore, 2003.
2. Lingaiah. K. and Narayana Iyengar, —Machine Design Data Hand Book‖, Vol. 1 & 2, Suma 1983

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 102		L	T	P	C	E	I	Total
	ROBOTIC ENGINEERING	3	0	0	3	70	30	100

Objective (s)	☐ To be familiar with the brief history of robot and applications. ☐ To give the student familiarities with the kinematics of robots. ☐ To give knowledge about robot end effectors and their design. ☐ To give knowledge about various Sensors and their applications in robots.
Outcome (s)	1. Students will be equipped with the brief history of robot configuration , subsystems,applicatios. 2. Students will have good knowledge about robot end effectors and their design concepts. 3. Understand different orientations of robot 4. Students will be familiarized with the kinematic motions of robot and 5. Able to solve the static and dynamic analysis of Planar robots 6. Students will be equipped with the principles of various Sensors, their applications in robots and concept of robot vision

1.	Total Hrs	9
Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Mechanisms and transmission, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.		
2.	Total Hrs	9
Rotation matrices, Euler angle and RPY representation, Homogeneous transformation matrices, Denavit-Hartenberg notation, representation of absolute position and orientation in terms of joint parameters, direct kinematics.		
3.	Total Hrs	9
Inverse Kinematics, inverse orientation, inverse locations, Singularities, Jacobian, Trajectory Planning: joint interpolation, task space interpolation, executing user specified tasks, sensor based motion planning: The Bug Algorithm, The Tangent Bug Algorithm, The Incremental Voronoi Graph.		
4.	Total Hrs	9
Static force analysis of RP type and RR type planar robots, Dynamic analysis using Lagrangean and Newton-Euler formulations of RR and RP type planar robots, , Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, force feedback, hybrid control		
5.	Total Hrs	9
Sensors and controllers: Internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser range finder Robot vision: image processing fundamentals for robotic applications, image acquisition and preprocessing. Segmentation and region characterization object recognition by image matching and based on features		
Total hours to be taught		

Text book (s)

1. Nagrath and Mittal, ―Robotics and Controll, Tata McGraw-Hill, 2003
2. Spong and Vidhyasagar, ―Robot Dynamics and Controll, John Wiley and sons, 2008

References:

1. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, Robotics, control, sensing, Vision and Intelligence, McGraw Hill International, 1987
2. Steve LaValle, ―Planning Algorithmsǁ, Cambridge Univ. Press, New York, 2006
3. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thurn, ―Principles of Robot Motion: Theory, Algorithms, and Implementationsǁ , Prentice Hall of India, 2005

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<table>
<tr><td>CBIT</td><td>Autonomous Regulation</td><td colspan="4">Semester-1</td><td colspan="3">AY - 2006-17</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td><td colspan="4">Programme Code & Name</td><td colspan="3">M.E. CAD/CAM</td></tr>
<tr><td>Course Code</td><td>Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">16MEE 103</td><td rowspan="2">PROGRAMMING METHODOLOGY AND DATA STRUCTURES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>E</td><td>I</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>70</td><td>30</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">• To improve logical thinking of the students.
• To encourage the student to use their own code to solve mechanical engineering Problems.</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">1. Different types of data storage and their structures
2. Implementing the concepts with programming in 'C'
3. Apply different sorting techniques in Mechanical engineering Applications
4. Classify the different Data Structures
5. differentiate between Linked lists,stacks and queues
6. Understand the concept of Trees and their traversals</td></tr>
<tr><td colspan="7">1.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Programming Methodology: Introduction, Algorithm, Data Flow Diagrams, Decision Tree, Decision Table and Life Cycles of Project Development.</td></tr>
<tr><td colspan="7">2.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Programming in 'C': Data types & Memory size, Expressions, Statements, Operators, Control flows, Arrays, Pointers, Structures, Functions, Dynamic Memory Allocation and Simple programs in Mechanical Engineering.</td></tr>
<tr><td colspan="7">3.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Sorting and Searching Techniques: Selection sort, Quick sort, Radix sort, Heap sort. Linear search, Binary search trees and Applications in Mechanical Engineering</td></tr>
<tr><td colspan="7">4.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Data Structures: Classification of Data Structures, Definitions of Linked Lists, Double Linked Lists, Stacks and Queues. Operations and Implementations of Stack, Queues and Linked List. General and Mechanical Engineering Applications</td></tr>
<tr><td colspan="7">5.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Advanced Data Structures: Tree, Basic Terminology, Binary Trees, Operations on Binary tree, Tree traversals, Graph, Graph representation Adjacency matrix, Adjacency Lists and Applications</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td></td><td></td></tr>
<tr><td colspan="9">Text book (s)</td></tr>
<tr><td colspan="9">1. G.Michael Schneider, Steven C.Bruell, —Concepts in Data Structures and Software Development", Jaico Publishing House,2002
2. Kernighan B.W, Ritchie D.M, —The C Programming Language", 2nd Edition, Prentice-Hall of India, 2003</td></tr>
<tr><td colspan="9">References:
1. Kruse RL, Bruce RL, Cloris Lt, —Data Structures and Program Design in C", PHI, 1991
2. Hyer, M.W., Stress Analysis of Fibre Reinforced Composite Materials, Mc Graw Hill Co., 1998.
3. Trembly and Sorenson, —An Introduction to Data Structures with application", McGraw Hill, 1984</td></tr>
</table>

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 104	**OPTIMIZATION TECHNIQUES**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100
Objective (s)	1. To Understand the need of the optimization methods. 2. To introduce the fundamental concepts of Optimization Techniques 3. To provide students with the modeling skills necessary to describe and formulate optimization problems 4. To make the learners aware of the importance of optimizations in real scenarios 5. To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable 6. Get a broad picture of the various applications of optimization methods used in engineering.							
Outcome (s)	1. Formulate and solve Linear programming problem 2. Apply different techniques to solve Non Linear programming problem 3. Implement constrained optimization techniques 4. Analyze dynamic programming and integer programming problems 5. Develop schedule for projects and apply PERT/CPM techniques 6. Apply Queuing theory to real life situations							

1. LINEAR AND TRASPORTATION PROBLEMS — **Total Hrs** **9**

Statement of Optimization Problem, Linear Programming: Simplex Method, Revised Simplex Method, Sensitivity Analysis, Parametric Programming, and Transportation Problem

2. NON-LINEAR PROBLEMS — **Total Hrs** **9**

Nonlinear Programming: Approach, Convergence and Scaling of Design variables; Unconstrained Optimization Direct Search Methods: Random Search, Univariate, Simplex Method; Indirect Search Methods: Steepest Descent, Conjugate Gradient, Newton, Quasi Newton, DFP Methods;

3. NON-LINEAR PROGRAMMING — **Total Hrs** **9**

Constrained Optimization Direct Methods: Lagrange Multipliers, Kuhn-Tucker, conditions, Beal's method, Indirect Method: Penalty Function and Applications

4. DYNAMIC PROGRAMMING — **Total Hrs** **9**

Introduction to Dynamic Programming; Concept of Sub optimization and the principle of optimality; Linear and Continuous Dynamic Programming with Applications; Introduction to Integer Programming; Cutting Plane Method; Branch and Bound method; Introduction to Genetic Algorithms, particle swarm optimization

5. PROJECT SCHEDULING — **Total Hrs** **9**

Sequencing and Scheduling, Project Scheduling by PERT-CPM; Probability and cost consideration in Project scheduling; Queuing Theory, Single and multi server models; Queues with combined arrivals and departures; Queues with priorities for service

Total hours to be taught — **Total Hrs** **45**

Text book (s)

1. Rao,S.S. Engineering "Optimization Theory and Practice", New Age Int. Pub., 3rd Ed., 1996.
2. Haug,E.J.and Arora, J.S., "Applied Optimal Design", Wiley Inter Science Publication, NY, 1979.

Reference(s)

1. Douglas J. Willde, "Globally Optimal Design", Jhon Wiley & Sons, New York, 1978
2. Johnson Ray C., "Optimum Design of Mechanical Elements", John Wiley & Sons, 1981.
3. S.D. Sharma, S.D. "Operations Research", Khanna Publications, 2001.
4. David Goldberg, "Genetic Algorithms", pearson publications, 2006.
5. Maurice cleric, "Particle Swarm Optimization", ISTE Publications, 2006
6. Prem Kumar Gupta, "Operations Research", S Chand publications, 2008

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE105	**VIBRATION ANALYSIS AND CONDITION MONITORING**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100
Objective (s)	• To familiarization with the basics of vibration measurements • To apply the vibration principles for condition monitoring of machinery							
Outcome (s)	1. Understand the Causes of Vibration and its effect on structures 2. Understand Single degree and multi degree of freedom systems of steady state and transient characteristics of vibration, simple harmonic motion, periodic motion, peak to Peak,RMS and average values. 3. Vibration measuring instruments, display and recording to elements, frequency analysis and filters, Vibration limits and standards 4. Know and be able to explain the aim and the basics of CM; 5. Be aware of some methods and procedures applied for general CM; 6. Appreciate and understand the basic idea behind vibration-based structural health monitoring and vibration- based condition monitoring, know the general stages of CM;							

1.	**Total Hrs**	**9**
Causes and effects of vibration. Vibrations of Single Degree, Two Degree and Multi Degree of freedom systems. Steady state and transient characteristics of vibration		
2.	**Total Hrs**	**9**
Introduction to Condition Monitoring, Failure types, investigation and occurrences, Causes of failure, Characteristics of vibration – SHM, Periodic motion, Displacement, Velocity and acceleration Peak to peak & RMS, linear and logarithmic scales and phase angle		
3.	**Total Hrs**	**9**
Vibration measuring instruments, vibration transducers, signal conditioning elements. Display and recording elements. Vibration meters and analyzers		
4.	**Total Hrs**	**9**
Condition Monitoring through vibration analysis. Frequency analysis, Filters, Vibration signature of active systems, vibration limits and standards. Contaminant analysis, SOAP and other contaminant monitoring techniques		
5.	**Total Hrs**	**9**
Special vibration measuring techniques - Change in sound method, Ultrasonic measurement method, Shock pulse measurement, Kurtosis, Acoustic emission monitoring, Cepstrum analysis, Modal analysis, critical speed analysis, Shaft –orbit & position analysis		
Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1. Collacott, R.A.,*Mechanical Fault Diagnosis and Condition Monitoring*, Chapman & Hall, London,1982
2. John S. Mitchell, *Introduction to Machinery Analysis and Monitoring*, Penn Well Books, Penn Well Publishing Company, Tulsa, Oklahoma, 1993.

Reference(s)

1. Nakra, B.C. Yadava, G.S. and Thuested, L.,*Vibration Measurement and Analysis, National Productivity Council, New Delhi, 1989*
2. Pox and Zenkins, *Time Series Analysis*
3. A.H. Search, *Vibration and Time Series Analysis*

Prasad

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 108	**TRIBOLOGY IN DESIGN**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To impart knowledge in the friction , wear and lubrication aspects of machine components
2. To understand the material properties which influence the tribological characteristics of surfaces

Outcome (s)

After the completion of the course, student will be able to :

1. Have a knowledge of surface topography and can model a rough engineering surface
2. Understand friction and wear aspects of machine
3. decide upon lubricants and lubrication regimes for different operating conditions
4. Understand Hertz contact and rough surface contact
5. Ability to select material / surface properties based on the tribological requirements
6. Analysis ability of different types of bearings for given load/ speed conditions.

Unit	Content	Total Hrs
1.	Topography of Surfaces – Surface features -Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction –Rolling Friction-Friction properties of metallic and non-metallic materials – friction in extreme conditions –Thermal considerations in sliding contact	9
2.	Types of wear – Mechanism of various types of wear – Laws of wear –Theoretical wear models-Wear of Metals and Non metals – Surface treatments – Surface modifications – surface coatings methods- Surface Topography measurements –Laser methods – instrumentation - International standards in friction and wear measurements.	9
3.	Lubricants and their physical properties- Viscosity and other properties of oils –Additives-and selection of Lubricants- Lubricants standards ISO,SAE,AGMA, BIS standards – Lubrication Regimes –Solid Lubrication-Dry and marginally lubricated contacts- Boundary Lubrication- Hydrodynamic lubrication — Elasto and plasto hydrodynamic - Magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication	9
4.	Reynolds Equation,-Assumptions and limitations-One and two dimensional Reynolds Equation-Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings-Long and short bearings-Pad bearings and Journal bearings- Squeeze film effects-Thermal considerations-Hydrostatic lubrication of Pad bearing-Pressure , flow , load and friction calculations-Stiffness considerations- Various types of flow restrictors in hydrostatic bearings	9
5.	Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts-Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory-Soft and hard EHL-Reynolds equation for elasto hydrodynamic lubrication- - Film shape within and outside contact zones-Film thickness and friction calculation- Rolling bearings- Stresses and deflections-Traction drives	9
	Total hours to be taught	45

Text book (s)

Reference(s)

1. Rabinowicz.E, ―Friction and Wear of materials‖, John Willey &Sons ,UK,1995
2. Cameron, A. ―Basic Lubrication Theory‖, Ellis Herward Ltd., UK, 1981
3. Halling, J. (Editor) – ―Principles of Tribology ―, Macmillian – 1984
4. Williams J.A. ― Engineering Tribology‖, Oxford Univ. Press, 1994
5. .K.Basu, S.N.Sengupta & B.B.Ahuja ,‖Fundamentals of Tribology‖, Prentice – Hall of India Pvt. Ltd., New Delhi, 2005
6. G.W.Stachowiak & A.W .Batchelor, Engineering Tribology, Butterworth-Heinemann,UK, 2005

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17			
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM			
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
16MEE 109	**ADVANCED MECHANICS OF MATERIALS**	L	T	P	C	E	I	Total	
		3	0	0	3	70	30	100	
Objective (s)	1. To understand the various stresses and deflections in beams 2. To understand the stress-strain relations and failure theories								
Outcome (s)	Students will be able to 1. understand the analysis and deformation, stress-strain relations, failure theories 2. analyze and design the columns 3. determine the stresses due to asymmetric bending 4. locate the shear centre of thin-walled sections. 5. Determine the stresses in curved beams 6. calculate the residual stresses in members under torsion/bending analyze the torsion of noncircular cross-sections.								

1. Total Hrs 9

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and curvilinear coordinates, differential equations of equilibrium-compatibility-boundary conditions-representation of three-dimensional stress of a tension generalized hook's law - St. Venant's principle - plane stress - Airy's stress function. Energy methods

2. Total Hrs 9

Location of shear center for various thin sections - shear flows. Stresses and Deflections in beams subjected to unsymmetrical loading-kern of a section

3. Total Hrs 9

Circumference and radial stresses – deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks. Solution of rectangular

4. Total Hrs 9

Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled tub

5. Total Hrs 9

Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress deflection of bodies in point and line contact applications

Total hours to be taught | Total Hrs | 45

Text book (s)

Reference(s)

1. Arthur P Boresi, Richard J. Schmidt, ―Advanced mechanics of materials‖,John Wiley, 2002
2. Timoshenko and Goodier, "Theory of Elasticity", McGraw Hill
3. Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mc-millan pub. Co., 1985
4. Srinath. L.S., ―Advanced Mechanics of solids‖, Tata McGraw Hill, 1992
5. G H Ryder Strength of Materials Macmillan, India Ltd, 2007
6. Allan F. Bower, ―Applied Mechanics of Solids‖, CRC press – Special Indian Edition -2012, 2010
7. K. Baskar and T.K. Varadan, ―Theory of Isotropic/Orthotropic Elasticity‖, Ane Books Pvt. Ltd., New Delhi, 2009

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 106	**CAD/CAM LABORATORY**	L	T	P	C	E	I	Total
		0	0	3	2		50	50

Objective(s):

1. To produce CAD drawings which communicate the appropriate manufacturing details, standards, and specifications..
2. To effectively communicate with others using oral, written, and graphical methods and procedures..
3. To function effectively on teams or on group projects and assume leadership roles when appropriate..
4. To introduce STUDENTS to the basic tools of computer-aided design (CAD) and computer-aided manufacturing (CAM)
5. To understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program
6. To prepare the student to be an effective user of a CAD/CAM system.

Outcome(s): After the completion of the course, students will be able to

1. use parametric CAD software for geometric modeling of mechanical designs
2. visualize of machine components and assemblies before their actual fabrication through modeling, animation, shading, rendering, lighting and coloring
3. apply of CAD computational analysis tools to engineering design.
4. create a complete CAD documentation for an engineering design.
5. model complex shapes including freeform curves and surfacesExplain the basic concepts of CNC programming and machining
6. implement CNC programs for milling and turning machining operations

List of Exercises:

CAD

1. Understanding of various CAD commands and creating simple objects.
2. Understanding of holes, cuts and model tree relations.
3. Creation shafts, rounds, chamfers and slots.
4. Sketch Tools & Datum planes.
5. Creation of objects by revolved features, patterns and copies, sweeps and blends.
6. Creation of engineering drawing details such as dimensioning, sectional views, adding esthetics.
7. Assembling of part models using constraints with bill of materials.
8. Assembly operations - part modifications, adding another assembly features – display.
9. Mass properties and tolerance analysis.

CAM

1. Understanding of CNC Machines and CNC Programming and Creation of 2-D contour Pockets, Slots
2. Drills and Facing, 2-D high Speed blend
3. Surface Roughing for Bottle die
4. Surface finishing for Phone die
5. Manufacturing of Crane Hook
6. Manufacturing of Connecting Rod
7. Manufacturing of Turbine Blade
8. 3-D Machining using ball nose cutters

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With effect from the academic year 2016- 2017

Scheme of Instruction & Examination
M.E. (CAD/CAM) – Mechanical Engineering - 4 Semesters (Full Time)

Semester - I

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1	4	30	70	100	4
2.	Core	3	1	4	30	70	100	4
3.	Core	3	1	4	30	70	100	4
4.	Elective	3	--	3	30	70	100	3
5.	Elective	3	--	3	30	70	100	3
6.	Elective	3	--	3	30	70	100	3
7.	Laboratory	--	3	3	50	--	50	2
8.	Seminar - I	--	3	3	50	--	50	2
9.	Soft Skills	--	--	--	--	--	--	--
	Total	**18**	**09**		**340**	**360**	**700**	**25**

Semester - II

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1		30	70	100	4
2.	Core	3	1		30	70	100	4
3.	Core	3	1		30	70	100	4
4.	Elective	3	--		30	70	100	3
5.	Elective	3	--		30	70	100	3
6.	Elective	3	--		30	70	100	3
7.	Laboratory - II	--	3		50	--	50	2
8.	Seminar - II	--	3		50	--	50	2
9.	Mini Project	--	2		50	--	50	1
	Total	**18**	**11**		**390**	**360**	**750**	**26**

Semester - III

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Seminar* (i)Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd Semester. (50 Marks) (ii) Preliminary work on Project implementation. (50 Marks)	100	--	100	6
	Total	100		100	6

Semester - IV

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Work	100	100	200	12

Note: Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars, Mini Project
and Soft Skills should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only, 50 marks awarded by the project guide
and 50 marks by the internal committee

Credit requirements for the award of degree, lower limit and upper limit of credits for registration by a student in a semester Credit Requirement for the award of M.E/M. Tech. Degree is 69

PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology
Gandipet, Hyderabad-500

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 104	**COMPUTER AIDED MECHANICAL DESIGN AND ANALYSIS**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

1. To develop the necessary skills to understand and analyze problems in pressure vessels
2. To achieve fundamental understanding of the theory of bending of flat plates with various loading and boundary conditions
3. To Understand design principles of a component and structures using fracture mechanics approaches
4. To enable the importance of vibrations in mechanical design and to understand the basic concepts of matrix algebra
5. To understand the different mode extraction methods in vibrations
6. To understand the fundamental concepts various algorithms used for dynamic analysis

Outcome (s)

1. Ability to apply knowledge of mathematics, sciences and computations in solving the stresses & strains in pressure vessels
2. Demonstrate the ability to identify, formulate and solve problems for a given flat plate bending applications
3. An ability to design a system or a component to meet the desired needs of fracture mechanics
4. Students are able to understand and solve various Eigen value and Eigen vectors
5. Students will understand different mode extraction methods to calculate frequencies
6. Student will understand numerical methods in solving multi degree freedom dynamic analysis problems

1. | **Total Hrs** | **9**

Design of pressure Vessels: Introduction and constructional features of pressure vessels, stresses in pressure vessels, shrink fit stresses in built up cylinders, auto frettage of thick cylinders, thermal stresses and their significance.

2. | **Total Hrs** | **9**

Stresses in flat plates: Introduction, Bending of plate in one direction, Bending of plate in two perpendicular directions, Thermal stresses in plates, Bending of circular plates of constant thickness, Bending of uniformly loaded plates of constant thickness

3. | **Total Hrs** | **9**

Fracture Mechanics: Introduction, Modes of fracture failure Griffith Analysis, Energy release rate, Energy release rate of DCB specimen; Stress Intensity Factor: SIF's for edge and centre line crack, Fracture toughness, Elastic plastic analysis through J-integral method: Relevance and scope, Definition of J-integral, Path independence, stress strain relation, Strain Energy Release Rate Vs J-integral

4. | **Total Hrs** | **9**

Eigen Value Problems: Properties of Eigen values and Eigen Vectors, Torsional, Longitudinal vibration, lateral vibration, Sturm sequence. Subspace iteration and Lanczo's method, Component mode synthesis, Eigen value problems applied to stepped beams and bars

5. | **Total Hrs** | **9**

Dynamic Analysis: Direct integration method, Central difference method, Wilson-θ method, Newmark method, Mode superposition, Single degree of freedom system response, Multi degree of freedom system response, Rayleigh damping, Condition for stability.
(Note: The related algorithms and codes to be practiced by students)

Total hours to be taught | **45**

Text book (s)

1. John, V. Harvey, Pressure Vessel Design: Nuclear and Chemical Applications, Affiliated East West Press Pvt. Ltd., 1969
2. Prasanth Kumar, Elements of Fracture Mechanics, Wheeler Publishing, New Delhi-1999

Reference (s)

1. Rammurti, Computer Aided Mechanical Design and Analysis, Tata Mc Graw Hill-1992
2. Bathe, J., Finite Element Procedures, Prentice Hall of India-1996.

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BIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM & Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 105	**FINITE ELEMENT TECHNIQUES**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

1. Identify mathematical model for solution of common engineering problems
2. Enable the students to formulate the design problems into FEA
3. Enable the students to perform engineering simulations using Finite Element Analysis software

Outcome (s)

Students are able to

1. implement finite element formulations to axial and quadratic elements and solve problems with hand calculations numerically
2. formulate numerically the truss, beam and frame elements and solve for deflection, strains and stresses
3. formulate numerically the plane and axisymmetric triangular elements and quadrilateral elements then solve for deflections, strains and stresses in structural mechanics problems
4. apply FE formulations to heat transfer of 1D and 2D elements and solve for temperature and heat flux in slabs, walls and plates
5. apply FE formulations to dynamic analysis of 1D and 2D elements and solve for eigen values and eigen vectors in bars and beams
6. apply FE formulations to 3D solids, plates and for non linear problems

1. FIELD PROBLMES AND MODELING — **Total Hrs** 9

Introduction to Finite Element Method of solving field problems. Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations.

One Dimensional Problem: Finite element modeling. Local, natural and global coordinates and shape functions. Potential Energy approach: Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions

2. ANALYSIS OF TRUSSES AND FRAMES — **Total Hrs** 9

Analysis of plane truss with number of unknowns not exceeding two at each node.

Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element. Analysis of frames with two translations and a rotational degree of freedom at each node

3. TWO DIMENSIONAL STRESS ANALYSIS — **Total Hrs** 9

Finite element modeling of two dimensional stress analysis problems with constant strain triangles treatment of boundary conditions. Two dimensional four noded isoparametric elements treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements.

Convergence requirements and geometric isotropy

4. HEAT TRANSFER PROBLEMS AND DYNAMIC ANALYSIS — **Total Hrs** 9

Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional, conduction analysis of thin plate, Time dependent field problems: Application to one dimensional heat flow in a rod.

Dynamic analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors, Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

5. THREE DIMENSIONAL PROBLEMS IN SRESS ANALYSIS — **Total Hrs** 9

Finite element formulation of three dimensional problems in stress analysis,

Bending of elastic plates: Thin and Thick plate formulations, Introduction to non-linear problems and Finite Element analysis software's

Total hours to be taught

Text book (s)

1. Tirupathi R Chandrupatla and Ashok.D. Belegundu, Introduction of Finite Element in Engineering. Prentice Hall of India, 2004
2. Rao S.S.,The Finite Element Methods in Engineering, 2nd Edn Pergamon Press, 2001.
3. David.V.Hutton, " Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003

References:

1. Robert Cook , "Concepts and applications of finite element analysis", 4e, John Wiley and sons,2009
2. Reddy J.N., An Introduction to Finite Element Methods ,Mc Graw Hill Company, 1984
3. K.J Bathe, Finite element procedures, 2nd Edn,Prentice Hall of India,2007
4. Logan, D. L. (2011). First course in finite element method, (5th Ed.). Mason, OH: SouthWestern, Cengage Learning.

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CBIT	Autonomous Regulation							
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Semester-I								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
16MEC 205	**COMPUTATIONAL FLUID DYNAMICS**	3	1	0	4	70	30	100

Objective (s)

1. To understand the basic equations and concept of CFD.
2. To make the students to learn concept of PDEs and finite difference methods.
3. To study various types of grid generation and errors in numerical solution.
4. To learn the Crank-Nihcolson, Implicit and Explicit methods
5. To prepare the students with Jacobi, Gauss Seidel and ADI methods
6. To enkindle the students importance of FVM

Outcome (s)

Students will be able to
1. derive CFD governing equations and turbulence models.
2. apply elliptical, parabolic and hyperbolic PDEs and forward, backward and center difference methods .
3. understand errors, stability, consistency and develop O,H and C grid generated models.
4. evaluate the use of Crank-Nihcolson, Implicit and Explicit methods.
5. analyze problem by Jacobi, Gauss Seidel and ADI methods.
6. solve conduction and convection problems using FVM

1	**BASIC EQUATIONS IN FLUID DYNAMICS**	**Total Hrs**	9

Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-ε turbulence Model.

2	**CLASSIFICATION OF PDEs**	**Total Hrs**	9

Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions.
Concepts of Finite difference methods – forward, backward and central difference.

3	**GRID GENERATION**	**Total Hrs**	9

Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria.

4	**FINITE DIFFERENCE SOLUTIONS**	**Total Hrs**	9

Finite difference solutions-Parabolic PDEs – Euler, Crank Nicholson, Implicit methods, Elliptic PDEs – Jacobi, Gauss Seidel, ADI, methods. FD- solution for Viscous incompressible flow using Stream function – Vorticity method & MAC method

5	**FINITE VOLUME METHOD**	**Total Hrs**	9

Introduction to Finite volume method. Finite volume formulations for diffusion equation, convection diffusion equation. Solution algorithm for pressure velocity coupling in steady flows. Use of Staggered grids SIMPLE Algorithm.

Total hours to be taught	**45**

Text book (s)

1	John D Anderson, 'Computational Fluid Dynamics', Mc Graw Hill, Inc., 2015.
2	H.K.Versteeg - 2015, Malala Shekara, Introduction to " Finite Volume Method" Pearson
3	Muralidhar K, Sundararajan T, 'Computational Fluid flow and Heat transfer', Narosa Publishing House, 2003
4	Patankar, S.V, 'Numerical Heat transfer and Fluid flow', Hemisphere Publishing Company, New York,1980

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 110	**MECHANICS OF COMPOSITE MATERIALS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.
2. An ability to predict the elastic properties of fiber composites based on the constituent properties.
3. An ability to analyze a laminated plate in bending, including finding laminate properties from lamina properties.
4. An ability to predict the failure strength of a laminated composite plate

Outcome (s)

1. Classify the composites, types of reinforcements, matrices and phases.
2. Recognize the fundamentals of orthotropic materials and mechanics of materials in micro and macro level.
3. Understand different fabrication methods of composites.
4. Demonstrate the fundamentals of directional stresses and strains. Transformation of stress and strain.
5. Understand the failure of composites including fracture.
6. Analyze different types of composite structures using plate and shell theory

1.	Total Hrs	9

Introduction: Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites and carbon carbon composites.

2.	Total Hrs	9

Micromechanics of lamina and mechanical properties: Prediction of Elastic constants, micromechanical approach, Halpin-Tsai equations. Thermal properties, Hygro properties, mechanics of load transfer from matrix to fibre

3.	Total Hrs	9

Macro-mechanics of lamina: Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances. Variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams

4.	Total Hrs	9

Strength, fracture, fatigue and design: Tensile and compressive strength of unidirectional fibre composites, fracture modes in composites: single and multiple fractures, de-bonding, fibre pullout and de-lamination failure, fatigue of laminate composites. Effect of variability of fibre strength. Strength of an orthotropic lamina: Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials

5.	Total Hrs	9

Analysis of laminated plates and shells: Plate equilibrium equations, Bending of composite plates, Levy and Navier solution for plates of composite materials. Analysis of composite cylindrical shells under axially symmetric loads.

Total hours to be taught	Total Hrs	45

Text book (s)

1. Jones, R.M., *Mechanics of Composite Materials, Mc Graw Hill Co., 1967*
2. B.D.Agarwal et.al, *Analysis and performance of fiber composites*,3rd edition, Wiley sons., 2013
3. Ever J Barbero, *Introduction to composite materials design*, Taylor &Francis, 1999.

Reference(s)

1. Whitney, I.M. Daniel, R.B. Pipes, *Experimental Mechanics of Fibre Reinforced Composite Materials*, Prentice Hall, 1984
2. Hyer, M.W., *Stress Analysis of Fibre Reinforced Composite Materials*, Mc Graw Hill Co., 1998
3. Carl. T. Herakovich, *Mechanics of Fibrous Composites*, John Wiley Sons Inc., 1998.

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 121	**PRODUCT DESIGN AND PROCESS PLANNING**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To impart the concepts about design and manufacturing engineering
2. To understand the ergonomic considerations to manufacture a product

Outcome (s)

1. Imparting basic foundation and advanced concepts about Design and Manufacturing Engineering.
2. Root cause analysis of a design engineering problem through basic and engineering sciences.
3. Understanding and learning of Manufacturing issues.
4. Imparting research activities through curriculum.
5. Solving complex design engineering problems. and apply latest engineering tools with advanced software knowledge .
6. Mechanical engineering solutions to green and sustainable development

1. — **Total Hrs 9**

Product design and process design functions, selection of a right product, essential factors of product design, Morphology of design, sources of new ideas for products, evaluation of new product ideas Product innovation procedure-Flow chart. Qualifications of product design Engineer. Criteria for success/failure of a product. Value of appearance, colours and Laws of appearance

2. — **Total Hrs 9**

Product reliability, Mortality Curve, Reliability systems, Manufacturing reliability and quality control. Patents: Definitions, classes of patents, applying for patents. Trademarks and copyrights. Cost and quality sensitivity of products, Elements of cost of a product, costing methods, cost reduction and cost control activities. Economic analysis, Break even analysis Charts. Value engineering in product design, creativity aspects and techniques. Procedures of value analysis – cost reduction, material and process selection.

3. — **Total Hrs 9**

Various manufacturing processes, degree of accuracy and finish obtainable, process capability studies. Methods of improving tolerances. Basic product design rules for Casting, Forging, Machining, Sheet metal and Welding. Physical properties of engineering materials and their importance on products. Selection of plastics, rubber and ceramics for product design

4. — **Total Hrs 9**

Industrial ergonomics: Man-machine considerations, ease of maintenance. Ergonomic considerations in product design-Anthropometry, Design of controls, man-machine information exchange. Process sheet detail and their importance, Advanced techniques for higher productivity. Just-in-time and Kanban System. Modern approaches to product design: quality function development, Rapid prototyping

5. — **Total Hrs 9**

Role of computer in product design and management of manufacturing, creation of manufacturing data base, Computer Integrated Manufacturing, communication network, production flow analysis, Group Technology, Computer Aided product design and process. Planning. Integrating product design, manufacture and production control

Total hours to be taught — **Total Hrs 45**

Text book (s)

1 Niebel, B.W., and Draper, A.B., Product design and process Engineering, Mc Graw Hill – Kogalkusha Ltd., Tokyo, 1974.

2 Chitale, A.K, and Gupta, R.C., Product Design and Manufacturing, Prentice Hall of India Pvt. Ltd., New Delhi, 2004

Reference(s)

1. Mahajan, M. Industrial Engineering and Production Management, Dhanpath Rai & Co., 2000

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 112	**EXPERIMENTAL TECHNIQUES AND DATA ANALYSIS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)	1. To get acquainted with improving quality of product/process by studying various parameters 2. To gain the knowledge regarding improvement of productivity
Outcome (s)	1. Show the general principle of measurement 2. Classify and apply different transducers for converting cutting forces into suitable signals 3. State the design requirements of tool-force dynamometers 4. Understand various surface measurement aspects 5. Able to apply Taguchi methods for different optimization problems

1. **Total Hrs 9**

Measurement of Cutting Forces: Strain gauge and piezoelectric transducers and their characteristics. Dynamometer construction, Bridge circuits. Instrumentation and calibration. Displacement and strain measurements by photoelasticity. Holography, interferometer, Moir techniques, strain gauge rosettes

2. **Total Hrs 9**

Temperature Measurement: Circuits and instrumentation for different transducers viz, bimetallic, expanding fluid, electrical resistance, thermister, thermocouples, pyrometers

Flow Measurement : Transducers for flow measurements of Non-compressible and compressible fluids. Obstruction and drag methods. Vortex shredding flow meters. Ultrasonic, Laser Dopler and Hotwire anemometer. Flow visualization techniques, Shadow graphs, Schlieren photography. Interferometer

3. **Total Hrs 9**

Metallurgical Studies: Optical and electron microscopy, X-Ray diffraction, Bragg's Law and its application for studying crystal structure and residual stresses, Electron spectroscopy, electron microprobe, Surface Measurements: Micro hardness, roughness, accuracy of dimensions and forms. 3-D co-ordinate, measuring machines

4. **Total Hrs 9**

Experiment design & data analysis: Statistical methods, Randomised block design, Latin and orthogonal squares, factorial design. Replication and randomization.

Data Analysis: Deterministic and random data, uncertainty analysis, tests for significance: Chi-square, student's 't' test. Regression modeling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modeling

5. **Total Hrs 9**

Taguchi Methods: Experiment design and planning with Orthogonal arrays and linear graphs. Additive cause effect model. Optimization of response level. Identification of Design and noise factors

Performance evaluation and Optimization by signal to noise ratios. Concept of loss function and its application.

Total hours to be taught **Total Hrs 45**

Text book (s)

1. Holman, J.P.: *Experimental Methods for Engineers*, McGraw Hill Int., New York
2. Venkatesh, V.C., and Chandrasekharan, *Experimental Methods in Metal Cutting*, Prentice Hall of India, Delhi

Reference(s)

1. Davis, O.V.; *The Design and Analysis of Industrial Experiments*, Longman, London
2. Box and Jenkins; *Time Series analysis, Forecasting and control*, Holden Day, Sanfrancisco
3. Dove and Adams, *Experimental stress analysis and motion measurement*, Prentice Hall of India, Delhi
4. Tapan P. Bagchi, *Taguchi Methods Explained*, Prentice Hall of India, Delhi

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 113	**DESIGN FOR MANUFACTURE**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)	1. To provide understanding of manufacturing processes and design concepts 2. To make the students understand the linkage required between design and manufacturing
Outcome (s)	Student will able to 1. understand constraints of manufacturing processes that limit design possibilities with respect to cycle time, material handling, and other factory costs 2. design suitable manufacturing process capable of designing metallic components 3. design suitable manufacturing process capable of designing non-metallic components 4. design welded assembly, gear box assembly etc. 5. design suitable manufacturing process capable of designing the bolted, screwed, flanged connections etc. 6. prepare a project or report applying DFM principles per an example from industry

1.	**Total Hrs**	**9**
Introduction: General design principles for manufacturability, strength and mechanical factors, mechanisms selection, evaluation method, geometrical tolerances, tolerance control and utilization. Economic Use of Raw Materials: Ferrous steel, hot rolled steel, cold finished steel, stainless steel, non ferrous materials aluminium, copper, brass, non metallic materials, plastics, rubber and composites		
2.	**Total Hrs**	**9**
Metallic Components Design: Metal extrusion, metal stamping, fine blanking, four slide parts, spring and wire forms, spun metal parts, cold headed parts, extruded parts, tube and section bends, rolled formed parts, power metal parts, forging electro forming parts, specialized forming methods, turned parts, machined round holes, drilled parts, milled parts.		
3.	**Total Hrs**	**9**
Non Metallic Components Design: Thermosetting plastic, injection moulded and rotational moulded parts, blow moulded, welded plastic articles, ceramics		
4.	**Total Hrs**	**9**
Assembled Parts Design: Welded parts, arc, resistance, brazed and soldered parts, gear box assembly, bearing assembly		
5.	**Total Hrs**	**9**
Assembled Parts Design: Retension, bolted connection, screwed connections, flanged connections, centred connections, press fitted connections, surface finishing, plated parts, heat treated parts, NC machining, group technology, low cost automation, computer aided manufacture, product design requirements. **Case Studies:** Identification of economical design and redesign for manufacture		
Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1. James G. Bralla, —*Hand book of product design for manufacturing*‖ McGraw Hill Co., 1986
2. K.G. Swift —*Knowledge based design for Manufacture*‖, Kogan page Limited, 1987.

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<table>
<tr><td>CBIT</td><td>Autonomous Regulation</td><td colspan="4">Semester-1</td><td colspan="3">AY - 2006-17</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td><td colspan="4">Programme Code & Name</td><td colspan="3">M.E. CAD/CAM</td></tr>
<tr><td>Course Code</td><td>Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">16MEE 114</td><td rowspan="2">DATA BASE MANAGEMENT SYSTEMS</td><td>L</td><td>T</td><td>P</td><td>C</td><td>E</td><td>I</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>70</td><td>30</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">1. To understand the different issues implementation of a database system.
2. To study the logical database designs, database modeling, relational network models
3. To understand data manipulation language to query and manage a database</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">After the completion of the course, the student will be able to :
1. Understand the basic concepts and applications of database systems.
2. Familiarized with commercial relational database system.
3. Demonstrate an understanding of the relational data model
4. Familiarized with indexing methods including B-tree, and hashing.
5. work successfully in a team by design and development of a database application
6. Understand the basics of query evaluation techniques and and query optimization</td></tr>
<tr><td colspan="7">1.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Introduction and E.R. Model: Purpose of database systems, Data abstraction, Data models, Data independent DDL, DML, DBA. Entities and entity sets. Relationships and relationship sets Mapping constraints, Primary Keys E-R diagrams, reducing E-R Diagram to tables.</td></tr>
<tr><td colspan="7">2.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Relational model and relational database design: Structure of relational database, former query languages, commercial query languages. Modifying the database views. Pitfalls in relational database design and normalization.</td></tr>
<tr><td colspan="7">3.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Network data model and hierarchical data model: data structure diagram, the DBTCCODASYL. Model data retrieval Update and set processing facility, Three structure diagram, data retrieval and update facility, virtual records</td></tr>
<tr><td colspan="7">4.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">File and System Structure, Indexing and Hashing: Physical storage media – file organization, buffer management, Mapping relations, networks and hierarchies to files – Index – sequential files. Bi-tree indexed files</td></tr>
<tr><td colspan="7">5.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Distributed database, security and integrity: Design, transparency and autonomy, query processing, recovery, concurrency control, deadlock handling and coordinator selection. Security and integrity, near database application</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>Total Hrs</td><td>45</td></tr>
<tr><td colspan="9">Text book (s)</td></tr>
<tr><td colspan="9">1. Korth, H.F. Silbenhatz, A., Database Concepts, Mc Graw Hill, 1986
2. Gio Wiederhold, Database Design, Mc Graw Hill, 1983</td></tr>
<tr><td colspan="9">Reference(s)</td></tr>
<tr><td colspan="9">1. Jefferey O Ullman, Principles of database systems
2. C.J. Date, An Introduction to database systems, Addison Wisely, 1980.
3. Trembley and Soreson, An Introduction to Data structures with applications, Mc Graw Hills.</td></tr>
</table>

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 115	**FRACTURE MECHANICS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To introduce students to the concepts of materials fracture and failure analysis
2. To equip them with knowledge on how to design against catastrophic failures

Outcome (s)

At the completion of the course ,the student can:

1. Identify and explain the types of fractures of engineered materials and their characteristic features;
2. Understand the differences in the classification of fracture mechanics (LEFM and EPFM)• and how their corresponding parameters can be utilized to determine conditions under which engineering materials will be liable to fail catastrophically in service;
3. Understand and explain the mechanisms of fracture;
4. Appreciate the theoretical basis of the experimental techniques utilized for fracture
5. Develop expertise on the experimental techniques utilized for fracture and failure analysis
6. Learn simple LEFM testing methods for evaluating the fracture toughness of materials

Unit	Total Hrs	
1.	**Total Hrs**	**9**

Introduction: Crack in a Structure – Griffth Criterion – Cleavage fracture – Ductile fracture – Fatigue Cracking. Service failure analysis.

2.	**Total Hrs**	**9**

Elastic Crack: Elastic Crack tip stress field – Solution to crack problems. Effect of finite size stress intensity factor – Special cases – Irwin plastic zone correction. Actual shape of plastic zone – Plane stress – Plane strain.

3.	**Total Hrs**	**9**

Energy Principle: Energy release rate – Criterion for crack growth – Crack resistance curve – Principles of crack arrest – Crack arrest in practice

Fatigue Crack Growth: Fatigue crack growth test, stress intensity factor, factors affecting stress intensity factor – Variable amplitude service loading, retardation model

4.	**Total Hrs**	**9**

Elastic Plastic Fracture Mechanics: Elastic plastic fracture concept – Crack tip opening displacement – J-integral technique; Determination of J-using FEM

5.	**Total Hrs**	**9**

Application of Fracture Mechanics: Fracture design – Selection of materials – fatigue crack growth rate curve – Stress intensity factor range – Use of crack growth law

Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1. David Broek – Elementary Engineering Fracture Mechanics: Sifth off an Noordhoff Internal Publishers – 1978.
2. Calcote, L.R., *The Analysis of Laminated Composite Structures*, Van Nostrand, 1969

Reference(s)

1. Jean Cernative and Jean Louis Chboche Mechanics of Solid Materials, Cambridge University Press Cambridge, 1987

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 116	**DESIGN OF PRESS TOOLS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To make the students understand the basic concepts involved in designing press tools
2. To make students capable of designing various press tools which are safe, easy to operate, reliable and economical for manufacturing.

Outcome (s)

Student will be able to

1. classify types of presses, characteristics and their principles.
2. understand the terminology in the design of Dies.
3. understand Elements of shearing dies
4. understand the basic concepts and principle involved in designing press tools.
5. ne in a position to independently design various press tools which will cater to requirement of industry
6. understand the different types of dies

1. | **Total Hrs** | **9**

Classification of Mechanical, Hydraulic, and pneumatic presses, Press Characteristics, safety devices in presses. Principles of stretch forming machines, principles of feeding and unloading equipment. Design principles of presses.

2. | **Total Hrs** | **9**

Design of Dies: Introduction terminology shearing dies- types of dies – analysis process shearing clearance – size and tolerances of die opening and punch – force, power, energy in shearing – loading center, shearing with inclined edges – strip layouts, economical stock – Utilization.

3. | **Total Hrs** | **9**

Elements of shearing dies – die plates – split dies, rules of development for split dies, inserts, types of punches, punch holders, punches – strippers – calculation of springs and rubber ejector, shedders, stops – pilots – stock guides – alignment system design for press tools

4. | **Total Hrs** | **9**

Compound dies, progressive dies, stock feeding devices – cam actuated die, horn dies (type, sub-press dies) – precision shearing dies, shaving dies, lamination dies – Bending dies, theory of bending development of blank, spring back, curling, flanging and press brake dies, bending on press brake

5. | **Total Hrs** | **9**

Drawing and forming Dies: Theory of drawing, blank development, strain factor, calculation of force, construction of drawing and drawing dies – Drawing of rectangular components (development, stages draw beeds) – Ironing (application of rubber and hydraulic system) – Defects in deep drawing – Modern Metal forming techniques – Discussion of various computer software for sheet metal design

Total hours to be taught | **Total Hrs** | **45**

Text book (s)

1. *Fundamentals of tool Design* – ASTME, Prentice Hall, New Delhi, 1987
2. *Die design Hand book* – AISME, Mc Graw Hills, New York, 1965

Reference(s)

1. Heinrich Makelt, *Mechanical Presses*, Edward Arnold, London, 1968
2. Serope Kalpakjain, *Mechanical Processing in Materials*, 1967
3. Javoronkov V.A and Chaturvedi. *R.C. Rolling of Metals*
4. Eary and Redds, *Shear Working of Metals*, Prentice Hall, New Delhi, 1969.
5. Honeyeeme R.W.K., *The plastic Deformation of metals*, Edward Arnold, London, 1968
6. Kamenschikov, *Forging Practice*, Mir. Pub., Moscow, 1968
7. *High Velocity Forming of metals*, ASME, Michigan, 1968
8. Bhattacharya.A, *New Technology*, Institute of Engineers, Calcutta, 1973

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<table>
<tr><td>CBIT</td><td>Autonomous Regulation</td><td colspan="4">Semester-1</td><td colspan="3">AY - 2006-17</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td><td colspan="4">Programme Code & Name</td><td colspan="3">M.E. CAD/CAM</td></tr>
<tr><td>Course Code</td><td>Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">16MEE 117</td><td rowspan="2">DESIGN OF DIES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>E</td><td>I</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>70</td><td>30</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">1. To make students understand the various steps and procedure involved in designing and manufacturing dies
2. To make students capable of solving complex geometric problems related to tool and die making</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">Upon completion of the subject, students will be able to:

1. Apply contemporary design principles when designing advanced moulds and dies;
2. Assess the performance of a given tool design based on the design criteria;
3. Evaluate the effects of a given tool design on the quality of the work.
4. Describe the principles of clamping, drill jigs and computer aided jig design
5. Design fixtures for milling, boring, lathe, grinding, welding; identify fixtures and cutting tools for NC machine tools
6. Explain the principles of dies and moulds design</td></tr>
<tr><td colspan="7">1.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Design principles for dies of thermo-plastic and thermo-setting components. Impression core cavities, strength of cavities, guide pillars and bushes, ejection systems, cooling methods, bolster types. Split moulds, methods of actuating the splits, moulds of threaded components, internal & external under cuts, moulds with under – feed systems. Design principles and standards for Transfer and compression moulding dies.
Design of Tools: Mould for a spindle component with sleeve, pin ejection. Mould with splits Multi-cavity mould with stripper plate, inserts, ejectors.</td></tr>
<tr><td colspan="7">2.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Design of Dies for metal mould Castings, Die casting, Shell moulding.
Design of casting cavity, sprue, slug, fixed and movable cores, finger cam, core, pin, draft, ejector pins, ejector plate, gate, goose-neck, nozzle, over-flow, platen plunger, runner, slot, slide, vent, water line. Design of hot chamber, cold chamber machines, vertical, horizontal,, die locking machines, toggle and hydraulic systems, injection systems, rack and pinion, knockout pins and plates, hydraulic ejection, Other parts of die casting machines</td></tr>
<tr><td colspan="7">3.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Design of various types of dies – Single cavity, multi cavity, combination, unit dies. Alignment of dies with sprue. Design approach for die elements. Selection of materials and heat treatment for die casting dies and elements – die casting alloys – types of die casting alloys, Case studies on executed dies and design details. Finishing, Trimming, and inspection. Gravity die casting – Die design with cores and inserts – Bulk forming tools</td></tr>
<tr><td colspan="7">4.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Open die forging, Advantages of open die forging over closed die forging. Calculation of allowances and tolerances. Methods of open die forging. Design of dies. Closed die forging. Preparation of material for forging. Calculation of raw-stock, cutting off, heating in furnaces. Allowances and tolerances for closed die forging as per IS: 3469 1974</td></tr>
<tr><td colspan="7">5.</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Die blocks for forging operations. Design of fuller impression, Roller impression, Bender impression, Blocker impression, Finisher impression. Swaging tools. Planning layout of multi impression dies. Flash and cutter calculations – additional operations on forging, piercing, and trimming dies, coining dies. Horizontal forging machines. Design of upsetting dies. Calculations on upsetting dies – Press forging reducer rollers. Forging equipment. Layout of forge shop. Roll forming, wire drawing forward & backward extrusion</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td>Total Hrs</td><td>45</td></tr>
<tr><td colspan="9">Text book (s)</td></tr>
<tr><td colspan="9">1. Rusinoff S.E., Forging & Forming Metals, Taraporewala, Bombay, 1952
2. Dochlar H.H., Die Casting Dies, Mc Grawhill, 1951</td></tr>
<tr><td colspan="9">Reference(s)</td></tr>
<tr><td colspan="9">1. I.S. Standards, BSI., New Delhi.
2. Pye R.G.W., Injection Mould Design, Longman scientific & Technical Publishers, London, 1989</td></tr>
</table>

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 118	**RAPID PROTOTYPING PRINCIPLES AND APPLICATIONS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

1. To make students understand the basic concepts of various rapid prototyping technologies.
2. To understand and apply criterion for selecting appropriate RPT technique for any given application.

Outcome (s)

1. identify different process and key characteristics of RP technologies and commonly used RP systems
2. describe various CAD issues for rapid prototyping and related operations for STL model generation and manipulation
3. Explain and summarize typical rapid tooling processes for quick batch production of plastic and metal parts
4. critically explore technologies used for rapid prototyping in terms of their parameters, application, limitations, cost, materials, equipment, outcomes and implications
5. distinguish the types of Additive Manufacturing capabilities based on part geometry customer demands and CNC machine capabilities
6. identify different post processing techniques involved after rapid prototyping.

1. — Total Hrs: 9

Introduction: Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain

2. — Total Hrs: 9

Liquid-based Rapid Prototyping Systems: Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. Solid ground curing (SGC): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies **Solid-based Rapid Prototyping Systems**: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies

3. — Total Hrs: 9

Powder Based Rapid Prototyping Systems: Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Rapid Tooling: Introduction to Rapid Tooling (RT), Conventional Tooling Vs RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP

4. — Total Hrs: 9

Rapid Prototyping Data Formats: STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats.
Rapid Prototyping Software's: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3D doctor

5. — Total Hrs: 9

RP Applications: Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. **RP Medical and Bioengineering Applications:** Planning and simulation of complex surgery, Customised Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visulization of Biomolecules

Total hours to be taught — **Total Hrs: 45**

Text book (s)

1. Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications , Third Edition, 2010
2. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer , 2001

Reference(s)

1. Wholers Report 2000 – Terry Wohlers, Wohlers Associates, 2000
2. Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press, 1996

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 119	**Flexible Manufacturing Systems**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

The course covers the significance of manufacturing systems over numerical control machining methods. The fundamentals of flexible manufacturing system are clearly stated from the design concepts that include usage of operation cycle description, robot automatic guided vehicle, chip removal, washing station, fixturing etc

Outcome (s)

Upon completion of the subject, student will be able to

1. the understand the elements of flexible manufacturing system
2. Students can independently develop the sequence of operations that are to be performed for manufacturing of a product
3. understand the functioning of programmable logical controller
4. understand Automated storage and retrieval systems
5. understand the concept of just in time manufacturing
6. understand the FMS design concept

1.	**Total Hrs**	**9**

Evolution of Manufacturing Systems: FMS definition and description, General FMS considerations, Manufacturing cells, Cellular versus Flexible Manufacturing.
Systems Planning: Objective, introduction planning, preparation guidelines, the project team, supplier selection, system description and sizing, facility preparation planning, FMS layouts. Human resources: staff considerations, team work, communication and involvement, the supervisors role, personnel selection, job classifications, employee training

2.	**Total Hrs**	**9**

Manufacturing's Driving Force: Definition, description and characteristics. Just in-time manufacturing, definition and description, benefits and relationship to FMS, implementation cornerstones, quality and quantity application principles. Single manufacture Cell – design scheduling of jobs on single manufacturing cells.
Group Technology: Concepts, classification and coding, benefits and relationship to FMS, design of group technology using rank order clustering technique

3.	**Total Hrs**	**9**

FMS Design – Using Bottleneck, Extended bottleneck models, Processing and Quality Assurance: Turning centres, Machining centre, construction and operations performed, axes, programming, and format information, work-holding and work-changing equipment, automated features and capabilities, cleaning and deburring – station types and operation description, importance to automated manufacturing, coordinate measuring machines, types, construction and general function, operation cycle description, importance to flexible cells and systems

4.	**Total Hrs**	**9**

Automated movement and storage systems–AGVs, Robots, automated storage and retrieval systems, storage space design, queuing carousels and automatic work changers, coolant and chip Disposal and recovery systems, auxiliary support equipment, cutting tools and tool Management – introduction, getting control of cutting tools, Tool Management, tool strategies, data transfer, tool monitoring and fault detection, guidelines, work holding considerations, General fixturing, Modular fixturing. FMS and the relationship with workstations – Manual, automated and transfer lines design aspects

5.	**Total Hrs**	**9**

FMS: computer Hardware, Software, Communications networks and Nanotechnology – general functions, and manufacturing usages, hardware configuration, programmable logic controllers, cell controllers, communications networks. FMS implementation

Total hours to be taught	**Total Hrs**	**45**

Text book (s)

1. Parrish, D.J., _*Flexible Manufacturing*', - Butter Worths – Heinemann, Oxford, 1993
2. Groover, M.P., _*Automation, Production Systems and CIM*', - Prentice Hall India, 1989

Reference(s)

1. Kusiak, A., _*Intelligent Manufacturing Systems*', - Prentice Hall, 1990
2. Considine,D.M., & Considine,G.D., _*Standard Handbook of Industrial Automation*',-Chapman & Hall, 1986
3. Ranky, P.G., _*Design and Operation of FMS*', - IFS Publishers, UK, 1988

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 120	**NON-TRADITIONAL MACHINING AND FORMING**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100
Objective (s)	1. To make the students understand the need and the applications of nontraditional machining processes. 2. To choose the NTM processes for particular applications							
Outcome (s)	Students can understand, 1.the importance ,principles of various Non-traditional processes 2.the processes of Thermal Metal Removal 3.the parameters and chemistry of Electro chemical process 4.the principles of Plasma Arc machining 5.the principles of laser Beam and Electron Beam machining 6.to make the comparison of conventional and high velocity forming methods							

1.	**Total Hrs**	**9**
Introduction: Need for non-traditional machining processes. Processes selection, classification, comparative study of different processes. **Mechanical Process:** Ultrasonic Machining-Definition-Mechanism of metal elements of the process- Tool feed mechanism. Theories of mechanics of causing effect of parameter applications. **Abrasive Jet Machining:** Principles - parameters of the process, applications, advantages and disadvantages. **Water Jet Machining (WJM):** Schematic diagram, equipment used, advantages and applications		
2.	**Total Hrs**	**9**
Thermal Metal Removal Process: Electric discharge machining Principle and operation – mechanism of meta removal, basic EDM circuitry-spark erosion. Analysis of relaxation type of circuit material removal rate in relaxation circuits- critical resistance parameters in Ro Circuit-Die electric fluids- Electrodes for surface finish. Applications. Wire EDM principle and operation. Wire materials, wire tension and its parameters. Applications		
3.	**Total Hrs**	**9**
Electro Chemical and Chemical Processes: Electro chemical machining (ECM) Classification ECM process-principle of ECM Chemistry of the ECM parameters of the processes-determination of the metal removal rate - dynamics of ECM process-Hydrodynamics of ECM process-polarization. Tool Design-advantages and disadvantages - applications. Electro Chemical Grinding-Electro Chemical holding Electrochemical deburring. **Plasma Arc Machining:** Introduction-Plasma-Generation of Plasma and equipment Mechanism of metals removal, PAN parameters-process characteristics - type of torches applications		
4.	**Total Hrs**	**9**
Electron Beam Machining (EBM): Introduction-Equipment for production of Electron beam - Theory of electron beam machining Thermal & Non thermal types characteristics – applications. **Laser Beam Machining (LBM):** Introduction-principle of generation of lasers Equipment and Machining procedure-Types of Lasers-Process characteristics-advantages and limitations-applications		
5.	**Total Hrs**	**9**
High Velocity Forming Process: introduction - development of specific process selection-comparison of conventional and high velocity forming methods - Types of high velocity forming methods- explosion forming process-elector hydraulics forming magnetic pulse forming. Electro-Magnetic Forming. Rubber Pad Forming: Principle of the process, process details, process variants - Guerin, wheelon, Marforming and Hydro forming processes and applications		
Total hours to be taught	**Total Hrs**	**45**
Text book (s)		
1. New Technology Institution of Engineers - Bhattacharya – India 2. Production Technology - HMT - Tata Mc Graw Hill - ISBN-10		
Reference(s)		
1. Modern Manufacturing Method - Adithan - New Age International (p) Limited 2. Modern Machining Processes - P.K. Mishra - Narosa Publishing House, New Delhi - 1997.		

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 107	**COMPUTATIONAL LABORATORY**	L	T	P	C	E	I	Total
		0	0	3	2		50	50

Objective(s)

1. To understand how and why finite element technique works
2. To learn the selection of the element type for a defined problem.
3. To use ANSYS package to solve engineering problems for a variety of application
4. To learn to use finite element analysis in design
5. To know various fields of engineering where these tools can be effectively used to improve the output of a product
6. To impart the fundamental knowledge on using various analytical tools like ANSYS Engineering Simulation.

Outcome(s):

Students will be able to:

1. Use the tools like ANSYS in solving real time problems and day to day problems.
2. Apply the Finite Element Method for the calculation stresses, strains and deformations in any component
3. critically evaluate the model results in comparison to simplified analytical solutions
4. Versatility in using these tools for any engineering and real time applications.
5. Gain knowledge on utilizing these tools for a better project in their curriculum
6. Face industry with confidence in using these tools in their respective jobs

List of Experiments:

1. Introduction to Finite Element Analysis Software.
2. Static analysis of a corner bracket.
3. Statically indeterminate reaction force analysis.
4. Determination of Beam stresses and Deflection.
5. Bending analysis of a Tee-shaped beam.
6. Analysis of cylindrical shell under pressure.
7. Bending of a circular plate using axisymmetric shell element.
8. Stress analysis in a long cylinder.
9. Solidification of a casting.
10. Transient Heat transfer in an infinite slab.
11. Transient Thermal stress in a cylinder.
12. Vibration analysis of a simply supported beam.
13. Natural frequency of a motor generator.
14. Thermal – structural contact analysis of two bodies.
15. Drop test of a container (Explicit Dynamics).

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Scheme of Instruction & Examination
M.E. (CAD/CAM) – Mechanical Engineering - 4 Semesters (Full Time)

Semester - I

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1	4	30	70	100	4
2.	Core	3	1	4	30	70	100	4
3.	Core	3	1	4	30	70	100	4
4.	Elective	3	--	3	30	70	100	3
5.	Elective	3	--	3	30	70	100	3
6.	Elective	3	--	3	30	70	100	3
7.	Laboratory	--	3	3	50	--	50	2
8.	Seminar - I	--	3	3	50	--	50	2
9.	Soft Skills	--	--	--	--	--	--	--
	Total	**18**	**09**		**340**	**360**	**700**	**25**

Semester - II

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1		30	70	100	4
2.	Core	3	1		30	70	100	4
3.	Core	3	1		30	70	100	4
4.	Elective	3	--		30	70	100	3
5.	Elective	3	--		30	70	100	3
6.	Elective	3	--		30	70	100	3
7.	Laboratory - II	--	3		50	--	50	2
8.	Seminar - II	--	3		50	--	50	2
9.	Mini Project	--	2		50	--	50	1
	Total	**18**	**11**		**390**	**360**	**750**	**26**

Semester - III

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Seminar* (i)Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd Semester. (50 Marks) (ii) Preliminary work on Project implementation. (50 Marks)	100	--	100	6
	Total	100		100	6

Semester - IV

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Work	100	100	200	12

Note: Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars, Mini Project
and Soft Skills should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only. 50 marks awarded by the project guide
and 50 marks by the internal committee

Credit requirements for the award of degree, lower limit and upper limit of credits for registration by a student in a semester Credit Requirement for the award of M.E/M. Tech. Degree is 69

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16MEC 110

MINIPROJECT GUIDELINES

Instruction	2 Hrs / week
Sessional	50 Marks
Credits	01

Objectives:

First year ME students will each do a 14-week mini project, each generally comprising about one week of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment (see assessment information below). Each student will be allotted to a Faculty supervisor for mentoring.

Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original. Mini projects should have inter disciplinary/ industry relevance. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling. All the investigations are clearly stated and documented with the reasons/explanations. All the projects should contain A clear statement of the research objectives, background of work, Literature review, techniques used, prospective deliverables, benefit from this [line of] research, Detailed discussion on results, Conclusions and references.

Outcomes:

Students are able to
1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained and write the documentation in standard format

Assessment:

1. 50 % of marks for a scientific report on the project.
   Regarding the formatting and structure, the report should be written as a journal article using the style file of a journal appropriate for the field of the research (which journal format is most appropriate should be agreed between student and supervisor). If the journal you selected has a page limit, it can be ignored but the report should not exceed 8000 words (common sense should be used if there are a lot of equations).

   Regarding content, the report should be understandable by your fellow students, so the introduction and literature review could be a bit more detailed than in a research paper. The results and discussions are in elaborate form and at end conclusions and include references.

2. 50 % of marks for an oral presentation which will take place at the end of the semester and evaluation by a committee consist of Supervisor, one senior faculty and Head of the department or his nominee.

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With effect from the academic year 2016- 2017

Scheme of Instruction & Examination
M.E. (CAD/CAM) – Mechanical Engineering - 4 Semesters (Full Time)

Semester - I

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1	4	30	70	100	4
2.	Core	3	1	4	30	70	100	4
3.	Core	3	1	4	30	70	100	4
4.	Elective	3	--	3	30	70	100	3
5.	Elective	3	--	3	30	70	100	3
6.	Elective	3	--	3	30	70	100	3
7.	Laboratory	--	3	3	50	--	50	2
8.	Seminar - I	--	3	3	50	--	50	2
9.	Soft Skills	--	--	--	--	--	--	--
	Total	18	09		340	360	700	25

Semester - II

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1		30	70	100	4
2.	Core	3	1		30	70	100	4
3.	Core	3	1		30	70	100	4
4.	Elective	3	--		30	70	100	3
5.	Elective	3	--		30	70	100	3
6.	Elective	3	--		30	70	100	3
7.	Laboratory - II	--	3		50	--	50	2
8.	Seminar - II	--	3		50	--	50	2
9.	Mini Project	--	2		50	--	50	1
	Total	18	11		390	360	750	26

Semester - III

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Seminar* (i)Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd Semester. (50 Marks) (ii) Preliminary work on Project implementation. (50 Marks)	100	--	100	6
	Total	100		100	6

Semester - IV

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Work	100	100	200	12

Note: Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars, Mini Project
and Soft Skills should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only, 50 marks awarded by the project guide
and 50 marks by the internal committee

Credit requirements for the award of degree, lower limit and upper limit of credits for registration by a student in a semester Credit Requirement for the award of M.E/M. Tech. Degree is 69

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 202	**ADVANCED THERMODYNAMICS**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

1. To review the basic laws of thermodynamics and create awareness of the importance of thermodynamic principles in engineering applications.
2. To understand the behavior of Real Gases vis-à-vis ideal gas.
3. To create awareness of the importance of combustion reactions in real time applications.
4. To understand thermodynamic applications in psychrometry, refrigeration.
5. To understand the basic principles power cycles and its relation with combustion processes.
6. To understand various methods of direct energy conversion

Outcome (s)

A student will be able to

1. apply various laws of thermodynamics to suit the engineering applications.
2. apply the knowledge of thermodynamics for the behavior of real gases.
3. understand the phenomenon of combustion in IC engines
4. select and design air conditioning or psychrometric process depending on application and comfort conditions
5. understand the application of power cycles to engineering practice.
6. understand various non-conventional energy conversion methods like fuel cells etc.

1. LAWS OF THERMODYNAMICS	**Total Hrs**	**9**

Review of Thermo dynamic Laws and Corollaries – Transient Flow Analysis – Second law of thermodynamics – Entropy - Availability and unavailability – Irreversibility – Thermo dynamic Potentials – Maxwell Relations – Specific Heat Relations – Mayer's relation - Evaluation of Thermodynamic properties of working substance

2. PSYCHROMETRY AND AIR CONDITIONING PROCESS	**Total Hrs**	**9**

P.V.T. surface – Equations of state – Real Gas Behaviour – Vander Waal's equation - Generalised compressibility Factor – Energy properties of Real Gases – Vapour pressure – Clausius – Clapeyron Equation – Throttling – Joule – Thompson coefficient Non-reactive Mixture of perfect Gases – Governing Laws – Evaluation of properties – Pychrometric Mixture properties and psychrometric chart – Air conditioning processes – Cooling Towers – Real Gas Mixture

3. COMBUSTION REACTIONS	**Total Hrs**	**9**

Combustion – Combustion Reactions – Enthalpy of Formation – Entropy of Formation – Reference Levels for Tables – Energy of formation – Heat of Reaction – Aiabatic flame Temperature General product – Enthalpies – Equilibrium. Chemical Equilibrium of Ideal Gases – Effects of Non-reacting Gases Equilibrium in Multiple Reactions. The van Hoff's Equation. The chemical potential and phase Equilibrium – The Gibbs phase Rule

4. POWER CYCLES	**Total Hrs**	**9**

Power cycles, Review Binary vapour cycle, co-generation and Combined cycles – Second law analysis of cycles – Refrigeration cycles. Thermo Dynamics off irreversible processes – Introduction – phenomenological laws – Onsagar Reciprocity Relation – Applicability of the phenomenological Relations– Heat Flux and Entropy Production – Thermo dynamic phenomena – Thermo electric circuits

5. DIRECT ENERGY CONVERSION	**Total Hrs**	**9**

Introduction – Fuel Cells - Thermo electric energy – Thermo-ionic power generation -Thermodynamic devices Magneto Hydrodynamic Generations – Photo voltaic cells.

Total hours to be taught		

Text book (s)

1. Nag, P.K., "Basic and Applied Thermodynamics",TMH,2008
2. Holman, J.P., "Thermo Dynamics", Mc Graw Hill, 2008
4. Obert Edward. F. & Young Rober L, "Elements of Thermodynamics" McGraw Hills
5. Younus.A.cengel & Michael A. Boles " Thermodynamics an engineering approach sixth edition,TMH
6. Arian Bejan "Advanced Engineering Thermodynamics " 3rd Edition Wiley Publications,2006

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 203	**ADVANCED HEAT & MASS TRANSFER**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

Student will

1. understand the basic principles of fins and unsteady state heat transfer applied to industries.
2. learn various equations and their application in engineering heat transfer
3. understand boundary layer concept and their applications
4. learn about phase heat transfer and their applications
5. understand the importance of radiation heat transfer
6. learn about mass transfer and its applications in process industries

Outcome (s)

Student will be able to

1. apply the equations pertaining to unsteady state heat transfer and knowledge in extended surfaces
2. evaluate mass, momentum and energy equations with approximate and exact methods
3. apply heat transfer knowledge in calculation of boundary layer thickness and various dimensionless numbers
4. evaluate heat transfer coefficients under phase change phenomena
5. apply the knowledge of radiation heat transfer in various fields like solar engineering, design of reactors etc,
6. apply the knowledge of mass transfer in process industries

1. BRIEF INTRODUCTION TO DIFFERENT MODES OF HEAT TRANSFER — Total Hrs 9

Brief Introduction to different modes of heat transfer; Conduction: General heat conduction equation-Initial and Boundary conditions Steady State Heat Transfer: Simplified heat transfer in 1D and 2D – Fins.Transient heat conduction; Lumped system analysis- Heisler charts-semi infinite solid-use of shape factors in conduction - 2D transient heat conduction – product solutions

2. FINITE DIFFERENCE METHODS FOR CONDUCTION — Total Hrs 9

Finite Difference methods for Conduction: 1D & 2D steady state and simple transient heat conduction problems – implicit and explicit methods. Forced Convection: Equations of Fluid Flow – Concepts of Continuity, momentum equations – Derivation of Energy equation - Methods to determine heat transfer coefficient: Analytical Methods - Dimensional Analysis and concept of exact solution. Approximate Method – Integral analysis

3. EXTERNAL FLOWS — Total Hrs 9

External flows: Flow over a flat plate: Integral method for laminar heat transfer coefficient for different velocity and temperature profiles. Application of empirical relations to variation geometrics for Laminar and Turbulent flows. Internal flows: Fully developed flow: Integral analysis for laminar heat transfer coefficient – Types of flow – Constant Wall Temperature and Constant Heat Flux Boundary Conditions - Hydrodynamic & thermal entry lengths; use of empirical correlations

4. FREE CONVECTION & RADIATION — Total Hrs 9

Free convection: Approximate analysis on laminar free convective heat transfer – Boussinesque Approximation - Different geometries – combined free and forced convectionBoiling and condensation: Boiling curve – Correlations- Nusselt's theory of film condensation on a vertical plate – Assumptions & correlations of film condensation for different geometrics

5. MASS TRANSFER — Total Hrs 9

Radiation Heat Transfer: Radiant heat exchange in grey, non-grey bodies, with transmitting, reflecting and absorbing media, specular surfaces, gas radiation – radiation from flames. Mass Transfer: Concepts of mass transfer – Diffusion & convective mass transfer Analogies – Significance of non-dimensional numbers

Total hours to be taught

Text book (s)

1. Necati Ozisik "Heat Transfer" TMH 1998
2. Incropera Dewitt Fundamentals of Heat & Mass Transfer – John Wiley 2007
3. Yunus Cengel Heat Transfer: A basic approach – TMH 2008
4. R.C.Sachdeva Fundamentals of Engineering Heat & Mass Transfer" New Age International Publications 2010
5. J.P.Holman "Heat Transfer" Tata Mc Graw Hill, 2008

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 204		L	T	P	C	E	I	Total
	ADVANCED I.C. ENGINES	3	1	0	4	70	30	100

Objective (s)

1. importance of combustion phenomena in I.C. Engines
2. phenomena of the engine performance and decrease the pollutants knocking in SI and CI engines
3. concept of formation and control of different exhaust emissions from IC engines.
4. use of alternate fuel technology to improve
5. suggested modifications in I.C. engine to suit bio-fuels
6. basic concepts of recent trends with change of engine configuration

Outcome (s)

1. Describe the phenomena of combustion and knock in SI engines
2. Understand the normal and abnormal combustion in CI engines
3. Explain the sources and formation of various pollutants from IC engines
4. Understand how the undesirable exhaust emissions from IC engines are controlled
5. Demonstrate an understanding of technological, environmental and social impacts of alternative fuels
6. Explain modern concepts like Lean burn, stratification, HCCI and GD

1. SPARK IGNITION ENGINES	Total Hrs	9
Spark ignition engine mixture requirements – Fuel – Injection systems – Monopoint, Multipoint injection, Direct injection – Stages of combustion – Normal and abnormal combustion – Factors affecting knock – Combustion chambers		
2. COMPRESSION IGNITION ENGINES	**Total Hrs**	**9**
Stages of combustion in C.I. Engine – Direct and indirect injection systems – Combustion chambers – Normal and Abnormal Combustion – Knock in C.I Engines-Basic Concepts and Study of Fuel Spray – Introduction to Turbo charging		
3. POLLUTANT FORMATION AND CONTROL	**Total Hrs**	**9**
Pollutant – Sources – Formation of carbon monoxide, Unburnt hydrocarbon, Aldehydes, NOx, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters and Particulate Traps- Methods of measurements and Introduction to emission norms		
4. ALTERNATIVE FUELS	**Total Hrs**	**9**
Alcohol, Hydrogen, Natural Gas and Liquefied Petroleum Gas- Properties, Suitability, Merits and Demerits as fuels, Engine Modifications		
5. RECENT TRENDS	**Total Hrs**	**9**
Modification in I.C. engine to suit bio-fuels- Lean Burn Engines – Stratified charge Engines – homogeneous charge compression ignition (HCCI) engines and GDI concepts		
Total hours to be taught		

Text book (s)

1. Obert, E.F.Internal Computation Engines Harper & Row, Publishers N.Y3rd edition 1973
2. GILL, P.W.and Smith (Jr,J.H, fundamentals of Internal combustion Engines, Oxford & IBH publishing Co.New Delhi, 1967.

References:

1. Heywood, J.B, Internal Combustion engine fundamentals, McGrave Hills, Book Co, New York, 1988.
2. Taylor C.F.and Taylor, E,S.The Internal Combustion Engine in Theory and Practice, M.I.T.Press, 1968
3. Mathur,M.L.and Sharma,R.P.,Internal Combustion Engine,Dhanpat Rai & Sons, Delhi, 5th Edition,1990
4. Ganeshan, V., Internal Combustion engines, Tata Mc Graw Hills Publishing Co.Ltd, New Delhi 1984

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<table>
<tr><td>CBIT</td><td>Autonomous Regulation</td><td colspan="4">Semester-1</td><td colspan="3">AY - 2006-17</td></tr>
<tr><td>Department</td><td>Mechanical Engineering</td><td colspan="4">Programme Code & Name</td><td colspan="3">M.E. Thermal Engineering</td></tr>
<tr><td>Course Code</td><td>Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">16MEE 215</td><td rowspan="2">THERMAL AND NUCLEAR POWER PLANTS</td><td></td><td>T</td><td>P</td><td>C</td><td>E</td><td>I</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>70</td><td>30</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="8">Student will be able to understand the
1. Performance of steam power plant and to observe the importance of combustion of coal
2. Working principles of steam generators, turbines & condensers
3. Combined cycle effect in gas turbine power plants
4. Compare different nuclear reactors and estimate the economical benefits
5. Calculate the different energy tariffs under various load conditions
6. pressure, temperature and flow parameters of a power plant</td></tr>
<tr><td>Outcome (s)</td><td colspan="8">Students will be able to
1. analyze on combustion of coal and find performance of different power plant cycles.
2. analyze various steam generators, cooling towers, turbines & condensers.
3. analysis on combined cycle, power plants and waste heat recovery systems.
4. design various types of nuclear reactors taking safety precautions and making economically beneficial.
5. calculate the energy rates of power distribution considering the factors affecting the economy.
6. determine the pressure, temperature and flow measurements of steam and water to operate the power plant most efficiently and suggest various remedies to control pollutants.</td></tr>
<tr><td colspan="7">1. Layout of Power Plants</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Sources of Energy, types of Power Plants, Direct Energy Conversion System, Energy Sources in India, Recent developments in Power Generation. Combustion of Coal, Volumetric Analysis, Gravimetric Analysis, Flue gas Analysis.
Steam Power Plants: Introduction – General Layout of Steam Power Plant, Modern Coal-fired Steam Power Plants, Power Plant cycles, Fuel handling, Combustion Equipment, Ash handling, Dust Collectors</td></tr>
<tr><td colspan="7">2. Combined Cycle Power plant</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Cogeneration, Combined cycle Power Plants, Analysis, Waste-Heat Recovery, IGCC Power Plants, Fluidized Bed Combustion – Advantages & Disadvantages</td></tr>
<tr><td colspan="7">3. Nuclear Power Plant</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Nuclear Physics, Nuclear Reactors, Classification – Types of Reactors, Site Selection, Methods of enriching Uranium, Applications of Nuclear Power Plants.
Nuclear Power Plants Safety: By-Products of Nuclear Power Generation, Economics of Nuclear Power Plants, Nuclear Power Plants in India, Future of Nuclear Power</td></tr>
<tr><td colspan="7">4. Economics of Power Plant</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Economics of Power Generation: Factors affecting the economics, Load Factor, Utilization factor, Performance and Operating Characteristics of Power Plants. Economic
Load Sharing, Depreciation, Energy Rates, Criteria for Optimum Loading, Specific Economic energy problems</td></tr>
<tr><td colspan="7">5. Power Plant Instrumentation</td><td>Total Hrs</td><td>9</td></tr>
<tr><td colspan="9">Classification, Pressure measuring instruments, Temperature measurement and Flow measurement.
Analysis of Combustion gases, Pollution – Types, Methods to Control.</td></tr>
<tr><td colspan="7">Total hours to be taught</td><td></td><td>45</td></tr>
<tr><td colspan="9">Text book (s)
1. EL- Wakil, M.M., "Power Plant Technology " Mc Graw Hill, New York, 1985
2. Weis Man, J.and Eckert, R, "Modern Power Plant Engineering", PHI, New Delhi, 1983</td></tr>
<tr><td colspan="9">References:
1. Arora and Domkundwar, "A course in Power Plant Engineering", Dhanpat Rai & sons 2002
2. P.K. Nag, "Power Plant Engineering," TMH, 2003
3. P.C.Sharma, "Power Plant Engineering" Kotaria Publications. 2007</td></tr>
</table>

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CBIT	Autonomous Regulation								
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering			
Semester-I									
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
16MEE 201		L	T	P	C	E	I	Total	
	COMPUTER AIDED GRAPHICS AND DESIGN	3	0	0	3	70	30	100	

Objective (s)

1. Understand the basics of computer aided design.
2. To impart knowledge on design process
3. Recognize and explain the uses of wireframe and surface entities
4. Understand solid modeling representation schemes
5. Understand and apply various Geometric transformations
6. Understand various advanced modeling concepts

Outcome (s)

Students are able to:

1. apply design concepts in design , analysis and can visualize the models through the graphics standards .
2. implement Various transformations on geometric models for manipulation
3. recognize various wireframe entities and model them.
4. apply surface modeling techniques for the generating various parts and implement
5. differentiate various solid modeling techniques
6. able to perform modeling using the software by understanding advanced modeling concepts

Unit	Title		Hours
1	**INTRODUCTION TO CAD**	**Total Hrs**	**9**
Criteria for selection of cad workstations, Shigle design process, Design criteria, Geometric modeling , Entities, 2d and 3d primitives, Computer Aided Design , Iterative Design ,CAD process Geometric Transformations : 2d Translation , Scaling, Rotation, Reflection and shearing, Homogeneous Coordinates , Rotation and Scaling about arbitrary points , 3D transformations Windowing - View ports -Clipping transformations Graphics standards: GKS , IGES , PDES and their relevance			
2	**MODELING of CURVES**	**Total Hrs**	**9**
Analytic curves : Lines, Circles, Ellipse, Conics. Synthetic curves – Cubic, Bezier, B-Splines, NURBS. Curve Manipulations Wireframe Modeling and its advantages and Limitations			
3	**SURFACE MODELING**	**Total Hrs**	**9**
Analytic Surfaces: Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder, Synthetic Surface - Cubic, Bezier, B-spline, Coons ,Surface Manipulations , Surface Modeling Techniques			
4	**SOLID MODELING**	**Total Hrs**	**9**
Boundary Representation (B-rep) & Constructive Solid Geometry (CSG) Modeling Graph Based Model, Boolean Models, Instances, Cell Decomposition & Spatial – Occupancy Enumeration,			
5	**SOLID MODELING USING SOFTWARE**	**Total Hrs**	**9**
Feature Based Modeling, Conceptual Design ,Modeling of oil storage tanks, Cylinder head , Piston, Cylinder liner, Crank Shaft, Exhaust manifold ,Catalytic Converter			
		Total hours to be taught	**45**

Text book (s)

1	Ibrahim Zeid, "CAD/CAM, Theory and Practice", McGraw Hill, 1998.
2	Foley, Van Dam, Feiner and Hughes, "Computer Graphics Principles and Practice", 2nd Ed., Addison – Wesley, 2000.

Reference Book(s)

1	E. Micheal, "Geometric Modelling", John Wiley & Sons, 1995.
2	Hill Jr, F.S., "Computer Graphics using open GL", Pearson Education, 2003.

CBIT	*Autonomous Regulation*								
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM & Thermal Engineering			
	Semester-I								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
16MEE 207		L	T	P	C	E	I	Total	
	ENGINEERING RESEARCH METHODOLOGY	3	0	0	3	70	30	100	
Objective (s)	1. To motivate the students to choose research as career. 2. To make the students to formulate the research problem. 3. To identify various sources for literature review and data collection. 4. To prepare the research design 5. To equip the students with good methods to analyze the collected data 6. To write a report and interpret the results								
Outcome (s)	Students will be able to 1. define research problem 2. review and asses the quality of literature from various sources. 3. understand and develop various research designs. 4. collect the data by various methods: observation, interview, questionnaires. 5. analyze problem by statistical techniques: ANOVA, F-test, Chi-square 6. improve the style and format of writing a report for technical paper/ Journal report								

1	**Research Methodology:**	**Total Hrs**	9

Objectives and Motivation of Research, Types of Research, Research Approaches, Significance of Research, Research Methods verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general.
Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem, Technique involved in Defining a Problem.

2	**Literature Survey:**	**Total Hrs**	9

Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Information through Internet.
Literature Review: Need of Review, Guidelines for Review, Record of Research Review.

3	**Research Design:**	**Total Hrs**	9

Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

4	**Data Collection:**	**Total Hrs**	9

Methods of data collection, importance of Parametric test, testing of proportions, testing of variance of two normal population, and Non Parametric test, relation between Spearman's r's and Kendall's W
Data Analysis: Tests for significance: Chi-square, ANOVA, F-test.

5	**Interpretation and report writing:**	**Total Hrs**	9

Meaning of Interpretation, layout of research report, Types of reports, Mechanics of writing a report. Research Proposal Preparation: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

Text Book (s):

1. C.R Kothari, Research Methodology, Methods & Technique; New Age International Publishers, 2004
2. R. Ganesan, Research Methodology for Engineers, MJP Publishers, 2011

References:

3. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation, Sterling Publs., Pvt., Ltd., New Delhi, 2004
4. Vijay Upagade and Aravind Shende, Research Methodology, S. Chand & Company Ltd., New Delhi, 2009
5. P. Ramdass and A. Wilson Aruni, Research and Writing across the Disciplines, MJP Publishers

CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 205	**DESIGN OF GAS TURBINES**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

Student will understand

1. To create awareness of the importance of principles of design of gas turbine and methods of improvement of efficiency.
2. the principles of design of rotary compressors and its classification
3. the operating principles of combustion chamber for gas turbine applications
4. to familiarize the design of blades and their cooling systems used in gas turbine
5. the principles of axial flow compressor
6. the design principles of gas turbine blades

Outcome (s)

Student will be able to

1. thermal efficiency of gas turbine cycle and its improvements by different methods
2. various methods used in improving performance of the gas turbine cycle
3. design elements in rotary compressors
4. understand the importance of various types of combustion chambers used in gas turbines
5. design or analyze the forces on blade of gas turbine
6. suggest different cooling methods of gas turbine blades

1. THERMODYNAMIC ANALYSIS OF GAS TURBINE CYCLES	**Total Hrs**	**9**
Joule/Brayton. Open and Closed Cycles. Methods of improving cycle efficiency – Inter-cooling. Reheating and Regeneration		
2. DESIGN OF ROTARY COMPRESSORS	**Total Hrs**	**9**
Applications of Turbo Compressors (Centrifugal and axial flow) in Gas turbine power plant. Euler equation of energy transfer in a turbomachine. Design of two stage centrifugal compressor with vaneless and vaned diffusers. Design of multi stage axial flow compressors		
3. COMBUSTION CHAMBERS OF GAS TURBINES	**Total Hrs**	**9**
Types of combustion chambers. Combustion chamber design for modern gas turbines. Can type, annular and tube type of combustors		
4. DESIGN OF AXIAL FLOW TURBINES	**Total Hrs**	**9**
Matching of compressor and turbine for varying load operation. Gas turbine for super charging and cryogenic applications. Small gas turbines for space applications		
5. DESIGN AND CONSTRUCTION OF GAS TURBINE ROTORS AND BLADES	**Total Hrs**	**9**
Blade materials. Blade attachment techniques. Cooling methods of turbine blades. Simple analysis of turbine blade vibrations and balancing of rotors.		
Total hours to be taught		**45**

Text book (s)

1. D.G.Wilson,The Design of High efficiency Turbomachinery and Gas Turbines, The MIT Press, Cambridge, U.K.
2. M.P.Boyce, Gas Turbine Engineering hand book, Gulf Publishing Co., New York.

References:
1. E. Balje, Turbo machines – A guide to Selection and Theory, John Wiley & Sons, New York
2. J.S. Rao, Rotor Dynamics, Wiley Eastern Publication, New Delhi.

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 206	**ADVANCED ENERGY SYSTEMS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

Student will understand

1. to create awareness of the importance of the principles of various non- conventional energy resources power and design concepts of wind tunnel
2. the working principles of various collectors used in solar
3. the importance of biogas and its production and the principles of waste heat recovery
4. stress the need for cogeneration systems
5. the design principles of wind rotor blades of wind turbine
6. the principles of waste heat recovery boilers

Outcome (s)

A student will be able to

1. design solar collectors, wind mill as per specifications
2. understand the potential of biogas plants and need for waste heat recovery in the scenario of energy savings
3. understand the need for cogeneration and various methods adopted for it
4. optimize the power plant efficiency
5. optimize power plant efficiency
6. design rotors of wind mill according to consideration of aerodynamics

1. SOLAR ENERGY	**Total Hrs**	**9**

Solar energy: solar radiation – measurement, collection and storage, design of flat plate and parabolic concentrating collectors. Solar power plants. Photo voltaic power systems. Application of SPV and Solar Thermal Systems

2. WIND ENRGY	**Total Hrs**	**9**

Estimation of wind energy potential. Horizontal and vertical axis wind turbine rotors. Aerodynamic design considerations for wind rotor blades. Wind electric generators-operation and control. Aero generators for battery charging.

3. BIO MASS	**Total Hrs**	**9**

Bio mass energy: Sources of biomass. Energy from solid wastes. Biomass for energy production. Methane production. Bio mass energy conversion technologies. Use of Bio-gasifier. Bio mass power generation using agricultural residues. Introduction of Hybrid energy systems

4. WASTE HEAT RECOVERY	**Total Hrs**	**9**

Principles of waste heat recovery and co-generation. Analysis of heat recovery systems. Regenerators and recuperators for waste heat recovery. Advantages of fluidized bed boilers. Atmospheric fluidized bed combustion (AFBC), Pressurized fluidized bed combustion (PFBC and Circulation fluidized bed combustion (CFBC).

5. CO-GENERATION POWER SYSTEMS	**Total Hrs**	**9**

Co-generation power systems, Condensate and back pressure steam turbines. Design of waste heat recovery boilers. Combined cycle power plants based on waste heat recovery. Integrated gasification combined cycle (IGCC) power plants. Optimization of Power plant cycle efficiency. Clean coal technologies

Total hours to be taught		**45**

Text book (s)

1. D.A. Relay, Waste Heat Recovery System.
2. G.C. Drydin, The efficient Use of Energy.

References:

1. J.A. Duffire and W.A. Beckmen, Solar Energy Thermal Processes
2. A.B. Meinel, Applied Solar Energy.
3. V.D. Hunt, Wind Power.
4. N.H Ravindranath and D O Hall, Bio Mass, Energy and Environment, Oxford University Press .V Jadhav, Energy and Environment, Himalaya publishing house, Mumbai

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 207		L	T	P	C	E	I	Total
	FUELS & COMBUSTION	3	0	0	3	70	30	100

Objective (s)

To make student understand

1. conventional energy resources and different types of solid fuels available with their properties
2. various processing methods of solid fuels
3. the principles of refining liquid fuels and their properties, analysis and handling
4. various types of gaseous fuels and their properties, process and cleaning
5. the thermodynamics of combustion and stoichiometric relations.
6. features of different types of burners

Outcome (s)

A student will be able to

1. list different solid fuels for different applications
2. know the various methods of processing solid fuels
3. know the properties handling and storage of liquid fuels
4. understand the production of various methods of gaseous fuels and identify fuels for various applications
5. understand different methods of combustion and estimate the air fuel ratio, adiabatic flame temperature based on the fuel.
6. understand design considerations of burners

1.CONVENTIONAL AND NON-CONVENTIONAL ENERGY RESOURCES — Total Hrs 9

Introduction: General, Conventional energy resources, Solar energy, Nuclear power, Energy from biomass, Wind power, Tidal power, Geothermal energy, Energy survey for India, Rocket Fuels, Definitions, Units, Measures

2. SOLID FUEL-COAL — Total Hrs 9

Solid Fuels: General, Biomass, Peat, Lignite or Brown Coal, Sub-bituminous Coal or Black Lignite, Bituminous Coal, Semi-anthracite, Anthracite, Cannel coal and Boghead coal, Natural coke (Jhama)/SLV fuel, Origin of coal, Composition of coal, Analysis and properties of coal, Action of heat on coal, Oxidation of coal, Hydrogenation of coal, Classification of coal. Processing of Solid Fuels: General Coal preparation, Storage of coal, Coal carbonization, Briquetting of solid fuels, Liquefaction of solid fuels

3. LIQUID FUELS — Total Hrs 9

Liquid Fuels : General, Petroleum, Origin of Petroleum, Petroleum production, Composition of petroleum, Classification of petroleum, Nature of Indian crude's, Petroleum processing, Important petroleum products, Properties and testing of petroleum and petroleum products, Petroleum refining in India, Liquid fuels from sources other than petroleum, Gasification of liquid fuels, Storage and handling of liquid fuels.

4. GASEOUS FUELS — Total Hrs 9

Gaseous fuels: General, Types of gaseous fuels, Natural gas, Methane from coal mines, Producer gas, Water gas, Carbureted water gas, Complete gasification of coal, Underground gasification of coal, Coal gas, Blast furnace gas, Gases from biomass, Refinery gases, Liquefied petroleum gases (LPG), Oil gasification, Cleaning and purification of gaseous fuels

5. COMBUSTION PROCESS — Total Hrs 9

Combustion Process (Stoichiometry and Thermodynamics): Combustion Stoichiometry : General, Examples, Rapid methods of combustion stoichiometry.

Combustion Thermodynamics : General Combustion Process (Kinetics): Nature of combustion process, Types of combustion processes, Mechanism of combustion reaction, Spontaneous Ignition Temperature (SIT), Velocity of flame propagation, Limits of inflammability, Structure of flame, Flame stability, Kinetics of liquid fuel combustion, Kinetics of solid fuel combustion.

Combustion Applications: General, Gas burners, Oil burners, Coal burning equipment

Total hours to be taught: **45**

Text book (s)

1. Loftness, R.L.," Energy hand book", New York, Van Nostrand 1998.
2. Wilson, P.J. and J.H. Wells, "Coal, Coke and Coal Chemicals", New York : McGraw-Hill, 1960

References:

1. "Gas Engineers Handbook", New York : Industrial Press, 1966.
2. Williams, D.A. and G. James, "Liquid Fuels", London Pergamon, 1963
3. Minkoff, G.J., and C.F.H. Tipper, "Chemistry of Combustion Reaction", London Butterworths, 1962.
4. Samir Sarkar, "Fuels & Combustion", Orient Long man 1996

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 208	**POWER PLANT CONTROL AND INSTRUMENTATION**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

Student will understand

1. the principles of static and dynamic characteristics of instruments
2. working principles of feedback control concepts of electrical parameters
3. To create awareness of the importance of working principles of various measuring instruments and their applications in engineering industry
4. To understand characteristics of instruments
5. To familiarize the principles of data acquisition along influence of electrical parameters on instrumentation
6. To understand the principles of modeling of power systems

Outcome (s)

A student will be able to

1. estimate static and dynamic characteristics of instruments
2. estimate the influence of electrical parameters on measurements
3. understand theory on stability of instruments used for thermal systems
4. model power systems using various numerical methods
5. estimate the role of computers for data acquisition
6. represent various types of process control system

1. STATIC & DYNAMIC CHARACTERISTICS OF INSTRUMENTS	**Total Hrs**	**9**
Static & dynamic characteristics of instruments, sensors, signal processing & data transmission elements, indicating & recording elements.		
2. DATA ACQUISITION	**Total Hrs**	**9**
Use of computers for data acquisition & instrumentation for measuring temperature, pressure flow, speed, vibration & noise		
3. ELECTRICAL PARAMETERS	**Total Hrs**	**9**
On-line process instruments. Automatic process control systems Representation. Feedback control concepts. Transient & Frequency response. Types of controllers		
4. STABILITY OF INSTRUMENTS	**Total Hrs**	**9**
Stability, Digital Control System Modern Control theory. Boiler Control, Governing & Control of turbo-machines		
5. COMPUTER AIDED POWER SYSTEMS ANALYSIS	**Total Hrs**	**9**
Modeling of power system, components, Formation of bus admittance and impedance matrices, Power flow solution Gauss-Seidel, Newton Raphson, and fast de-coupled load flow, Short Circuit studies, Static equivalents of power system, Basic concepts of security analysis and state estimation.		
Total hours to be taught		**45**

Text book (s)

Beckwith and Buck, Mechanical Measurements

A.K.Tayal, Instruments and Mechanical Measurements, Galgotia Publication

References:

1. McCloy and Martin H.R., The Control of Fluid Power, Longman Publication, 1973
2. Williams, D.A. and G. James, "Liquid Fuels", London Pergamon, 1963
3. David Lindsley "Power-Plant Control and Instrumentation "IEE Control Engineering Series 585
4. W.Bolton "Instrumentation and Control Systems", 1st Edition Elsevier, 2004

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 209	**DESIGN OF PUMPS AND COMPRESSORS**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

Objective (s)

Student will understand

1. the basic concepts of build mechanics & governing laws of fluid flow
2. the various principles involved in maintenance of pumps
3. To create awareness of the importance of working principles of design of rotary pumps and rotary compressors
4. To understand the concepts of selection and design of pumps
5. To familiarize the principles involved in testing and maintenance of pumps
6. To understand the concept of design and selection of drive of rotary compressors along with impellors

Outcome (s)

A student will be able to

1. apply the laws of fluid mechanics to turbo machines
2. install a pumping system & monitor the maintenance of the pumps
3. select pump depending on application
4. do testing of pumping systems
5. to select drive and develop layout of the compressor system
6. to design different types of impellors of centrifugal compressor

1. INTRODUCTION TO PUMPS AND COMPRESSORS — **Total Hrs 9**

Characteristics of working fluids, Fluid mechanics concepts and governing laws of fluid flow.

2. DESIGN OF PUMPS — **Total Hrs 9**

Pumps – various components and their functions. Classification of pumping systems – based on the applications and working fluids. Design of pumps – data required for the design of pump and design calculations. Selection of the drive – Types of drives, their behavior and advantages, Selection of the pumps- types of pumps. Selection of piping and other components. Development of a schematic layout of the piping system

3. OPERATION AND MAINTANANCE OF PUMPS — **Total Hrs 9**

Operation and maintenance – installation of pumping system. Testing of the pumping systems – Various methods based on the working fluid, drive and pump etc., Maintenance of the pumps – Prediction and correction methods. Factors affecting the maintenance and their evaluation

4. ROTARY COMPRESSORS — **Total Hrs 9**

Rotary compressor system – various components and their functions. Classification of compressors. Design of compressor – data and analysis. Characteristics of the compressors. Selection of the drive and compressors. Development of the schematic layout of the compressor system.

5. DESIGN OF IMPELLORS — **Total Hrs 9**

Design of impeller, Types of impellers – centrifugal and axial. Design of a diffuser – Vaneless and vaned diffuser. Types of casings, casing design. Performance characteristics of turbo compressors.

Total hours to be taught — **45**

Text book (s)

1. S.M. Yahya, Turbines, Compressors and Fans, Tata McGraw Hill Publishing Co
2. Val.S. Lobanoff and Robert R. Ross, Centrifugal Pumps – Designs and Application, Jaico book publishing Co

References:

3. Igor J. Karassik and Joseph P. Messina "Pump Handbook 1986
4. Kovats, Andre, Design and performance of centrifugal and axial flow pumps and compressors, Oxford, New York, Pergamon Press, 1964.

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 210			T	P	C	E	I	Total
	NUMERICAL METHODS	3	0	0	3	70	30	100

Objective (s)

Student will understand

1. the non-linear set of equations in engineering practice
2. linear set of equations applied to engineering applications
3. the importance of working principles of numerical analysis and its applications in engineering
4. understand the various sets of equations used in engineering applications
5. familiarize the concept of various methods of interpolation and its importance in engineering
6. understand various techniques used for solving differential equations used in engineering applications

Outcome (s)

A student will be able to

1. apply different techniques in solving linear and non linear sets of equations
2. apply different methods of interpolation techniques
3. solve numerical differentiation by different methods concerned to engineering practice
4. apply different techniques for numerical differentiation
5. identify various techniques of numerical methods applicable to engineering applications
6. apply different procedures to solve ordinary differential equations

Unit	Total Hrs	
1. LINEAR SETS OF EQUATIONS	**Total Hrs**	**9**
Gauss Elimination, LV Decomposition, Matrix Inversion, Scalar Tridiagonal Matrix, Thomas Algorithm, Gauss Seidel Method, Secant Method		
2. **NON-LINEAR SETS OF EQUATIONS**	**Total Hrs**	**9**
Solving nonlinear sets of equations Minimization of function, Newton's Method, Quasi-Newton Method, Steepest Descent Method, Eigen Values & Vectors.		
3. INTERPOLATION	**Total Hrs**	**9**
Interpolation & Polynomial Approximation Least Squares Method, Lagrange Interpolation, Hermite Interpolation, Cubic Spline Interpolation, Chebeshev Polynomials & Series		
4. **NUMERICAL DIFFERENTIATION**	**Total Hrs**	**9**
Numerical Differentiation & Integration Numerical Differentiation, Richardson's Extrapolation, Definite & Indefinite Integrals, Simpson's Rule, Trapezoid Rule, Gaussian Quadrature		
5. **ORDINARY DIFFERNENTIAL EQUATIONS**	**Total Hrs**	**9**
First and Higher Order Taylor Series, First order Runge-kutta Method, Fourth order Runge-kutta Method, Stiff Equations, Errors, Convergence Criteria		
Total hours to be taught		**45**

Text book (s)

1. Cheney E. Ward, Kincaid D.R., Numerical Methods and Applications, 2008, Cengage Learning
2. Gerald C.F., Wheatley P.O., Applied Numerical Analysis, 7^{th} Ed, Pearson Education

References:

1. Burden R.L., Faires J.D., Numerical Analysis: Theory and Applications, 2005, Cengage Learning
2. Chapra S.C., Canale R.P., Numerical Methods for Engineers, 4^{th} Ed,Tata McGraw Hill
3. Mathews J.H., Fink K.D., Numerical Methods using MA TLAB, 4th Ed, Pearson Education
4. Press W.H., Taukolsky S.A., Vetterling W.T., Flannery B.P., Numerical Recipes in C++, 2^{nd} Ed, Cambridge University Press

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CBIT	Autonomous Regulation							
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Semester-I								
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
16MEC 2062	**THERMAL SYSTEMS LABORATORY (Lab-1)**	0	0	3	2		50	50
Objective(s)	1. To evaluate the performance of computerized I.C Engine 2. To determine heat transfer coefficient in two phase heat transfer 3. To determine effectiveness of cross flow heat exchanger 4. To evaluate the performance of heat pipe 5. To evaluate the thermal properties of fluids 6. To conduct performance test on solar collectors							
Outcome(s)	A student will be able to 1. estimate the thermal efficiency of IC engine 2. prove that value of convection heat transfer coefficient is very high with two phase heat transfer 3. estimate the effectiveness of cross flow heat exchanger and prove that it is very high compared with other configurations 4. calculate heat of condensation and vaporization pipe 5. estimate the efficiency of solar collector 6. find out properties of fluids such as coefficient of thermal expansion, enthalpy of fusion							

List of Experiments:

1. Performance Evaluation on single cylinder 4-stroke SI Engine with alternate fuels with computer interfacing.
2. Performance Evaluation on single cylinder 4 stroke CI Engine with alternate fuels with computer interfacing
3. Determination of heat transfer coefficient in Film wise and Drop wise condensation
4. Cross flow Heat Exchanger.
5. Heat Pipe Demonstration
6. Performance text on Axial flow compressor
7. Performance test on solar collector
8. Determination of coefficient of thermal expansion of Solids, Liquids and Gases
9. Determination of thermal capacity of Solids
10. Determination of isentropic coefficient of air by Clement-Desormes method
11. Measure of enthalpy of fusion and solidification
12. Measurement of Temperature Distribution in the interior and external Surface of an electric water heater with thermometers and thermo-camera

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With effect from the academic year 2016- 2017

Scheme of Instruction & Examination
M.E. (THERMAL ENGINEERING) – 4 Semesters (Full Time)

Semester - I

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1	4	30	70	100	4
2.	Core	3	1	4	30	70	100	4
3.	Core	3	1	4	30	70	100	4
4.	Elective-1	3	--	3	30	70	100	3
5.	Elective-2	3	--	3	30	70	100	3
6.	Elective-3	3	--	3	30	70	100	3
7.	Laboratory - I	--	3	3	50	--	50	2
8.	Seminar - I	--	3	3	50	--	50	2
9.	Soft Skills	--	--	--	--	--	--	--
	Total	**18**	**09**		**340**	**360**	**700**	**25**

Semester - II

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core-4	3	1		30	70	100	4
2.	Core-5	3	1		30	70	100	4
3.	Core-6	3	1		30	70	100	4
4.	Elective-4	3	--		30	70	100	3
5.	Elective-5	3	--		30	70	100	3
6.	Elective-6	3	--		30	70	100	3
7.	Laboratory - II	--	3		50	--	50	2
8.	Seminar - II	--	3		50	--	50	2
9.	Mini Project	--	2		50	--	50	1
	Total	**18**	**11**		**390**	**360**	**750**	**26**

Semester - III

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Seminar* (i) Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd Semester. (50 Marks) (ii) Preliminary work on Project implementation. (50 Marks)	**100**	--	**100**	**6**
	Total	**100**		**100**	**6**

Semester - IV

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Work	**100**	**100**	**200**	**12**

Note : Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars, Mini Project and Soft Skills should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only, 50 marks awarded by the project guide and
50 marks by the internal committee

Credit requirements for the award of degree, lower limit and upper limit of credits for registration by a student in a semester Credit Requirement for the award of M.E/M. Tech. Degree is 69

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<table>
<tr><td>CBIT</td><td colspan="2">Autonomous Regulation</td><td colspan="4">Semester-1</td><td colspan="3">AY - 2006-17</td></tr>
<tr><td>Department</td><td colspan="2">Mechanical Engineering</td><td colspan="4">Programme Code & Name</td><td colspan="3">M.E. Thermal Engineering</td></tr>
<tr><td>Course Code</td><td colspan="2">Course Name</td><td colspan="3">Hours/ Week</td><td>Credit</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">16MEC 105</td><td colspan="2" rowspan="2">FINITE ELEMENT TECHNIQUES</td><td>L</td><td>T</td><td>P</td><td>C</td><td>E</td><td>I</td><td>Total</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td><td>70</td><td>30</td><td>100</td></tr>
<tr><td>Objective (s)</td><td colspan="9">1. Identify mathematical model for solution of common engineering problems
2. Enable the students to formulate the design problems into FEA
3. Enable the students to perform engineering simulations using Finite Element Analysis software</td></tr>
<tr><td>Outcome (s)</td><td colspan="9">Students are able to
1. implement finite element formulations to axial and quadratic elements and solve problems with hand calculations numerically
2. formulate numerically the truss, beam and frame elements and solve for deflection, strains and stresses
3. formulate numerically the plane and axisymmetric triangular elements and quadrilateral elements then solve for deflections, strains and stresses in structural mechanics problems
4. apply FE formulations to heat transfer of 1D and 2D elements and solve for temperature and heat flux in slabs, walls and plates
5. apply FE formulations to dynamic analysis of 1D and 2D elements and solve for eigen values and eigen vectors in bars and beams
6. apply FE formulations to 3D solids, plates and for non linear problems</td></tr>
<tr><td colspan="8">1. FIELD PROBLMES AND MODELING</td><td>Total Hrs</td><td>10</td></tr>
<tr><td colspan="10">Introduction to Finite Element Method of solving field problems. Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations.
One Dimensional Problem: Finite element modeling. Local, natural and global coordinates and shape functions. Potential Energy approach: Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions</td></tr>
<tr><td colspan="8">2. ANALYSIS OF TRUSSES AND FRAMES</td><td>Total Hrs</td><td>10</td></tr>
<tr><td colspan="10">Analysis of plane truss with number of unknowns not exceeding two at each node.
Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element. Analysis of frames with two translations and a rotational degree of freedom at each node</td></tr>
<tr><td colspan="8">3. TWO DIMENSIONAL STRESS ANALYSIS</td><td>Total Hrs</td><td>10</td></tr>
<tr><td colspan="10">Finite element modeling of two dimensional stress analysis problems with constant strain triangles treatment of boundary conditions. Two dimensional four noded isoparametric elements treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements.
Convergence requirements and geometric isotropy</td></tr>
<tr><td colspan="8">4. HEAT TRANSFER PROBLEMS AND DYNAMIC ANALYSIS</td><td>Total Hrs</td><td>10</td></tr>
<tr><td colspan="10">Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional, conduction analysis of thin plate,
Time dependent field problems: Application to one dimensional heat flow in a rod.
Dynamic analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors, Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.</td></tr>
<tr><td colspan="8">5. THREE DIMENSIONAL PROBLEMS IN SRESS ANALYSIS</td><td>Total Hrs</td><td>10</td></tr>
<tr><td colspan="10">Finite element formulation of three dimensional problems in stress analysis.
Bending of elastic plates: Thin and Thick plate formulations, Introduction to non-linear problems and Finite Element analysis software's</td></tr>
<tr><td colspan="8">Total hours to be taught</td><td></td><td></td></tr>
<tr><td colspan="10">Text book (s)
1. Tirupathi R Chandrupatla and Ashok.D. Belegundu, Introduction of Finite Element in Engineering. Prentice Hall of India, 2004
2. Rao S.S.,The Finite Element Methods in Engineering, 2nd Edn Pergamon Press, 2001.
3. David.V.Hutton, " Fundamentals of Finite Element Analysis", Tata McGraw Hill,2003</td></tr>
<tr><td colspan="10">References:
1. Robert Cook , "Concepts and applications of finite element analysis", 4e, John Wiley and sons,2009
2. Reddy J.N., An Introduction to Finite Element Methods ,Mc Graw Hill Company, 1984
3. K.J Bathe, Finite element procedures, 2nd Edn,Prentice Hall of India,2007
4. Logan, D. L. (2011). First course in finite element method, (5th Ed.). Mason, OH: SouthWestern, Cengage Learning.</td></tr>
</table>

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 201	**FLUID FLOWS & GAS DYNAMICS**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

Student will
1. understand different types of fluid flows and various functions related to fluids
2. learn important equations related to fluids
3. understand the concept of boundary layer
4. learn the concept of steady flow energy equation
5. understand the isentropic behavior of gas in nozzles
6. learn about shocks of fluids

Outcome (s)

Student will be able to
1. understand the concept of stream and velocity potential function
2. apply of the knowledge of equations for analysis in CFD
3. calculate thickness of boundary layer and shear stress
4. apply SFEE for various types of turbomachines
5. design nozzles and diffusers
6. estimate various parameters in fluids subjected to shocks

1. FLUID FLOWS — Total Hrs 9

Fluid flow: Classification of fluids. Lagrangian and Eularian Methods of Study of fluid flow. Velocity and acceleration vectors. Circulation and Vorticity. Stream lines. Stream tube. Path lines. Streak lines and Time lines. Stream function and Potential function

2. LAW OF FLUID FLOWS — Total Hrs 9

Basic laws of fluid flow – Continuity. Euler's and Bernoulli's equations. Incompressible and Compressible flows. Potential and viscous flows. Navier – Stoke's equation and applications

3. CONCEPT OF BOUNDARY LAYER — Total Hrs 9

Flow over an aerofoil – Lift and Drag coefficients. Boundary layer theory – laminar and turbulent boundary layers. Hydrodynamic and thermal boundary layer equations. Flow separation in boundary layers

4. FUNDAMENTALS OF GAS DYNAMICS — Total Hrs 9

Gas dynamics: Energy equation for flow and non flow processes. Application of Steady flow energy equation for turbines, turbo-compressors, nozzles and diffusers. Adiabatic energy equation. Acoustic velocity, Mach Number. Stagnation properties. Relationships between static and stagnation properties. Various regimes of flow – Steady flow ellipse

5. PRINCIPLES OF GAS DYNAMICS APPLICABLE TO SHOCKS — Total Hrs 9

Isentropic flow through variable area passages. Design of supersonic and subsonic nozzles and diffusers. Super sonic flows. Expansion and Shock waves. Normal and Oblique Shock waves. Prandtl-Meyer and Rankine-Hugoniot Relations. Simple problems on normal and oblique shock waves.

Total hours to be taught

Text book (s)

1. C P Kothandaraman, R Rudramoorthy, Basic Fluid Mechanics, New Age Intl. Publishers, 2014
2. S.M. Yahya, Fundamentals of Compressible flow, Wiley Eastern Ltd,2014
3. S. Radhakrishnan, "Fundamentals of Compressible flow," TMH,,2014

References:

1. Shapiro, Compressible fluid flow. Ronold Press, New York, 1956
2. Liepmen & Rosko, Elements of Gas Dynamics, Wiley, New York, 1956.
3. Zoeb Hussain, Gas Dynamics Though Problem

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CBIT	Autonomous Regulation									
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering				
Semester-I										
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks				
		L	T	P	C	E	I	Total		
16MEC 205	**COMPUTATIONAL FLUID DYNAMICS**	3	1	0	4	70	30	100		

Objective (s)	1. To understand the basic equations and concept of CFD. 2. To make the students to learn concept of PDEs and finite difference methods. 3. To study various types of grid generation and errors in numerical solution. 4. To learn the Crank-Nihcolson, Implicit and Explicit methods 5. To prepare the students with Jacobi, Gauss Seidel and ADI methods 6. To enkindle the students importance of FVM
Outcome (s)	Students will be able to 1. derive CFD governing equations and turbulence models. 2. apply elliptical, parabolic and hyperbolic PDEs and forward, backward and center difference methods . 3. understand errors, stability, consistency and develop O,H and C grid generated models. 4. evaluate the use of Crank-Nihcolson, Implicit and Explicit methods. 5. analyze problem by Jacobi, Gauss Seidel and ADI methods. 6. solve conduction and convection problems using FVM

1	**BASIC EQUATIONS IN FLUID DYNAMICS**	**Total Hrs**	**9**
Continuity, Momentum and Energy equations, Navier Stokes equations, Reynolds and Favre averaged N – S equations. Introduction to turbulence, Turbulence models-mixing length model, K-ε turbulence Model.			
2	**CLASSIFICATION OF PDEs**	**Total Hrs**	**9**
Elliptic, parabolic and hyperbolic equations, Initial and boundary conditions. Concepts of Finite difference methods – forward, backward and central difference.			
3	**GRID GENERATION**	**Total Hrs**	**9**
Grid Generation- Types of grid O,H,C. Coordinate transformation, Unstructured grid generation, Errors, Consistency, Stability analysis by von Neumann. Convergence criteria.			
4	**FINITE DIFFERENCE SOLUTIONS**	**Total Hrs**	**9**
Finite difference solutions-Parabolic PDEs – Euler, Crank Nicholson, Implicit methods, Elliptic PDEs – Jacobi, Gauss Seidel, ADI, methods. FD- solution for Viscous incompressible flow using Stream function – Vorticity method & MAC method			
5	**FINITE VOLUME METHOD**	**Total Hrs**	**9**
Introduction to Finite volume method. Finite volume formulations for diffusion equation, convection diffusion equation. Solution algorithm for pressure velocity coupling in steady flows. Use of Staggered grids SIMPLE Algorithm.			
	Total hours to be taught		**45**

Text book (s)	
1	John D Anderson, 'Computational Fluid Dynamics', Mc Graw Hill, Inc., 2015.
2	H.K.Versteeg - 2015, Malala Shekara, Introduction to " Finite Volume Method" Pearson
3	Muralidhar K, Sundararajan T, 'Computational Fluid flow and Heat transfer', Narosa Publishing House, 2003
4	Patankar, S.V, 'Numerical Heat transfer and Fluid flow', Hemisphere Publishing Company, New York,1980

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CBIT	Autonomous Regulation	Semester-1			AY - 2006-17			
Department	Mechanical Engineering	Programme Code & Name			M.E. Thermal Engineering			
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE105	**OPTIMIZATION TECHNIQUES**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

1. To Understand the need of the optimization methods.
2. To introduce the fundamental concepts of Optimization Techniques
3. To provide students with the modeling skills necessary to describe and formulate optimization problems
4. To make the learners aware of the importance of optimizations in real scenarios
5. To provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable
6. Get a broad picture of the various applications of optimization methods used in engineering.

Outcome (s)

1. Formulate and solve Linear programming problem
2. Apply different techniques to solve Non Linear programming problem
3. Implement constrained optimization techniques
4. Analyze dynamic programming and integer programming problems
5. Develop schedule for projects and apply PERT/CPM techniques
6. Apply Queuing theory to real life situations

1. LINEAR AND TRASPORTATION PROBLEMS — Total Hrs 9

Statement of Optimization Problem, Linear Programming: Simplex Method, Revised Simplex Method, Sensitivity Analysis, Parametric Programming, and Transportation Problem

2. NON-LINEAR PROBLEMS — Total Hrs 9

Nonlinear Programming: Approach, Convergence and Scaling of Design variables; Unconstrained Optimization Direct Search Methods: Random Search, Univariate, Simplex Method; Indirect Search Methods: Steepest Descent, Conjugate Gradient, Newton, Quasi Newton, DFP Methods;

3. NON-LINEAR PROGRAMMING — Total Hrs 9

Constrained Optimization Direct Methods: Lagrange Multipliers, Kuhn-Tucker, conditions, Beal's method, Indirect Method: Penalty Function and Applications

4. DYNAMIC PROGRAMMING — Total Hrs 9

Introduction to Dynamic Programming; Concept of Sub optimization and the principle of optimality; Linear and Continuous Dynamic Programming with Applications; Introduction to Integer Programming; Cutting Plane Method; Branch and Bound method; Introduction to Genetic Algorithms, particle swarm optimization

5. PROJECT SCHEDULING — Total Hrs 9

Sequencing and Scheduling, Project Scheduling by PERT-CPM; Probability and cost consideration in Project scheduling; Queuing Theory, Single and multi server models; Queues with combined arrivals and departures; Queues with priorities for service

Total hours to be taught — **Total Hrs** **45**

Text book (s)

1. Rao,S.S. Engineering "Optimization Theory and Practice", New Age Int. Pub., 3rd Ed., 1996.
2. Haug,E.J.and Arora, J.S., "Applied Optimal Design", Wiley Inter Science Publication, NY, 1979.

Reference(s)

1. Douglas J. Wilde, "Globally Optimal Design", Jhon Wiley & Sons, New York, 1978
2. Johnson Ray C., "Optimum Design of Mechanical Elements", John Wiley & Sons, 1981.
3. S.D. Sharma, S.D. "Operations Research", Khanna Publications, 2001.
4. David Goldberg, "Genetic Algorithms", pearson publications, 2006.
5. Maurice cleric, "Particle Swarm Optimization", ISTE Publications, 2006
6. Prem Kumar Gupta, "Operations Research", S Chand publications, 2008

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CBIT	Autonomous Regulation								
Department	Mechanical Engineering	Programme Code & Name				M.E. (THERMAL ENGINEERING)			
Semester-I									
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
16MEE 202		L	T	P	C	End Exam	Internal Assessment	Total	
	TURBO MACHINES	3	0	0	3	70	30	100	

Objectives

1. To learn principles and equations of turbo machinery.
2. To know about velocity triangle and power developed by steam turbines.
3. To understand the working principles of Pelton, Francis and Kaplan turbines.
4. To familiarize the working principles of axial flow compressor
5. To understand the working principle of Centrifugal compressor and its performance
6. To learn the power required for Rotary compressors and power developed by Gas turbines

Outcomes

Students will be able to

1. apply gas dynamics equations depending upon applications.
2. estimate the power developed by steam turbines
3. calculate hydraulic efficiency of Impulse and Reaction turbines
4. find efficiency, pressure rise and degree of reaction of axial flow compressor
5. analyze the slip factor and performance of centrifugal compressor
6. understand cycles and improve the cycle efficiency in gas turbines

1	FUNDAMENTALS OF TURBO MACHINES:	Total Hrs	7

Classifications, Applications, Isentropic flow. Energy transfer. Efficiencies, Static and Stagnation conditions, Continuity equations, Euler's flow through variable cross sectional areas.

2	STEAM TURBINES:	Total Hrs	9

Convergent and Convergent-Divergent nozzles, Energy Balance, Effect of back pressure, Design of nozzles. Steam Turbines: Impulse turbines, Work done and Velocity triangle, Efficiencies Compounding.

3	HYDRAULIC TURBINES:	Total Hrs	9

Introduction, Classification of turbines, Impulse and reaction turbines, construction, working and performance of Pelton, Francis and Kaplan Turbines, Selection of turbines: specific speed, unit quantities

4	AXIAL FLOW COMPRESSORS AND CENTRIFUGAL COMRESSORS:	Total Hrs	9

Work and velocity triangles, Efficiencies, Stage pressure rise, Degree of reaction, Performance of compressors

Types; Velocity triangles and efficiencies; slip factor; performance of compressors

5	GAS TURBINES:	Total Hrs	9

Principle of working – Classification – Joule's cycle – workdone and efficiency – Brayton Cycle – Optimum Pressure ratio for maximum power and maximum efficiency – P_{max} and η_{max} – Improvement in cycle performance – Intercooling, Reheating and Regeneration (Heat exchanging) – Problems using these principles

Total hours to be taught: **43**

Text book (s)

1	S.M. Yahya, Turbines, Compreessors and Fans, Fourth edition, Tata McGraw-Hill Education Pvt. Ltd., 2010
2	Gopalakrishnan G, Prithvi Raj D, "A treatise on Turbomachines", Scitec Publications, Chennai, 2002
3	Seppo. A. Korpela, Principles of Turbomachinery, John Wiley & sons Inc. Publications, 2011

Reference(s)

1	R.K.Turton, Principles of Turbomachinery, E & F N Spon Publishers, London & New York.
2	Dennis G. Shepherd, Principles of Turbomachines, Macmillan, 2007

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 207		L	T	P	C	E	I	Total
	FUELS & COMBUSTION	3	0	0	3	70	30	100

Objective (s)

To make student understand
1. conventional energy resources and different types of solid fuels available with their properties
2. various processing methods of solid fuels
3. the principles of refining liquid fuels and their properties, analysis and handling
4. various types of gaseous fuels and their properties, process and cleaning
5. the thermodynamics of combustion and stoichiometric relations.
6. features of different types of burners

Outcome (s)

A student will be able to
1. list different solid fuels for different applications
2. know the various methods of processing solid fuels
3. know the properties handling and storage of liquid fuels
4. understand the production of various methods of gaseous fuels and identify fuels for various applications
5. understand different methods of combustion and estimate the air fuel ratio, adiabatic flame temperature based on the fuel.
6. understand design considerations of burners

1.CONVENTIONAL AND NON-CONVENTIONAL ENERGY RESOURCES	**Total Hrs**	**9**

Introduction: General, Conventional energy resources, Solar energy, Nuclear power, Energy from biomass, Wind power, Tidal power, Geothermal energy, Energy survey for India, Rocket Fuels, Definitions, Units, Measures

2. SOLID FUEL-COAL	**Total Hrs**	**9**

Solid Fuels: General, Biomass, Peat, Lignite or Brown Coal, Sub-bituminous Coal or Black Lignite, Bituminous Coal, Semi-anthracite, Anthracite, Cannel coal and Boghead coal, Natural coke (Jhama)/SLV fuel, Origin of coal, Composition of coal, Analysis and properties of coal, Action of heat on coal, Oxidation of coal, Hydrogenation of coal, Classification of coal. Processing of Solid Fuels: General Coal preparation, Storage of coal, Coal carbonization, Briquetting of solid fuels, Liquefaction of solid fuels

3. LIQUID FUELS	**Total Hrs**	**9**

Liquid Fuels : General, Petroleum, Origin of Petroleum, Petroleum production, Composition of petroleum, Classification of petroleum, Nature of Indian crude's, Petroleum processing, Important petroleum products, Properties and testing of petroleum and petroleum products, Petroleum refining in India, Liquid fuels from sources other than petroleum, Gasification of liquid fuels, Storage and handling of liquid fuels.

4. GASEOUS FUELS	**Total Hrs**	**9**

Gaseous fuels: General, Types of gaseous fuels, Natural gas, Methane from coal mines, Producer gas, Water gas, Carbureted water gas, Complete gasification of coal, Underground gasification of coal, Coal gas, Blast furnace gas, Gases from biomass, Refinery gases, Liquefied petroleum gases (LPG), Oil gasification, Cleaning and purification of gaseous fuels

5. COMBUSTION PROCESS	**Total Hrs**	**9**

Combustion Process (Stoichiometry and Thermodynamics): Combustion Stoichiometry : General, Examples, Rapid methods of combustion stoichiometry.

Combustion Thermodynamics : General Combustion Process (Kinetics): Nature of combustion process, Types of combustion processes, Mechanism of combustion reaction, Spontaneous Ignition Temperature (SIT), Velocity of flame propagation, Limits of inflammability, Structure of flame, Flame stability, Kinetics of liquid fuel combustion, Kinetics of solid fuel combustion.

Combustion Applications: General, Gas burners, Oil burners, Coal burning equipment

Total hours to be taught		45

Text book (s)

1. Loftness, R.L.," Energy hand book", New York, Van Nostrand 1998.
2. Wilson, P.J. and J.H. Wells, "Coal, Coke and Coal Chemicals", New York : McGraw-Hill, 1960

References:

1. "Gas Engineers Handbook", New York : Industrial Press, 1966.
2. Williams, D.A. and G. James, "Liquid Fuels", London Pergamon, 1963
3. Minkoff, G.J., and C.F.H. Tipper, "Chemistry of Combustion Reaction", London Butterworths, 1962.
4. Samir Sarkar, "Fuels & Combustion", Orient Long man 1996

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 203	**FLUID POWER SYSTEMS**	L	T	P	C	E	I	Total
		3	1	0	4	70	30	100

Objective (s)

Student will understand

1. behavior and properties of fluids
2. working principles of hydraulic pumps & motors
3. working principles of hydraulic control valves
4. working principles of various elements associated with hydraulic power
5. characteristics and applications of pneumatics
6. working and operating principles of pneumatic transmission lines

Outcome (s)

A student will be able to

1. understand various types of fluids along with properties used for different applications
2. select motor and pump depending on application
3. analyze the various types of hydraulic valves
4. calculate design nozzles and other elements used for hydraulic purposes such as in pneumatics
5. apply the principles of engineering for linear dynamics
6. Design feedback control of elements

1. HYDRAULIC FLUIDS — **Total Hrs 9**

Advantages and Disadvantages of Fluid control, Types of Hydraulic Fluids, physical, chemical and thermal properties of hydraulic fluids, selection of hydraulic fluid, fluid flow fundamentals

2. HYDRAULIC PUMPS AND CONTROL VALVES — **Total Hrs 9**

Hydraulic Pumps and Motors: Basic Types and constructions, ideal pump and motor analysis, Performance curves and parameters,

Hydraulic Control Valves- Valve configurations, general valve analysis, critical center, open center, three way spool valve analysis and Flapper valve analysis, pressure control valves, single and two stage pressure control valves, flow control valves, introduction to electro hydraulic valves

3. HYDRAULIC POWER ELEMENTS — **Total Hrs 9**

Hydraulic Power Elements: Valve controlled motor, valve controlled piston, three way valve controlled piston, pump controlled motor, pressure transients in power elements

4. PNEUMATICS — **Total Hrs 9**

Characteristics of Pneumatics, Applications of Pneumatics, Basic Pneumatic elements, Steady flow of Ideal gases, orifice and nozzle calculations, capillary flow, flow of real gases, linearised flow equations in Orifices and Nozzles.

Steady state analysis of pneumatic components: Multiple restriction and volume calculations, sensing chambers, valves, Single acting actuators.

5. TRANSIENTS IN ELEMENTARY PNEMATIC SYSTEMS — **Total Hrs 9**

Linear dynamics-linear pneumatic spring rate, linear dynamics of a variable volume of gas, Pneumatic transmission lines, linear dynamics in single acting actuators. Applications in industrial process controls: On-Off pneumatic feedback systems, feedback control of proportional gain, derivative action, integral action, Design of a Pneumatic Pressure Regulator

Total hours to be taught — **45**

Text book (s)

1. Herbert E. Merritt, "Hydraulic Control Systems", John Wiley & Sons, 1967.
2. W. Anderson, The Analysis and Design of Pneumatic Systems, Wiley, 1967.

References:

1. A.B. Goodwin, Fluid Power Systems, Macmillan, 1976.
2. Anthony Esposito, "Fluid power with applications", Prentice Hall, 7th Edition, 2002.
3. Arthur Akers, Max Gassman, Richard Smith, "Hydraulic Power System Analysis", Taylor and Francis Group, 2006
4. John Pippenger & Tyler Hicks, "Industrial Hydraulics", 3rd edition, McGraw Hill, 1980

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CBIT	Autonomous Regulation	Semester-I				A.Y 2016-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
		L	T	P	C	E	I	Total
16MEE 211	**ENVIRONMENTAL ENGINEERING AND POLLUTION CONTROL**	3	1	0	4	70	30	100
Objective (s)	Student will understand 1. different methods to control air pollution 2. the importance of harmful effects of different types of pollution levels and their effect on human beings and environment 3. different techniques adopted in solid waste management 4. causes and remedies for water pollution 5. other types of pollution like oils, pesticides, noise etc. 6. controlling methods adopted to reduce pollution from their power plants							
Outcome (s)	A student will able to 1. Estimate pollution levels in various resources and suggest suitable remedial methods to control them 2. analyze air pollutants and suggest controlling methods 3. suggest a suitable solid waste disposal system 4. suggest suitable remedy to control water pollution 5. suggest suitable remedy to control other pollutants like oils, pesticides, noise etc. 6. Suggest a suitable instrumentation for pollution control							

1	**AIR POLLUTION**	**Total Hrs**	9
	Sources and Effect - Acid Rain - Air Sampling and Measurement - Analysis of Air Pollutants - Air Pollution Control Methods and Equipments - Issues in Air Pollution control.		
2	**SOLID WASTE MANAGEMENT**	**Total Hrs**	9
	Sources and Classification - Characteristics of solid waste-Potential methods of solid waste Disposal – Process and Equipments for Energy Recovery from Municipal Solid Waste and Industrial Solid Waste		
3	**WATER POLLUTION**	**Total Hrs**	9
	Sources and Classification of Water Pollutants - Characteristics - Waste Water Sampling Analysis - Waste Water Treatment - Monitoring compliance with Standards - Treatment, Utilization and Disposal of Sludge		
4	**OTHER TYPES OF POLLUTION**	**Total Hrs**	9
	Noise Pollution and its impact - Oil Pollution - Pesticides - Radioactivity Pollution Prevention and Control		
5	**POLLUTION FROM THERMAL POWER PLANTS AND CONTROL METHODS:**	**Total Hrs**	9
	Instrumentation for pollution control - Water Pollution from Tanneries and other Industries and their control		
		Total hours to be taught	45

Text book (s)

1. G.Masters" Introduction to Environmental Engineering and Science, Prentice -Hall 1998 International Editions.
2. S.Peavy, D.R..Rowe, G.Tchobanoglous "Environmental Engineering" - McGraw- Hill Book Company,NewYork.1985.

References

1. H.Ludwig, W.Evans :" Manual of Environmental Technology in Developing Countries, 1991
2. Environmental Considerations in Energy Development, Asian Development Bank (ADB), Manilla 1991

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CBIT	Autonomous Regulation									
Department	Mechanical Engineering	Programme Code & Name					M.E. Thermal Engineering			
Semester-I										
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks				
		L	T	P	C	E	I	Total		
16MEE 212	**REFRIGERATION MACHINERY & COMPONENTS**	3	0	0	3	70	30	100		

Objective (s)	Student will understand 1. different types compressors and their working 2. the importance of design of condensors 3. different types of evaporators 4. different types Refrigerant driers strainers, Receivers, Accumulators 5. other types of pollution like oils, pesticides, noise etc. 6. System Accessories and Controls
Outcome (s)	A student will able to 1. estimate energy efficiency aspects of Hermetic compressors 2. analyze heat transfer coefficient, Fouling factor, Friction factor 3. design of evaporators 4. evaluate different types Refrigerant driers strainers, Receivers, Accumulators, Low pressure receivers 5. deal with refrigerant pumps, cooling tower fans, 6. teat air conditioners, refrigerators, visicoolers, cold rooms,

1	**REFRIGERANT COMPRESSORS**	**Total Hrs**	**9**
Hermetic compressors - Reciprocating, Rotary, Scroll Compressors, Open type compressors-Reciprocating, Centrifugal, Screw Compressors. Semi hermetic compressors – Construction , working and Energy Efficiency aspects. Applications of each type.			
2	**DESIGN OF CONDENSERS**	**Total Hrs**	**9**
Estimation of heat transfer coefficient, Fouling factor, Friction factor. Design procedures, Wilson plots, Designing different types of condensers, BIS Standards, Optimization studies.			
3	**DESIGN OF EVAPORATORS**	**Total Hrs**	**9**
: Different types of evaporators, Design procedure, Selection procedure, Thermal Stress calculations, matching of components, Design of evaporative condensers.			
4	**REFRIGERATION SYSTEM COMPONENTS**	**Total Hrs**	**9**
Evaporators and condensers - Different types, capacity control, circuitry, Oil return, Oil separators - Different types Refrigerant driers strainers, Receivers, Accumulators, Low pressure receivers, Air Washers, Spray ponds.			
5	**SYSTEM ACCESSORIES AND CONTROLS**	**Total Hrs**	**9**
Refrigerant Pumps, Cooling Tower fans, Compressor Motor protection devices, Oil equalizing in multiple evaporators, Different Defrosting and capacity control methods and their implications -Testing of Air conditioners, Refrigerators, Visicoolers, Cold rooms, Calorimetric tests.			
		Total hours to be taught	**45**

Text book (s)	
1	Chlumsky, "Reciprocating & Rotary compressors", SNTL Publishers for Technical literature, 1965.
2	Hains, J.B, "Automatic Control of Heating & Air conditioning" Mc Graw Hill, 1981.
Reference(s)	
1	Althose, A.D. & Turnquist, C.H. "Modern Refrigeration and Air-conditioning" Good Heart -Wilcox Co. Inc., 1985.
2	Recent release of BIS Code for relevant testing practice.
3	ASHRAE Hand book: Equipments, 1998
4	Cooper &Williams, B. "Commercial, Industrial, Institutional Refrigeration, Design, Installation and Trouble Shooting " Eagle Wood Cliffs (NT) Prentice Hall, 1989.

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17			
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering			
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks			
16MEE 213	**ENERGY MANAGEMENT**	L	T	P	C	E	I	Total	
		3	0	0	3	70	30	100	
Objective (s)	1. To create awareness of the importance of the energy auditing and determination of 2. evaluation methods of engineering projects 3. To understand the principles of energy management for various types of industries 4. To understand the need and necessity of energy auditing and estimate the budget for industry 5. To understand the importance of renewable energies in the scenario of depletion of conventional energy resources								
Outcome (s)	A student will be able to 1. grasp the importance of energy auditing 2. estimate the requirement of any proposed industry 3. evaluate the projects and he can act as energy consultant 4. realize the importance of alternative energy techniques in the context of depletion of conventional energy resources 5. evaluation of projects : payback – annualised costs – investor's rate of return – present worth – internal rate of return 6. know importance of alternative energy sources								
1. PRINCIPLES OF ENERGY MANAGEMENT								**Total Hrs**	**9**
Managerial Organization – Functional Areas for i. Manufacturing Industry ii. Process Industry iii. Commerce iv. Government. Role of Energy. Manager in each of these organizations initiating.									
2. ENERGY AUDITING								**Total Hrs**	**9**
Energy Audit: Definition and Concepts, Types of Energy Audits – Basic Energy Concepts – Resources for Plant Energy Studies – Data Gathering – Analytical Techniques Energy Conservation: Technologies for Energy Conservation , Design for Conservation of Energy materials – energy flow networks – critical assessment of energy usage– formulation of objectives and constraints – synthesis of alternative options and technical analysis of options – process integration.									
3. ECONOMIC ANALYSIS								**Total Hrs**	**9**
Economic Analysis: Scope, Characterization of an Investment Project – Types of Deprecication – Time Value of money – budget considerations, Risk Analysis									
4. METHODS OF EVALUATION OF PROJECTS								**Total Hrs**	**9**
Methods of Evaluation of Projects : Payback – Annualised Costs – Investor's Rate of return – Present worth – Internal Rate of Return – Pros and Cons of the common methods of analysis – replacement analysis. Energy Consultant: Need of Energy Consultant – Consultant Selection Criteria.									
5. ALTERNATIVE ENERGY SOURCES								**Total Hrs**	**9**
Alternative Energy Sources : Solar Energy – Types of devices for Solar Energy Collection – Thermal Storage System – Control Systems-Wind Energy – Availability – Wind Devices – Wind Characteristics – Performance of Turbines and systems									
						Total hours to be taught			**45**
Text book (s)									
1. W.C. Turner "Energy Management Hand book" 5th edition, the Fair Mount Press 2. R.Murphy and G.Mc Kay "Energy Management", Butterworth Publications									
References: 1. C.B.Smith "Energy Management Principles" Pergamon Press 2. Stephen W.Fardo, Dile, R.Patric, "Energy conservation Guide Book" Fair Mount Press 3. Frank Krieth, D.Yogi Goswamy "Energy management & conservation hand book" CRC Press 2008									

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. Thermal Engineering		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEE 214	**CONVECTIVE HEAT TRANSFER**	L	T	P	C	E	I	Total
		3	0	0	3	70	30	100

objective (s)

1. to create the awareness of the importance of principles of heat transfer by convection and its applications in engineering along with solution
2. to understand the principles, different types of convection heat transfer and their equations to apply for various engineering applications
3. to familiarize the concept of forced convection and its behavior pipes
4. to understand the principles of conjugate heat transfer and its applications in engineering heat transfer

outcome (s)

a student will be able to

1. select the mode of convection heat transfer rate and calculate heat transfer rate depending on the application
2. use this theory in advanced subjects like cfd and various software packages
3. calculate the heat transfer rate in conjugative system like porous media,
4. calculate the rate of heat transfer with the combination of conduction and convection in applications like heat exchangers
5. evaluate forced and free convection
6. analyse flow through the porous media

1. NTRODUCTION TO CONVECTIVE HEAT TRANSFER — Total Hrs 9

Forced, free & combined convection – convective heat transfer coefficient – Application of dimensional analysis to convection – Physical interpretation of dimensionless numbers. Equations of Convective Heat Transfer: Continuity, Navier-Strokes equation & energy equation for steady state flows – similarity – Equations for turbulent convective heat transfer – Boundary layer equations for laminar, turbulent flows – Boundary layer integral equations

2. FORCED CONVECTION — Total Hrs 9

External Laminar Forced Convection: Similarity solution for flow over an isothermal plate – integral equation solutions – Numerical solutions – Viscous dissipation effects on flow over a flat plate. External Turbulent Flows: Analogy solutions for boundary layer flows – Integral equation solutions – Effects of dissipation on flow over a flat plate. Internal Laminar Flows: Fully developed laminar flow in pipe, plane duct & ducts with other cross-sectional shapes – Pipe flow & plane duct flow with developing temperature field – Pipe flows & plane duct flow with developing velocity & temperature fields. Internal Turbulent Flows: Analogy solutions for fully developed pipe flow –Thermally developing pipe & plane duct flow.

3. NATURAL CONVECTION — Total Hrs 9

Boussineq approximation – Governing equations – Similarity – Boundary layer equations for free convective laminar flows – Numerical solution of boundary layer equations. Free Convective flows through a vertical channel across a rectangular enclosure – Horizontal enclosure – Turbulent natural convection

4. COMBINED CONVECTION — Total Hrs 9

Governing parameters & equations – laminar boundary layer flow over an isothermal vertical plate – combined convection over a horizontal plate – correlations for mixed convection – effect of boundary forces on turbulent flows – internal flows - internal mixed convective flows – Fully developed mixed convective flow in a vertical plane channel & in a horizontal duct

5. HEAT TRANSFER THROUGH POROUS MEDIA — Total Hrs 9

Area weighted velocity – Darcy flow model – energy equation – boundary layer solutions for 2-D forced convection – Fully developed duct flow – Natural convection in porous media – filled enclosures – stability of horizontal porous layers

Total hours to be taught: 45

Text book (s)

1. Patrick H. Oosthuigen & David Naylor "Introduction to Convective Heat Transfer Analysis" (TMH)
2. Kays & Crawford "Convective Heat & Mass Transfer" TMH, 2000

References:

1. Oosthigen, "Convective Heat and Mass Transfer" McGrawhill, 1998
2. Adrian Bejan "Convection Heat Transfer", 2nd Edition John Wiley,1984

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CBIT	Autonomous Regulation	Semester-1				AY - 2006-17		
Department	Mechanical Engineering	Programme Code & Name				M.E. CAD/CAM		
Course Code	Course Name	Hours/ Week			Credit	Maximum Marks		
16MEC 207	**COMPUTATIONAL FLUID DEYNAMCS LABORATORY (Lab-II)**	L	T	P	C	E	I	Total
		0	0	3	2		50	50

Objective(s)

Student to understand the

1. Concept of fluid mechanics
2. Basic steps in a CFD simulation: ANSYS Workbench design modular and meshing
3. Simulation of steady and unsteady problems
4. Physics setup involves boundary conditions
5. Solution of Thermal related problems
6. Post processor of workbench tool for various problems

Outcome(s):

A student will be to

1. analyze laminar flow problems in plates and pipes
2. solve steady and unsteady flows
3. perform analysis free and forced convection
4. evaluate thermal flow in hot and cold fluid
5. simulate NACA aerofoil blades
6. analyze problems related to combustion

The following simulations will be performed using ANSYS workbench tools

List of Experiments:

1. Laminar Flow over Flat plate
2. Laminar Pipe Flow.
3. Steady Flow past a Cylinder
4. Unsteady Flow past a Cylinder
5. Two Dimensional Steady Free Convection
6. Forced Convection for pipe cross section.
7. Study of Hot & Cold Fluid Mix
8. Flow analysis of Airfoil.
9. Compressible Flow in a Nozzle
10. Partially Premixed Combustion
11. Supersonic Flow Over Wedge
12. Bifurcating Artery

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With effect from the academic year 2016- 2017

Scheme of Instruction & Examination
M.E. (THERMAL ENGINEERING) – 4 Semesters (Full Time)

Semester - I

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1	4	30	70	100	4
2.	Core	3	1	4	30	70	100	4
3.	Core	3	1	4	30	70	100	4
4.	Elective-1	3	--	3	30	70	100	3
5.	Elective-2	3	--	3	30	70	100	3
6.	Elective-3	3	--	3	30	70	100	3
7.	Laboratory - I	--	3	3	50	--	50	2
8.	Seminar - I	--	3	3	50	--	50	2
9.	Soft Skills	--	--	--	--	--	--	--
	Total	**18**	**09**		**340**	**360**	**700**	**25**

Semester - II

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core-4	3	1		30	70	100	4
2.	Core-5	3	1		30	70	100	4
3.	Core-6	3	1		30	70	100	4
4.	Elective-4	3	--		30	70	100	3
5.	Elective-5	3	--		30	70	100	3
6.	Elective-6	3	--		30	70	100	3
7.	Laboratory - II	--	3		50	--	50	2
8.	Seminar - II	--	3		50	--	50	2
9.	Mini Project	--	2		50	--	50	1
	Total	**18**	**11**		**390**	**360**	**750**	**26**

Semester - III

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Seminar* (i) Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd Semester. (50 Marks) (ii) Preliminary work on Project implementation. (50 Marks)	100	--	100	6
	Total	**100**		**100**	**6**

Semester - IV

Sl. No	Subject	Marks for		Total Marks	Credits
		Internal Assessment	End Exam		
1	Project Work	100	100	200	12

Note : Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars, Mini Project and Soft Skills should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only, 50 marks awarded by the project guide and
50 marks by the internal committee

Credit requirements for the award of degree, lower limit and upper limit of credits for registration by a student in a semester Credit Requirement for the award of M.E/M. Tech. Degree is 69

PROFESSOR & HEAD
Department of Mechanical Engineering
Chaitanya Bharathi Institute of Technology (A)
Gandipet, Hyderabad-500 075. Telangana

16MEC210

MINIPROJECT GUIDELINES

Instruction	2 Hrs / week
Sessional	50 Marks
Credits	01

Objectives:

First year ME students will each do a 14-week mini project, each generally comprising about one week of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment (see assessment information below). Each student will be allotted to a Faculty supervisor for mentoring.

Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original. Mini projects should have inter disciplinary/ industry relevance. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling. All the investigations are clearly stated and documented with the reasons/explanations. All the projects should contain A clear statement of the research objectives, background of work, Literature review, techniques used, prospective deliverables, benefit from this [line of] research, Detailed discussion on results, Conclusions and references.

Outcomes:

Students are able to
1. Formulate a specific problem and give solution
2. Develop model/models either theoretical/practical/numerical form
3. Solve, interpret/correlate the results and discussions
4. Conclude the results obtained and write the documentation in standard format

Assessment:

1. 50 % of marks for a scientific report on the project.
   Regarding the formatting and structure, the report should be written as a journal article using the style file of a journal appropriate for the field of the research (which journal format is most appropriate should be agreed between student and supervisor). If the journal you selected has a page limit, it can be ignored but the report should not exceed 8000 words (common sense should be used if there are a lot of equations).

   Regarding content, the report should be understandable by your fellow students, so the introduction and literature review could be a bit more detailed than in a research paper. The results and discussions are in elaborate form and at end conclusions and include references.

2. 50 % of marks for an oral presentation which will take place at the end of the semester and evaluation by a committee consist of Supervisor, one senior faculty and Head of the department or his nominee.

PROFESSOR & HEAD
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With effect from the academic year 2016- 2017

Scheme of Instruction & Examination
M.E. (THERMAL ENGINEERING) – 4 Semesters (Full Time)

Semester - I

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core	3	1	4	30	70	100	4
2.	Core	3	1	4	30	70	100	4
3.	Core	3	1	4	30	70	100	4
4.	Elective-1	3	--	3	30	70	100	3
5.	Elective-2	3	--	3	30	70	100	3
6.	Elective-3	3	--	3	30	70	100	3
7.	Laboratory - I	--	3	3	50	--	50	2
8.	Seminar - I	--	3	3	50	--	50	2
9.	Soft Skills	--	--	--	--	--	--	--
	Total	**18**	**09**		**340**	**360**	**700**	**25**

Semester - II

Sl. No	Subject	No. of Hrs. per week		Duration (Hrs)	Marks for		Total Marks	Credits
		Lecture	T/P/S		Internal Assessment	End Exam		
1.	Core-4	3	1		30	70	100	4
2.	Core-5	3	1		30	70	100	4
3.	Core-6	3	1		30	70	100	4
4.	Elective-4	3	--		30	70	100	3
5.	Elective-5	3	--		30	70	100	3
6.	Elective-6	3	--		30	70	100	3
7.	Laboratory - II	--	3		50	--	50	2
8.	Seminar - II	--	3		50	--	50	2
9.	Mini Project	--	2		50	--	50	1
	Total	**18**	**11**		**390**	**360**	**750**	**26**

Semester - III

Sl. No	Subject	Marks for Internal Assessment	End Exam	Total Marks	Credits
1	Project Seminar* (i) Problem formulation and submission of synopsis within 8 weeks from the commencement of 3rd Semester. (50 Marks) (ii) Preliminary work on Project implementation. (50 Marks)	**100**	--	**100**	**6**
	Total	**100**		**100**	**6**

Semester - IV

Sl. No	Subject	Marks for Internal Assessment	End Exam	Total Marks	Credits
1	Project Work	**100**	**100**	**200**	**12**

Note : Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars, Mini Project and Soft Skills should normally be completed by the end of semester II.

* Project seminar presentation on the topic of Dissertation only, 50 marks awarded by the project guide and
50 marks by the internal committee

Credit requirements for the award of degree, lower limit and upper limit of credits for registration by a student in a semester Credit Requirement for the award of M.E/M. Tech. Degree is 69

PROFESSOR & HEAD
...rtment of Mechanical Engineering
...Bharathi Institute of Technology (A)
...ndipet, Hyderabad-500 075. Telangana

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)

Choice Based Credit System (with effect from 2016-17)

B.Tech (Bio-Technology)

I - Semester						
S.No	**Code**	**Subject**	**L**	**T**	**P/D**	**Credits**
1	16MT C02/ 16BT C01	Mathematics - I / Basics of Biology - I	3	1	0	4
2	16PY C01	Engineering Physics	3	-	0	3
3	16CY C01	Engineering Chemistry	3	-	0	3
4	16EE C01	Elements of Electrical Engineering	3	-	0	3
5	16BT C02	Elements of Bio-Technology	3	-	0	3
6	16EG C01	Professional Communication in English	3	-	0	3
7	16ME C02	Engineering Graphics	1	-	3	3
8	16PY C03	Engineering Physics Laboratory	0	-	2	1
9	16CY C03	Engineering Chemistry Laboratory	0	-	2	1
10	16EG C02	Professional Communication Laboratory	0	-	2	1
TOTAL			**19**	**01**	**09**	**25**

L – Lecture (clock hours) T - Tutorial (clock hours) P/D - Practical / Drawing (clock hours)

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16MT C02

MATHEMATICS – I (for BPC Stream)

Instruction	3L + 1T Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	4

Course Objectives:

1. The purpose of E.T is to learn simple steps and its derivatives.
2. It is also essential to learn how to calculate steps, Evaluations and height of High tower buildings.
3. Limits, continuity and differentiability is very essential to function any system or organization.
4. To learn matrices is very important on day to day life in the form of Minimization or Maximization of price etc.
5. To assess the system of Thing for period of short time or long time the curve fitting is very useful.
6. These elementary operations very important to grow further and achieve results in the form of Research and Development.

Course Outcomes: On successful completion of this course the students shall be able to

1. Basics of elementary trigonometry is very essential to solve Engineering problems.
2. Very useful to find out Slopes, Heights and Distances.
3. Basics of limits, continuity and differentiability are must to develop the mathematical modeling.
4. Applications of matrices are abundantly used in Industry as well as Research and Development.
5. It is very useful to find constant co-efficient of straight line and curved equations by curve fitting methods and it uses are plenty at surveying agricultural fields.
6. It is a live wire for Research and Development..

UNIT-I

Trigonometry: Trigonometric ratios and compound angles, trigonometric ratios of multiple and sub multiple angles. Transformations-sum and product rules. Hyperbolic and Inverse Hyperbolic functions.

UNIT-II

Limits, Continuity: Intervals and neighborhoods, limits and concept of a limit. Standard limits and related problems.

UNIT-III

Differentiation: Derivatives of a function, Elementary properties. Derivatives of Trigonometric, Inverse Trigonometric, Hyperbolic and inverse Hyperbolic functions. Methods of differentiation, second and higher order derivatives.

UNIT-IV

Matrices: Types of matrices, multiplication of matrices, scalar multiplication. Inverse of matrix-determinant, singular, non-singular, minor, cofactors, adjoint, Rank-Echelon form, consistency, inconsistency Solutions of simultaneous linear equations.

UNIT-V

Curve Fitting: Residues, Principle of Least squares and Curve fitting by the method of least squares, Fitting of a straight line, parabola, Fitting of the curves of the form ab^x, ae^{bx}.

Text Books:

1. Text Book of Mathematics Telugu Academy Papers-I (A&B) & II (A&B)
2. B.S.Grewal "Numerical Methods for Scientists and Engineers ".

Suggested Reading:

1. A.R.Vasistha "Matrices" , Krishna Prakashan Media (P) Ltd. (2014)
2. P.N.Chatterji / A.R.Vasistha "Differential calculus "
3. TOM M.APOSTOL Calculus Volume -I

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16BT C01

BASICS OF BIOLOGY– I (for MPC Stream)

Instruction	3L + 1T Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	4

Course Objectives:
1. To provide knowledge on basic concepts of Biology to mathematic background students.
2. To give understanding fundamentals of origin of life onwards and various theories of evolution.
3. To provide an insight into classification of plants and their propagation mode.
4. To give the students an understanding of knowledge on microbes and their economic importance.
5. To impart theoretical knowledge on various physiological aspects of plants.

Course Outcomes: At the end of the course student should
1. Be able to understand the theories behind the origin of life and evolution studies.
2. Be able to classify plants based on the habit and habitat of plants.
3. The study can understand the mechanism of reproduction and development of seed in plants.
4. Be able to understand the basic structure and function of various organelles of plant cell.
5. Be able to have a basic knowledge of various microbes and their economic importance.
6. Be able to follow basic physiological aspects in plants.

UNIT-I
HISTORY OF LIFE AND EVOLUTION
History of earth, evolutionary concepts of origin of life. Experimental verification of chemical origin of life - Miller's Experiment. Darwinism, Natural selection, Sexual selection, Artificial selection, Mendelism, Hugo de Vries mutation theory, neo-darwinism

UNIT-II
PLANT SYSTEMATIC AND REPRODUCTION
Plant kingdom, salient features of classification. Alternation of generation of the plants. Type studies of Algae (Spirogyra), Fungi (Rhizopus), Bryophytes (Pteris), Gymnosperms (Cycas) and general characteristics and life cycle of Angiosperms. Overview of modes of reproduction-Asexual: vegetative propagation, budding, sporulation, binary fission; Sexual reproduction: pollination, fertilization, development of embryo, endosperm, fruit and seed formation. Apomixes, pathenocarpy, polyembrony type of reproduction

UNIT-III
CELL STRUCTURE AND INTERNAL ORGANIZATION OF PLANTS
Cell as basic unit of life, overview of the plant cell, cell cycle, cell division, mitosis and meiosis. Concept of Growth, meristems (apical, intercalary and lateral) their functions. Simple tissue (parenchyma, collenchyma and sclerenchyma), complex tissues (xylem and phloem). Tissue systems (epidermal, ground and vascular)

UNIT-IV
MICROBIOLOGY
Introduction and importance of classification – five kingdoms. General account of prokaryotes, bacterial viruses - T4, plant viruses – TMV, animal viruses – HIV, Protista, Fungi, Plantae and Animalia. Reproduction in bacteria (asexual - binary fission and sexual - conjugation) and viruses (lytic and lysogenic). Economic importance of beneficial bacteria (agriculture, industry, medicine and biotechnology).

UNIT-V:
PLANT PHYSIOLOGY AND CONCEPTS IN PLANT BIOTECHNOLOGY
Absorption of water – soil water, water potential, diffusion, imbibitions, osmosis, plasmolysis, absorption of water, ascent of sap, transportation. Crop improvement - Heterosis and mutation breeding. Plant tissue culture techniques and their applications. Plant growth regulators.

Text Books:
1. Text book of Botany I and II year, Vignan Publishers .
2. Text book of Botany, I and II year, Telugu Akademi, Hyderabad 2012.
3. Biology. Raven, Johnson, Losos, Mason, Singer. Tata Mc Graw Hill Publishing Co. Pvt. Ltd 9th edition, 2010.

Suggested Reading:
1. Beginning Science: Biology. B.S. Beckett. Oxford University Press.1 st edition, 1983.
2. Campbell, N.A. and Reece, J. B. (2008) Biology 8th edition, Pearson Benjamin Cummings, San Francisco.
3. Raven, P.H *et al* (2006) Biology 7th edition Tata McGrawHill Publications, New Delhi
4. Griffiths, A.J.F *et al* (2008) Introduction to Genetic Analysis, 9th edition, W.H. Freeman & Co. NY
5. Botany for Degree students. A.C. Dutta, Oxford University Press. 6th Edition, 1998.

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16PY C01

ENGINEERING PHYSICS

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives: The objective of the course is to make the student

1. Understand the general concepts of physics
2. Acquire knowledge of different kinds of waves and their behavior
3. Familiar with crystal physics and materials
4. To introduce the general concepts of physics

Course Outcomes: At the end of the course, the student will be able to

1. Describe the types of oscillations and analyze them
2. Demonstrate the wave nature of the light
3. Develop the concepts related to electromagnetic behavior
4. Identify the various crystal systems and defects
5. Explain the origin of magnetism and dielectric polarization and applications of these materials in the field of engineering & technology

UNIT – I Waves and Oscillations: Review of free oscillations - Superposition of two mutually perpendicular linear SHMs of same frequency and 1:2 ratio frequency – Lissajous figures – Damped vibrations – Differential equation and its solution – Logarithmic decrement - Relaxation time – Quality factor – Forced vibrations – Differential equation and its solution – Amplitude resonance-Torsional pendulum.
Ultrasonics: Production of ultrasonics by piezoelectric and magnetostriction methods – Detection of ultrasonics – Determination of ultrasonic velocity in liquids – Applications.

UNIT – II Interference: Division of amplitude – Interference in thin films (reflected light) – Newton's rings – & division of wavefront – Fresnel's biprism.
Diffraction: Distinction between Fresnel and Fraunhoffer diffraction – Diffraction at single slit – Diffraction grating (N Slits) – Resolving power of grating.

UNIT – III Polarization: Malus's law – Double refraction – Nicol's prism – Quarter & Half wave plates – Optical activity – Laurent's half shade polarimeter.
Electromagnetic Theory: Review of steady and varying fields – Conduction and displacement current – Maxwell's equations in differential and integral forms – Electromagnetic wave propagation in free space, dielectric and conducting media – Poynting theorem.

UNIT – IV Crystallography: Space lattice - Crystal systems and Bravais lattices – Crystal planes and directions (Miller indices) – Interplanar spacing – Bragg's law – Lattice constant of cubic crystals by powder diffraction method.
Crystal Imperfections: Classification of defects – Point defects – Concentration of Schottky and Frenkel defects – Line defects – Edge dislocation – Screw dislocation – Burger's vector.

UNIT – V Magnetic Materials: Classification of magnetic materials – Langevin theory of paramagnetism – Weiss molecular field theory – Domain theory – Hysteresis curve – Structure of ferrites (spinel & Inverse spinel) – Soft and hard magnetic materials.
Dielectric Materials: Dielectric polarization – Types of dielectric polarization: electronic, ionic, orientation and space-charge polarization (Qualitative) – Frequency and temperature dependence of dielectric polarization – Determination of dielectric constant (Schering bridge method) – Ferroelectricity – Barium titanate – Applications of ferroelectrics.

Text Books:

1. B.K. Pandey and S. Chaturvedi, "Engineering Physics", Cengage Publications, 2012
2. M.N. Avadhanulu and P.G. Kshirsagar, "A Text Book Engineering Physics", S. Chand Publications, 2014.
3. M. Arumugam, "Materials Science", Anuradha Publications, 2015.
4. S.L. Gupta and Sanjeev Gupta, Modern Engineering Physics, Dhanpat Rai Publications, 2011.

Suggested Reading:

1. R. Murugeshan and Kiruthiga Sivaprasath, "Modern Physics", S. Chand Publications S. Chand Publications, 2014
2. V. Rajendran, "Engineering Physics", McGahill Education Publications, 2013
3. P.K. Palanisamy, Engineering Physics", Scitech Publications, 2012
4. V. Raghavan, "Materials Science and Engineering", Prentice Hall India Learning Private Ltd., 6th Revised edition, 2015

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16CY C01

ENGINEERING CHEMISTRY

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives

The syllabus has sought to fulfill the objective of making the student of engineering and technology realize that chemistry is the real base of his profession and that therefore he must have a good understanding of chemistry before he can use it in his profession.

" the study of chemistry is profitable not only in as much as it promotes the material interest of mankind ,but also because it furnishes us with insight into the wonders of creation , which immediately surround us and with which our existence, life and development, are most closely connected." Justus Von Leibig (German Chemist)

The various units of the syllabus is so designed to fulfill the following objectives.

1. This syllabus helps at providing the necessary introduction of the chemical principles involved and devices in a comprehensive manner understandable to the students aspiring to become practicing engineers.
2. The aim of framing the syllabus is to impart intensive and extensive knowledge of the subject so that students can understand the role of chemistry in the field of engineering.
3. Thermodynamics and Electrochemistry units give conceptual knowledge about spontaneous processes and how can they be harnessed for producing electrical energy and efficiency of systems.
4. Fuels have been taught with a view to give awareness as to materials which can be used as sources of energy
5. To understand importance of analytical instrumentation for different chemical analysis.

Course Outcome

1. This syllabus gives necessary theoretical aspects required for understanding intricacies of the subject and also gives sufficient exposure to the chemistry aspects in different disciplines of engineering
2. The above knowledge also helps students to carry out inter disciplinary research such that the findings benefit the common man.
3. This syllabus imparts a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

UNIT – I

Chemical Thermodynamics : Introduction and definition of the terms, the concept of reversible and irreversible processes, Work done in isothermal and adiabatic processes, Success and limitations of First law of thermodynamics, need for second law of thermodynamics, statements of second law of thermodynamics, Carnot cycle, heat engine and its efficiency, Carnot theorem, concept of Entropy - Entropy changes in reversible and irreversible processes, physical significance of entropy criteria of spontaneity in terms of entropy and Gibb's free energy function , Gibb's-Helmholtz equation and applications, Numericals.

UNIT – II

Phase rule & Chemical Equilibria

Phase rule : Statement , definition of the terms - phases, components , degrees of freedom with examples, Phase diagram - one component system (water system), two component system (siver-lead system) , desilverisation of lead.

Chemical Equilibria - Homogenous and Heterogenous Equilibria - applications

UNIT – III

Fuels: Classification, requirements of a good fuel, calorific value, types of calorific value, calculation of CV using Dulong's formula, Combustion - calculation of air quantities by weight and volume, Numericals.

Solid fuels: coal - analysis of coal – proximate and ultimate analysis - importance.

Liquid fuels - crude oil - fractional distillation, cracking - Fixed bed catalytic cracking, knocking, antiknocking agents (TEL, MTBE), octane number, cetane number, unleaded petrol.

Gaseous fuels - LPG, CNG - composition and uses

UNIT – IV

Electrochemistry Introduction, construction of electrochemical cell, sign convention, cell notation, cell emf, SOP and SRP, electrochemical series and its applications, Nernst equation and applications, Types of Electrodes - Standard Hydrogen Electrode, Saturated Calomel Electrode, Quinhydrone electrode and Ion selective electrode (Glass electrode), construction, Numericals

UNIT –V

Instrumental Techniques in Chemical Analysis: Principle, method and applications of Conductometry (acid-base titration), Potentiometry (acid-base, redox titration), pH- metry (acid – base titration), Colorimetry (Beer Lambert's law)

Green Chemistry - outlines and Principles

Text Books:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai Pub, Co., New Delhi (2002)
2. Puri & Sharma, "Principles of Physical Chemistry
3. S.S.Dara & S.S.Umare, "Engineering Chemistry", S.Chand company
4. J.C. Kuriacase & J. Rajaram, "Chemistry in engineering and Technology", Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
5. B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
6. P.R.Vijayasarathi, "Engineering Chemistry" PHI Learning Private Limited, New Delhi (2011)

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Suggested Reading:

1. Physical chemistry by P.W.Atkin (ELBS OXFORD PRESS)
2. Physical chemistry by W.J.Moore (Orient Longman)
3. Physical Chemistry by Glasstone
4. Physical Chemistry by T.Engel & Philip Reid, Pearson Publication.
5. B.K.Sharma "Engineering chemistry" Krishna Prakasan Media (P) Ltd.,Meerut (2001)

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16EE C 01

ELEMENTS OF ELECTRICAL ENGINEERING

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:
1. To understand the basic concepts of electrical circuits.
2. To understand the principles of electromagnetic induction.
3. To know about different types of batteries, charging and discharging of batteries and types of fuel cells etc.
4. To know about different types of electrical wires and cables, domestic and industrial wiring.
5. To understand safety rules and methods of earthing.

Course Outcomes: After completion of the course, the student will be able to:
1. Acquire the knowledge of basic concepts of electrical circuits such as Ohm's law, Kirchhorff's laws etc.
2. Acquire the knowledge of basic Faraday's laws of electromagnetic induction.
3. Acquire the knowledge to solve the problem of AC circuits.
4. Acquire the knowledge of specifications of batteries, types of cells and sources of renewable energy.
5. Acquire the knowledge of electrical wiring and cables and their types and electrical equipment and their specification.
6. Acquire the knowledge of safety precautions in handling electrical appliances, importance of grounding and methods of earthing.

UNIT-I DC Circuits
Current, voltage, power and energy, sources of electrical energy, independent and dependent sources, source conversion, circuit elements, Resistor, Inductor, Capacitor Ohm's law, Kirchhoff's laws, analysis of series, parallel and series-parallel circuits, star-delta conversion, Node and Mesh analysis (with independent sources only).

UNIT-II : Electromagnetism & AC Circuits Electric charge, electric field, lines of force, electric field intensity, electric flux and flux density, Faraday's laws of electromagnetic induction, static and dynamically induced EMF.
A.C. Circuits: Generation of alternating voltage and current, equation of alternating voltage and current, average and rms values of sinusoidal quantities, form and peak factors, phasor representation of sinusoidal quantities, AC through pure resistance pure Inductance, pure capacitance, RL,RC,RLC circuits.

UNIT-III: Batteries and Fuel Cell
Introduction to batteries, simple cell, EMF and internal resistance of a cell, primary and secondary cells, cell capacity, types and specifications of batteries, charging and discharging of battery, safe disposal of batteries; fuel cell, principle and types of fuel cell, different sources of renewable energy.

UNIT-IV: Electrical Wiring
Types of wires and cables, types of connectors and switches, system of wiring, domestic and industrial wiring, simple control circuit in domestic installation, electrical equipment and their specifications

UNIT-V: Safety & Protection
Safety precautions in handling electrical appliances, electric shock, first aid for electric shock, other electrics hazards, safety rules, importance of grounding and earthing of electrical equipment, methods of earthing, circuit protection devices: Fuses, MCB, ELCB and Relays.

Text Books:
1. Edward Hughes, "Electrical and Electronics Technology", 10th Edition, Peasson Publishers 2010.
2. V.K. Mehta & Rohit Mehta, "Principles of Electrical Engineering", S.Chand Company Limited 2008
3. B.L. Theraja & A.K. Theraja, "Electrical Technology", Vol.I, S.Chand Company Limited 2008.

Suggested Reading:
1. P.V.Prasad & S. Siva Nagraju, "Electrical Engineering: Concepts & Applications", Cengage Learning, 2012.
2. S. Rao, "Electrical Safety, fire safety engineering & Safety Management", Khanna publications, 1998.
3. Surjit singh & Ravi Deep Singh, "Electrical Estimating and Costing", Dhanapath Rai & Co., 1997.

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16BT C02

ELEMENTS OF BIOTECHNOLOGY

Instruction	3L Periods per week
Duration of University Examination	3 Hours
University Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:
1. Define biotechnology and identify some basic applications.
2. Structure and functions of the basic biomolecules of life.
3. Learns the emerging potential of bioinformatics.
4. Understand the role of biotechnology in production of recombinant products.
5. Introduce the medical applications of biotechnology.
6. Basic understanding of biotechnology and industry.

Course Outcomes:
1. Cite examples of current applications of biotechnology and advances in the different areas like medical, microbial, environmental etc.
2. Familiarize with the use of computers in applied biotechnology.
3. Define terms associated with downstream processing and the process.
4. Understanding of the ethical issues related to biotech products.
5. Familiarize with the medical applications of Biotechnology.
6. Get a broad insight into the multidisciplinary field of biotechnology.

UNIT-I
INTRODUCTION TO BIOTECHNOLOGY
Historical perspectives, Classical vs Modern Biotechnology. Applications of Biotechnology in different fields. Introduction to prokaryotic cell and eukaryotic cell and its differences. The beneficial and harmful role of microorganisms

UNIT –II
INTRODUCTION TO BIOMOLECULES AND BIOINFORMATICS
Structure and functions of nucleic acids, lipids, carbohydrates, amino acids in brief. Introduction to Bioinformatics, role of bioinformatics in biotechnology, types of biological databases and their applications, Human Genome project.

UNIT –III
MOLECULAR BASIS OF BIOTECHNOLOGY
Identification of genetic material- classical experiments, structure of DNA and chromosome and its functions, Central dogma of molecular biology- from genes to proteins, a brief view on transcription and translation. Basics of rDNA technology- basic steps in rDNA technology (Case study of Insulin production). Bioethical issues in biotechnology.

UNIT –IV
MEDICAL BIOTECHNOLOGY.
Elements of Immunology - Types of immunity (Acquired and Innate), structure and functions of antigen, types of antibodies, monoclonal antibodies – hybridoma technology, Etiology of cancer. Introduction to stem cells -types, characteristics and applications

UNIT –V
PROCESS BIOTECHNOLOGY
Upstream process - basic structure of fermenter, types of fermentation processes, aerobic and anaerobic process, Batch and Continuous fermentation. Downstream process - overview and importance. Characteristics of bioproducts (intracellular and extracellular)

Text Books:

1. Cell Biology. C.B. Powar. Himalaya publication. 2nd edition, 1981.
2. Principles of Genetics. John Gardner, Simmons and Snustad. John wiley and sons. 8th edition, 2006.
3. Principles of Genetics. P.K. Gupta. Rastogi Publication, Meerut, 2000.
4. Principles of Genetics. Simmons, Snustad and Jenkins. John wiley and sons. 8th Edition, 1997.
5. Bioinformatics: Methods and Applications. SC Rastogi, N Mendiratta & P Rastogi. PHI, New Delhi. 4th edition, 2005.
6. Bioseparations: Downstream processing for biotechnology. Paul A.Belter, E. L. Cussler and Wei-Shou Hu. Wiley, 1988.
7. Kuby Immunology. Richard A. Goldsby, Thomas J.Kindt, Barbara A. Osborne. WH freeman company. 6th edition, 2006.
8. Introduction to the cellular and molecular biology of cancer. Edited by L.M. Franks, N.M.Teich. Oxford university press. 4th edition, 2005.

Suggested Reading:

1. The Cell: A Molecular approach. Geoffrey M Cooper and Robert E. Hausman. Sinauer associates incorporated. 5th ed, 2009.
2. Principles of fermentation technology. Peter F. Stanbury, Allan Whitaker & Stephen J. Hall. Butterworth-Heinemann Limited, 1995
3. Industrial Microbiology. L.E. Casida. New age international, 2000.
4. Bioseparations: principles and techniques. B.Sivasankar: PHI learning Pvt Ltd, 2010.
5. Cell and Molecular biology eighth edition, Derobertis & Derobertis LippincoH Williams and Willins (2010)
6. Biotechnology: A text books of industrial microbiology. Wulf Crueger and Anneliese Crueger. Editor of English edition Thomas D. Brock. Sinauer Associates, 1990

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7. Riott's essential immunology. Peter J. Delves, Seamus J. Martin, Dennis R. Burton and Ivan M. Riott. Wiley - Blackwell. 12th edition, 2011.
8. The Biology of Cancer. Robert A. Weinberg. Garland Science. 2nd edition, 2013.

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16EG C01

PROFESSIONAL COMMUNICATION IN ENGLISH

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. To enable the students to understand the role and importance of communication and to develop their basic communication skills in English.
2. To strengthen the students' usage of grammar and to develop their vocabulary.
3. To improve the students' listening skills and introduce them to different reading strategies.
4. To equip the students with appropriate writing skills.
5. To enhance imaginative and critical thinking through literary texts and book review.

Course Outcomes: The students will

1. Understand the nature, process and types of communication and will communicate effectively without barriers.
2. Understand the nuances of listening and will learn to make notes
3. Read different texts, comprehend and draw inferences and conclusions.
4. Write effective paragraphs, letters and reports
5. Critically analyze texts and write book reviews

UNIT- I

Understanding Communication in English: Introduction, nature and importance of communication. Process of communication. Basic types of communication - verbal and non verbal. One way vs. Two way communication. Barriers to communication. Intrapersonal and interpersonal communication. Johari Window.

Grammar & Vocabulary: Parts of speech, figures of speech – Euphemism, Hyperbole, Irony, Metaphor, Onomatopoeia, Oxymoron, Paradox, Personification, Pun & Simile

UNIT- II

Developing Listening Skills: Exposure to recorded and structured talks, class room lectures- problems in comprehension and retention. Types of listening, barriers to listening, effective listening strategies. Note –taking.

Grammar & Vocabulary: Articles, Prepositions, Phrasal verbs, Idioms.

UNIT- III:

Developing Writing Skills: Sentence structure. Brevity and clarity in writing. Cohesion and coherence. Paragraph writing. Letter writing - form and structure, style and tone. Kinds of Letters –Apology and request letters. Email etiquette. Report writing.

Grammar & Vocabulary: Tense, Conditionals, homonyms, homophones.

UNIT - IV: Developing Reading Skills: The reading process, purpose, different kinds of texts. Reading comprehension. Techniques of comprehension – skimming, scanning, drawing inferences and conclusions. Note-making

Grammar &Vocabulary: Concord, Connectives, Active and Passive voice, Words often confused.

UNIT- V: Reading for Enrichment

1. The Road Not Taken — Robert Frost
2. Goodbye Party For Miss Pushpa T. S — Nissim Ezekiel
3. The Open Window — Saki
4. The Romance Of A Busy Broker — O. Henry

Book reviews -Oral and written review of a chosen / novel/ play - a brief written analysis including summary and appreciation. Oral presentation of the novel/play

Grammar & Vocabulary: Indianisms, Common errors, Parallelisms.

Text Books:

1. Vibrant English, Orient Blackswan Ltd,

Suggested Reading:

1. M .Ashraf Rizvi, Effective Technical Communication, Tata Mc Graw- Hill, New Delhi
2. Meenakshi Raman and Sangeetha Sharma, Technical Communication - Principles and Practice, Oxford Univ. Press, New Delhi.
3. Sunil Solomon, English for Success, Oxford University Press, 2015
4. Krishna Mohan, Meera Banerji, Developing Communication Skills, McMillan India Ltd.
5. Michael McCarthy, English Vocabulary in Use.
6. Brikram K Das, Kalyani Samantray, An Introduction to Professional English and Soft Skills Cambridge University Press, New Delhi.

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16ME C02

ENGINEERING GRAPHICS

Instruction	1L + 3D Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. To provide an exposure in understanding the drawings during a multidisciplinary approach towards a problem
2. To train up in perception and imagination of a three dimensional scenario.

Course Outcomes:

1. To understand theory of projections
2. Ability to improve visualization skills
3. Ability to sketch Engineering Objects

UNIT – I

Introduction to Engineering Drawing: Drawing Instruments and their uses, types of lines, use of pencils, Lettering, Rules of dimensioning

Conic Sections: Ellipse, Parabola, Hyperbola including the Rectangular Hyperbola (General method only)

Cycloidal curves: Construction of cycloid, epi-cycloid, hypo-cycloid & involutes

UNIT – II

Orthographic Projections: Principles of Orthographic Projections – Conventions , Projection of Points, Projection of Lines - inclined to both planes.

UNIT – III

Projections of Planes: Projections of regular Planes – Perpendicular planes and Oblique planes.

UNIT – IV

Projections of Solids: Projections of Regular Solids – Regular Polyhedra, solids of revolution, (Simple position only)

Sections of Solids: Types of cutting planes – their representation – sections of solids in simple position.

UNIT – V

Introduction to Graphic packages: Getting started, Basic drawing and editing commands, creating lines, planes and solids.

Note: Syllabus for external examination will be from unit 1 to unit 4 only & unit-5 is exempted from external examination. Unit 5 is for internal examination only.

Text Books:

1. N.D.Bhatt," Elementary Engineering Drawing", Charotar Publishers, 2012
2. Basanth Agrawal and C M Agrawal "Engineering Drawing 2e ", McGraw-Hill Education(India) Pvt. Ltd.

Suggested Reading:

1. K.L.Narayana and P.K.Kannaiah, "Text Book of Engineering Drawing", Scitech Publications, 2011
2. P.S.Gill' "Engineering Graphics", Kataria Publications, 2011
3. K.Veenugopal, "Engineering Drawing and Graphics + Autocad", New Age International Pvt. Ltd, 2011
4. Shaw M.B and Rana B.C., "Engineering drawing", Pearson, 2nd edition, 2009
5. P I Varghees, " Engineering Graphics ",Tata McGraw-Hill publications, 2013
6. Bhattacharya. B, "Engineering Graphics", I. K. International Pvt. Ltd, 2009
7. Dhawan R.K., "Principles of Engineering Graphics and Drawing", S. Chand, 2011

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16PY C03

ENGINEERING PHYSICS LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives: The objectives of the course is to make the student

1. Apply theoretical physics knowledge in doing experiments
2. Understand the behavior of the light experimentally
3. Analyze the behavior of magnetic and dielectric materials

Course Outcomes: At the end of the course, the student will be able to

1. Understand the concept of errors and find the ways to minimize the errors
2. Demonstrate interference and diffraction phenomena experimentally
3. Distinguish between polarized and unpolarized light
4. Determine the loss of energy of a ferromagnetic material and its uses in electrical engineering
5. Understand the suitability of dielectric materials in engineering applications

List of Experiments:

1. Error Analysis – Estimation of errors in the determination of time period of a torsional pendulum
2. Newton's Rings – Determination of wavelength of given monochromatic source
3. Single Slit Diffraction – Determination of wavelength of given monochromatic source
4. Diffraction Grating – Determination of wavelengths of two yellow lines of mercury light
5. Malus's Law – Verification of Malus's law
6. Double Refraction – Determination of refractive indices of O-ray and E-ray of given calcite crystal
7. Polarimeter – Determination of specific rotation of glucose
8. B-H Curve – Determination of hysteresis loss of given specimen
9. Dielectric Constant – Determination of dielectric constant of given PZT sample
10. Ultrasonic Interferometer – Determination of velocity of ultrasonics in given liquid

Note: A student must perform a minimum of eight experiments.

Suggested Reading:

1. "Engineering Physics" - Manual by Department of Physics, CBIT, 2016
2. S.K. Gupta, "Engineering Physics Practical", Krishna's Educational Publishers, 2014
3. O.P. Singh, V. Kumar and R.P. Singh, "Engineering Physics Practical Manual", Ram Prasad & Sons Publications, 2009

16CY C03

ENGINEERING CHEMISTRY LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives

1. To impart fundamental knowledge in handling the equipment / glassware and chemicals in chemistry laboratory
2. For practical understanding of theoretical concept of chemistry

Course Outcomes:

1. This syllabus helps the student to understand importance of analytical instrumentation for different chemical analysis.
2. The above knowledge also helps students to carry out inter disciplinary research such that the findings benefit the common man.

List of Experiments:

1. Introduction to chemical analysis.
2. Preparation of standard solution of oxalic acid and Standardization of NaOH
3. Estimation of amount of Fe^{+2} in the given solution using Mohr's salt and $KMnO_4$
4. Estimation of amount of Fe^{+2} in the given solution using Mohr's salt and $K_2Cr_2O_7$5.

Estimation of amount of copper in the given solution using hypo solution.

6. Estimation of amount of HCl pH metrically using NaOH solution
7. Estimation of amount of CH_3COOH pH metrically using NaOH solution
8. Determination of concentration of given KMnO4 solution Colorimetrically
9. Determination of concentration of given $K_2Cr_2O_7$ solution Colorimetrically
10. Distribution of acetic acid between n-butanol and water.
11. Distribution of benzoic acid between benzene and water
12. Preparation of urea – formaldehyde / phenol- formaldehyde resin.

Suggested Reading:

1. Vogel' S text book of quantitative chemical analysis by J. Mendham and Thomas,Person education Pvt.Ltd New Delhi ,6th ed. 2002
2. Laboratory Manual on Engineering Chemistry by Dr. Subdharani (Dhanpat Rai Publishing)
3. A Textbook on experiment and calculation in engineering chemistry by S.S. Dara S.Chand
4. Instrumental methods of Chemical Analysis, MERITT & WILLARD East-West Press).

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16EG C02

PROFESSIONAL COMMUNICATION LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives:

1. To introduce students to phonetics and the different sounds in English.
2. To familiarize the students with the software and give them sufficient practice in correct pronunciation.
3. To enable students to speak English correctly with focus on stress and intonation.
4. To help students overcome their inhibitions while speaking in English and to build their confidence. The focus shall be on fluency rather than accuracy.
5. To understand team work, role behavior and to develop the ability to analyze, evaluate, construct and refute arguments.

Course Outcomes:

1. The students will understand the speech sounds in English and the nuances of pronunciation.
2. The students will understand tone, intonation and rhythm and apply stress correctly.
3. The students will be able to participate in group discussions with clarity and confidence.
4. The students will speak confidently on stage with appropriate body language.
5. The students will debate on various issues and learn to work in teams.

Exercises

1. **Introduction to English Phonetics**: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. **Sound system of English**: Phonetic sounds and phonemic sounds, introduction to international phonetic alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters.
3. **Aspects of connected speech**: Strong forms, weak forms, contracted forms, elision.
4. **Word stress**: Primary stress, secondary stress, functional stress, rules of word stress.
5. **Rhythm & Intonation**: Introduction to Rhythm and Intonation. Major patterns, intonation of English with the semantic implications.
6. **Listening skills** – practice with IELTS and TOEFL material
7. **Situational dialogues and role play**
8. **Public speaking** is to be shown by incorporating narrative examples and extracts from speeches.
9. **Group Discussions**– videos to be shown and practice sessions
10. **Poster making** – preparation and presentation
11. **Debate** - Differences between a debate and a group discussion. Essentials of a debate, conducting a debate.

Suggested Reading:

1. E Suresh kumar et al, . English for Success (with CD), Cambridge University Press India Pvt Ltd. 2010.
2. Aruna Koneru, Professional Speaking Skills, Oxford University Press, 2016
3. T Balasubramanian. A Textbook of English Phonetics for Indian Students, Macmillan, 2008.
4. J Sethi et al. A Practical Course in English Pronunciation (with CD), Prentice Hall India, 2005.
5. Edgar Thorpe. Winning at Interviews, Pearson Education, 2006
6. Priyadarshi Patnaik. Group Discussions and Interviews, Cambridge University Press Pvt Ltd 2011

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)
Choice Based Credit System (with effect from 2016-17)

B.Tech (Bio-Technology)

II – Semester						
S.No	**Code**	**Subject**	**L**	**T**	**P/D**	**Credits**
1	16MT C04/ 16BT C03	Mathematics - II / Basics of Biology - II	3*	-	0	3
2	16CY C05	Bio Organic Chemistry	3	-	0	3
3	16PY C05	Bio Physics	3	-	0	3
4	16CS C01	Programming and Problem Solving	3	1	0	4
5	16BT C04	Introduction to Anatomy and Physiology of Humans	4	-	0	4
6	16CE C03	Professional Ethics and Human Values	1	-	0	1
7	16CE C02	Environmental Studies	1	-	0	1
8	16CS C02	Programming Laboratory	0	-	2	1
9	16ME C03	Mechanical and IT Workshop	0	-	3	2
10	16PY C06	Bio Physics Laboratory	0	-	2	1
11	16CY C06	Bio Organic Chemistry Laboratory	0	-	2	1
TOTAL			**18**	**01**	**09**	**24**

L – Lecture (clock hours) T - Tutorial (clock hours) P/D - Practical / Drawing (clock hours)

* One extra hour may be permitted in the timetable

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16 MT C04

MATHEMATICS – II (for BPC Stream)

Instruction	3L Periods per week + 1 (extra hour)
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:
1. The student is expected to know the behavior of single valued functions of partial fractions and Rational functions.
2. Master the methods and techniques of integration and definite integrals.
3. Expected to know learn the basics of formation of First Order Differential equations and identifying the Nature of equations.
4. Expected to learn Higher Order Linear Differential Equations and its solutions by various methods.
5. Expected to learn system of Linear Equations and its solutions by various methods.
6. Students enable to learn formation of Differential Equations and modeling of Algebraic Equations and its solutions.

Course Outcomes: On successful completion of this course the students shall be able to
1. To find out Areas, Surface Areas, Volumes can be obtained by definite integrals.
2. Any complicated fraction can be decomposed by using partial fractions, then it makes integrable.
3. Model the First-Order Differential Equations and solve it for various Engineering Branches ECE, EEE, etc. (Such as L-R, L-R-C, Newton's laws of delay and growth problems)
4. Model the Higher Order Linear Differential Equations and solve it for various Engineering branches Mech, Civil, ECE, EEE and etc.
5. To learn how to find out approximate values of Multivariable Algebraic Equations by various methods.
6. All above serial numbers are live wire of Research and Development.

UNIT- I: Partial Fractions: Resolving f(x)/g(x) in to partial fractions, g(x) contains non repeated linear factors, g(x) contains repeated and non repeated linear factors, g(x) contains non repeated irreducible factors, g(x) contains repeated and not repeated irreducible factors.

UNIT - II Integration: Integration considered as converse of differentiation, simple integrations of algebraic, trigonometric and exponential etc. Methods of integration, integration by parts, integration of rational, irrational and Trigonometric functions, definite integrals

UNIT- III Differential Equations: Differential equations of First order and first degree, Variable separable, Homogeneous, linear, Bernoulli's equations, Exact differential Equations.

UNIT- IV Differential Equations of Higher Order: Differential equations of higher order with constant coefficients, Complimentary functions and particular Integrals, Particular Integrals of e^{ax} , sin ax , cos ax , x^m , e^{ax} sin bx , e^{ax} cos bx Differential equations of higher order with variable coefficients Cauchy linear equations.

UNIT- V Linear Algebra: Solution of system of Linear equations by Inverse, Gauss Jordan and Cramer‟s Rule. Cayley Hamilton Theorem (without proof)

Text Books:
1. Text Book of Mathematics Telugu Academy Papers-I (A&B) & II (A&B)
2. B.S. Grewal "Higher Engineering Mathematics"

Suggested Reading:
1. A.R.Vasistha "Matrices" , Krishna Prakashan Media (P) Ltd. (2014)

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16BT C03

BASICS OF BIOLOGY– II (for MPC Stream)

Instruction	3L Periods per week+ 1 (extra hour)
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

1. This course aims at providing knowledge on basic concepts of Biology to mathematic background students.
2. The course is designed to give understanding salient features of animal kingdom classification.
3. This course aims at providing an insight into animal tissues and their types.
4. To provide knowledge on various parasites, lifecycle and diseases caused by them.
5. The course aims at imparting theoretical knowledge on various biotic interactions in nature.

Course Outcomes:

By the end of the course students be able to

1. Explain the criteria for classification of various organisms in animal kingdom.
2. Identify the basic structure and function of various organelles of animal cell
3. Discuss the organization symmetry and tissue types in animal system.
4. Outline various biotic interactions in nature.
5. Demonstrate the basic information on gene, alleles and its inheritance.
6. Compare the gene regulation system in prokaryotes and eukaryotes.

UNIT- I

ANIMAL KINGDOM CLASSIFICATION

Classification of animal kingdom. Phylogeny of invertebrate and vertebrate phyla. Salient features of nonchordates up to phyla, and chordates up to class level. Binomial and trinomial nomenclature. Concept of species and genus

UNIT- II

CELL AND TISSUES: STRUCTURE AND FUNCTIONS

Structure of animal cell and its organelles. Differences between plant and animal cell. Level of organization, multicellularity, diploblastic and triploblastic conditions. Asymmetry, symmetry: radial symmetry and bilateral symmetry. Acoelomates, pseudocoelomates and eucoelomates in brief. Animal tissues structure and functions. Different types of animal tissues and their functions. Epithelial, Connective, Muscular and Nervous tissues in brief

UNIT- III

PARASITOLOGY: PARASITISM AND PARASITIC ADAPTATION

Health and disease: introduction, life cycle, pathogenecity, treatment and prevention; *Entamoeba histolytica*, *Plasmodium vivax*, *Ascaris lumbricoides* and *Wuchereria bancrofti*. Brief account of pathogencity, treatment and prevention of typhoid, pneumonia, common cold and ring worm.

UNIT - IV

ECOLOGY AND ENVIRONMENT

Organism and environment, habitat and niche. Population and ecological adaptations, population interactions. Abiotic environmental factors – light, temperature, water and radiation

Biotic environmental factors –neutralism, competition, mutualism, commensalism, parasitism, predation. Attributes, growth, birth rate and death rate, age distributions

UNIT - V

GENETICS

Structure and Functions of chromosome. Concept of gene and alleles, multiple alleles, ABO blood groups. Sex chromosomes, sex linked inheritance, gene expression and regulation in prokaryotes and eukaryotes.

Text Books:

1. Text book of Zoology, I and II year, Vignan publisher, Guntur
2. Biology. Raven, Johnson, Losos, Mason, Singer. Tata Mc Graw Hill Publishing Co. Pvt. Ltd 9th edition, 2010

Suggested Reading:

1. Beginning Science: Biology. B.S. Beckett. Oxford University Press.1st edition, 1983
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The Invertebrates: A New Synthesis.III Edition, Blackwell Science
3. Introduction to Applied biology and Biotechnology. K Vaidhyanath, K Pratap Reddy and K Sathya Prasad.BS Publications, India, 2004

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16CY C05

BIO ORGANIC CHEMISTRY

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course Objectives:

Biotechnology students should have a fundamental knowledge in chemistry from which they develop core expertise in organic chemistry like structure of compounds, reactivity and functions of various bio-molecules.

1. Student is made to understand the basics of Bio–Organic chemistry, i.e. an understanding of the importance and reason for course
2. To understand the structure and function of the basic molecules found in living cells.
3. To understand carbohydrates, lipids structures and functions.
4. Student is able to understand the structure, Preparation and classification of amino acids and protein synthesis
5. To understand DNA and RNA structure and function
6. To understand the characterization of Bio-products

Course Outcomes:

1. To prepare graduates for employments as chemists and have mastered a broad range of basic lab skills applicable to biochemistry and biotechnology.
2. Bio-Organic Chemistry majors will have a firm foundation in chemical principles as well as higher level of understanding in each of the chemistry sub disciplines: analytical, biochemistry, organic etc.
3. Understand the mechanism involved in various chemical reactions.
4. Understand the structure and functions of bio-molecules like carbohydrates, lipids, amino acids etc.
5. Understand a broad range of basic Bio-Organic and biological concepts, and can apply and analyze these in at least one specialty area
6. Be aware of the role of bio-molecules in Biotechnology

UNIT – I

Introduction to Organic Chemistry: Nomenclature of organic compounds, Hybridization; Functional Group properties- Carbonyl, carboxylic acid, Ester, Hydroxyl and Amine Functional Groups; Isomerism- structural (keto-enol-tautomerism) and Stereoisomerism-l, geometrical and conformational isomerism, Optical isomerism-enantiomers, diastereomers, meso compounds, Racemic mixture. Sequence rules for R, S-configuration and Fisher projections of Lactic acid

UNIT-II

Structure Reactivity Correlations of Organic Molecules: Electron displacements in a molecule-Inductive and mesomeric effect, resonance, hyper conjugation and electromeric effects; rules and effects of Organic reactions – Saytzeff's Rule and Markonikoff's Rule, Kharash effect, Orientation Effect and Functional Group effect and stearic effect

UNIT-III

Types of Organic Reactions and Some Name Reactions: Types of Organic reactions- Nucleophilic Substitution reactions (SN^1 & SN^2), Electrophilic substitution, free radical Substitution, Addition reactions, Elimination (E^1 & E^2) and Rearrangement (Oxime - rearrangement) reactions. Concepts of Aromaticity-Huckel's Rule. Name Reactions – Aldol Condensation, Hoffman bromamide degradation, Perkin reaction

UNIT – IV

Biomolecules – Chemistry of Carbohydrates : Classification and Structure of Carbohydrates- glucose, fructose, maltose, cellulose and starch; determination of Open chain structure of glucose and fructose , Hawarth (cyclic) structure of glucose and fructose, General reactions of glucose and fructose, and their inter conversions-mutarotation.

Chemistry of Lipids – Fatty Acids-saturated and unsaturated fatty acids, Oils- Properties of oils, Tests to check the purity of oils - acid value, saponification value, Iodine Value, Reichert-Meisel value

UNIT-V

Biomolecules -Amino acids: Chemistry of Amino acids-Classification, structure and reactivity. Synthesis of amino acids- amination of α-halogen acids, Gabriel phthalimide synthesis, strecker synthesis

Chemistry of Nucleic Acids: Proteins-Introduction, structure of proteins, peptide bond. Nucleic acids-Structure of DNA and RNA

Text Books:

1. Organic chemistry. Robert. T. Morrison and Robert N. Boyd, Prentice Hall India, Delhi. 6th edition,2002
2. Fundamentals of Biochemstry-JL Jain.
3. Organic chemistry 6e. Morison & Boyed, PHI (Prentice-Hall India)-Delhi.
4. Fundamentals of Biochemstry-JL Jain.
5. Text Book of Organic Chemistry-Vol-I,IL FINAR,Longman Group.

Suggested Reading:

1. Principles of Organic Chemistry- M. K. Jain 9th edition-S.Nagh & Co.
2. Organic Chemistry by SOLOMON
3. Natural Products by O.P.Agarwal-vol-I & vol-II

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16PY C05

BIO PHYSICS

Instruction	3L Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	3

Course objectives:

The objective of the course is to make the student:

1. Understand basic electrical properties of cell, light and electron microscopy techniques
2. Learn Physical phenomenon involved in the functioning of eye and ear sensory systems
3. Get knowledge of the nature of ionizing radiation and its action on biomolecules
4. Understand of some biomedical instrumentation techniques
5. Gain the knowledge of measurement of viscosity and surface tension

Course outcomes:

At the end of the course, the student will be able to

1. Make use of appropriate microscope for the analysis of bio sample based on their nature. They also understand electrical properties of cell.
2. Understand Biophysics of sound and light in ear and eye.
3. Understand damages by ionizing radiation to different bio molecules such as proteins, nucleic acids, chromosomes, cells and tissues and to measure radiation.
4. Apply different imaging and diagnostic techniques of human body.
5. Describe transport phenomenon osmosis and its effect in blood.

UNIT – I

Introduction: Definition of Biophysics– Cell theory and Atomic theory – Electrical properties of cell and tissues–Electrical oscillatory phenomenon associated with cell division(Cellular spin resonance).

Microscopes: Structure, construction and functions of a compound microscope– Types and functions of different Microscopes: Phase Contrast Microscope, Interference Microscope, Polarizing Microscope and Electron Microscope – High Resolution Optical Imaging.

UNIT – II

Human Eye: Structure of retina and its biometrics– Optics of the Eye– Camera principle & its application to the Eye– Mechanism of accommodation–Visual acuity– Colors and its recognition – Defects of vision and their correction: Myopia, Hyperopia, Presbyopia and Astigmatism.

Human Ear: Structure and mechanics of hearing–Auditory receptors and Genesis of different potential charges in the Ear–Determination of pitch, Loudness and quality of sound.

UNIT – III

Radiation and Light Action: Nature of Ionizing Radiation – Target theory– Inactivation of proteins and nucleic acids through radiation effects – Radiation Effects on cells and tissues – Action of ionizing radiation on Chromosomes– GM counter and dosimetry of radiation – Photosynthesis.

UNIT – IV

Biomedical Instrumentation: Principle, working and biological applications of ultrasonic imaging–Endoscopy – Computational Tomography (CT)– Nuclear Magnetic Resonance (NMR) – Magnetic Resonance Imaging (MRI)– Positron Emission Tomography (PET) – Electrocardiograph (ECG) Electroencephalograph (EEG)-Determination of Blood pressure.

UNIT – V

Osmosis Phenomenon: Osmosis – Osmotic fragility of red blood cells – Transport through membrane – Solute Transport: Artificial kidney.

Methods of Determination of Viscosity and Surface Tension of Bioliquids: Viscosity Specific and intrinsic viscosities and their determination by Ostwald's method – Experimental determination of viscosity and surface tension of bioliquids by capillary flow method.

Text Books:

1. Text Book of Medical Physiology by Guyton and Hall, Elsevier Publications, 2013
2. Fundamentals of Polymer Physics and Molecular Biophysics by Himadri B. Bohidar, Cambridge University Press, 2015
3. Physics for Diagnostic Radiology by P.P. Dendy and B. Heaton, CRC Press, 2011
4. A Text of Biophysics by Dr. R. N. Roy New Central Book Agency (P) Ltd., 2009

Suggested Reading:

1. Intermediate Physics for Medicine and Biology by Russel K. Hebby, Springer Publications, 2007
2. Biomedical Electronics and Instrumentation by Omkar N. Pandey and Rakesh Kumar, S.K. kataria & Sons Publications, 2009
3. Biophysics by Glaser R., Springer Publications, 2012
4. Essentials of Biophysics by Narayanan P., New Age International Publications, 2008

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16CS C01

PROGRAMMING AND PROBLEM SOLVING

Instruction	3L + 1T Periods per week
Duration of End Examination	3 Hours
End Examination	70 Marks
Sessional	30 Marks
Credits	4

Course Objective:
1. To acquire problem solving Skills.
2. To be able to write Algorithms.
3. To understand structured programming Approach.
4. To understand Memory structure.
5. To implement I/O Programming.
6. To be able to write program in C Language.

Course Outcomes: Student will be able to:
1. Develop algorithms for scientific problems.
2. Explore algorithmic approaches to problem solving.
3. Understand the components of computing systems.
4. Choose data types and structure to solve mathematical problem.
5. Develop modular programs using control structure, arrays and structures.
6. Write programs to solve real world problems using structured features.

UNIT – I Introduction to Computers: Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts.
Introduction to C Language: Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.

UNIT – II Control Statements: Bitwise Operators, Relational and Logical Operators, If, If-Else, Switch-Statement and Examples. Loop Control Statements: For, While, Do-While and Examples. Continue, Break and goto statements.
Functions: Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Parameter Passing-Call-by-value, call-by-reference, Recursion**.**

UNIT – III Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers.
Arrays: Concepts, Using Arrays in C, Array Applications, Two- Dimensional Arrays, Multidimensional Arrays.
Searching and Sorting: Linear and Binary Search, Selection Sort and Bubble Sort.

UNIT – IV Pointers: Introduction, Pointers to Pointers, Compatibility, Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocation Functions, Array of Pointers, Programming Applications, Pointers to void, Pointers to Functions, Command-line Arguments.
Strings: Concepts, String Input /Output Functions, Arrays of Strings, String Manipulation Functions.

UNIT – V Structures: Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Unions, Type Definition (typedef), Enumerated Types.
Input and Output: Introduction to Files, Modes of Files, Streams, Standard Library Input/output Functions, Character Input/output Functions
Preprocessors: Preprocessor Commands.

Text Books:
1. Pradip Dey and Manas Ghosh “Programming in C 2/e” Oxford University Press , 2nd Edition 2011.
2. B. W. Kernighan and D.M. Ritchie, "The 'C' Programming Language” Prentice Hall India, 2nd Edition. 1990.
3. B.A.Forouzan and R.F. Gilberg A Structured Programming Approach in C, Cengage Learning,2007.

Suggested Reading:
1. Rajaraman V. "The Fundamentals of Computers" 4th Edition, Prentice Hall of India, 2006.
2. R S Bichker “programming in c” University Press ,2012.

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16 BT C04

INTRODUCTION TO ANATOMY AND PHYSIOLOGY OF HUMANS

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	70Marks
Sessionals	30 Marks
Credits	4

Course Objectives:

1. Student gets an overview of the human body tissues and endocrine system.
2. The various organs associated with digestion and excretion is taught.
3. Heart structure and functioning is detailed, including the gaseous exchange occurring through the respiratory system.
4. Knowledge of Spinal cord, the associated nerves and the different sense organs are imparted.
5. Reproductive physiology is explained.
6. Importance of blood pressure is emphasized.

Course Outcomes:

By the end of the course students be able to

1. Outline the structure of Human body.
2. Explain the appropriate terminology related to anatomy and physiology.
3. Discuss the anatomical structures and the physiological functions of body's main systems.
4. Apply the interrelationships within and between anatomical and physiological systems of the human body.
5. Identify the importance of homeostasis and the use of feedback loops to control physiological systems in the human body.
6. Apply the knowledge of monitoring vital parameters for proper body functioning.

UNIT – I INTRODUCTION TO ANATOMICAL TERMS AND ENDOCRINE GLANDS

Definition of Anatomy and Physiology; Major types of human tissues. Various systems of human body and their general roles. Homeostasis. Types of endocrine glands- anatomy and physiological of pituitary, thyroid, pancreas

UNIT- II ANATOMY OF SKELETAL, DIGESTIVE AND EXCRETORY SYSTEMS

Structure and function of bones and muscles Digestive system- organs and functions; role of liver and pancreas, Excretory system- kidney and urinary bladder; physiology of excretory system- urine formation

UNIT- III ANATOMY OF CIRCULATORY AND RESPIRATORY SYSTEMS

Circulatory system- anatomy of heart, heart beat, blood circulation Anatomy of blood vessels- arteries and veins. Respiratory system- anatomy of lungs and mechanism of respiration

UNIT- IV ANATOMY OF NERVOUS SYSTEM AND OTHER SENSORY SYSTEMS

Nervous system- peripheral and autonomous nervous system; Spinal nerves and Cranial nerves, transmission of nerve impulse, reflex arc. Special senses- eye, ear, tongue and nose

UNIT- V REPRODUCTIVE SYSTEM AND BLOOD PHYSIOLOGY

Mechanism of blood oxygenation, Blood pressure recording and regulating techniques, Reproductive system- male and female reproductive organs and physiology. Menstrual cycle

Text Books:

1. Charles E. Tobin, Basic Human Anatomy, McGraw Hill, 1980.
2. An Introduction to Human Physiology. Third Edition. By J. H. Green. Oxford University Press, New York, 1972.

Suggested Reading:

1. Human Physiology- the Mechanism of body functions, McGraw-Hill Science/Engineering/Math; 11th edition 2007.
2. Essentials of Human Anatomy and Physiology by .Elaine.N. Marieb, 8th Ed, Pearson Education, New Delhi

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16CE C02

ENVIRONMENTAL STUDIES

Instruction	1L Periods per week
Duration of End Examination	2 Hours
End Examination	50 Marks
Sessional	- - -
Credits	1

Course Objectives:
1. To equip the students with inputs on the environment, natural resources and their conservation.
2. To study the interrelationship between the living organisms and the natural environment and also to enable the students to understand the structure and functioning of the ecosystems.
3. To understand the importance of biodiversity and create awareness on its threats and conservation strategies.
4. To enable the students become aware of pollution of various environmental segments including their causes, effects and control measures.
5. To create awareness about environmental legislations in the context of national conventions.

Course Outcomes: At the end of the course, the student should have learnt
1. To understand the scope and importance of environmental studies, identify the natural resources and ecosystems and contribute for their conservation.
2. To understand the ecological services of biodiversity and contribute for their conservation.
3. To develop skills to solve the problems of environmental pollution and contribute for the framing of legislation for protection of environment.
4. To relate the social issues and the environment and contribute for the sustainable development.
5. To understand the essence of the ethical values of the environment for conserving depletable resources and pollution control.

UNIT – I
Environmental Studies: Definition, Scope and importance, need for public awareness.
Natural resources: Water resources- hydrological cycle, use and over utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Food resources- Changes caused by modern agriculture, fertilizers-pesticideproblems, water logging and salinity. Forest resources- use and over exploitation, deforestation. Mineral resources- Use and exploitation, effects of mining. Energy resources- Growing energy needs, various renewable and non-renewable energy sources. Land resources- land as a resource, land degradation- causes and effects, Role of individuals in conservation of natural resources.

UNIT – II
Ecosystems: Concept of an ecosystem, structure and function of an ecosystem, concept of food chains, food webs, ecological pyramids.

UNIT – III
Biodiversity: Types/classification of biodiversity, India as a mega diversity nation, values of biodiversity, threats to biodiversity, Conservation of biodiversity.

UNIT – IV
Environmental Pollution: Cause, effects and control measures of air pollution, water pollution, Soil pollution, Noise pollution and Thermal pollution.
Environmental Legislations: Environment protection act, Air, Water, Forest & Wild life acts.

UNIT – V
Social issues and the environment: Water conservation methods: Rain water harvesting and watershed management, Environmental ethics, Sustainable development, Population explosion and Climate change: Global warming, Acid rain, Ozone layer depletion.

Text Books:

1. P. D.Sharma, “Ecology & Environment”, Ashish publications, 1994
2. Y. Anjaneyulu, “Introduction to Environmental Science”, B S Publications, 2004

Suggested Reading:

1. Dr. Suresh K. Dhameja, “Environmental Studies”, S. K. Kataria & Sons, 2009
2. C. S. Rao, “Environmental Pollution Control Engineering”, Wiley, 1991
3. S. S. Dara, “A Text Book of Enviromental Chemistry & Polution Control”, S. Chand Limited, 2006

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16CS C02

PROGRAMMING LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

1. Demonstration of control structures.
2. Demonstration of switch case (menu driven).
3. Demonstration of Parameter passing Methods.
4. Demonstration of Functions using Recursion.
5. Demonstration of arrays Operations on Matrix.
6. Implementation of bubble sort.
7. Implementation of selection sort.
8. Implementation of Linear and Binary Search.
9. Implementation of string manipulation operations with and without library function.
10. Demonstration using Pointers.
11. Demonstration of Array of Structures.
12. Sequential file operations.

Text Books:

1. Pradip Dey and Manas Ghosh “Programming in C 2/e” Oxford University Press, 2nd Edition 2011
2. B. W. Kernighan and D.M. Ritchie, "The 'C' Programming Language” Prentice Hall India, 2nd Edition. 1990

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16ME C03

MECHANICAL AND IT WORKSHOP

Instruction	3P Periods per week
Duration of End Examination	3 Hours
End Examination	50 Marks
Sessional	25 Marks
Credits	2

Mechanical Workshop

Trades for Practice 1. Fitting 2. Tin Smithy 3. Carpentry 4. House Wiring Exercises in Fitting

1. To make a perfect rectangular MS flat
2. To do parallel cuts using Hack saw
3. To drill a hole and tap it
4. To make male and female fitting using MS flats-Assembly1
5. To make male and female fitting using MS flats-Assembly2

Exercises in Tin smithy

1. To make a square tray from the given sheet metal.
2. To make a rectangular box from the given sheet metal with base and top open. Solder the corners.
3. To make a scoop.
4. To make a dust pan from the given sheet metal.
5. To make a pamphlet box.

Exercises in Carpentry

1. To plane the given wooden piece to required size
2. To make a cross lap joint on the given wooden piece according to the given dimensions.
3. To make a Tee lap joint on the given wooden piece according to the given dimensions.
4. To make a dove tail-joint on the given wooden piece according to the given dimensions.
5. To make a bridle joint on the given wooden piece according to the given dimensions.

Exercises in House Wiring

1. Wiring of one light point controlled by one single pole switch, a three pin socket controlled by a single pole switch, and wiring of one buzzer controlled by a bell push.
2. Wiring of two light points connected in series and controlled by single pole switch. Verify the above circuit with different bulbs.
3. Wiring of two light points connected in parallel from two single pole switches and a three pin socket
4. Stair case wiring-wiring of one light point controlled from two different places independently using two 2-way switches.
5. Go-down wiring.

Demonstration of plumbing and welding trades

Note: ***A minimum of 12 exercises from the above need to be done***

Suggested Reading:

1. Workshop Technology -- Hazra chowdary

IT Workshop

List of Tasks:

Task 1: MS Word: Formatting text, inserting images, tables, equations and hyperlinks
Document Management: Page layout techniques and printing

Task 2: MS Excel: Functions and formulas and graph plotting

Task 3: MS Power point presentation: Guidelines for effective presentation, inserting objects, charts, hyperlinks and navigation between slides

Task 4: Essentials Search Engines & Net etiquette, Plagiarism, Open source tools and other utility tools

Suggested Reading:

1. Scott Mueller's Upgrading and Repairing PCs, 18/e, Scott. Mueller, QUE, Pearson, 2008.
2. The Complete Computer upgrade and repair book, 3/e, Cheryl A Schmidt, Dreamtech

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16PY C06

BIO PHYSICS LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives:

The objectives of the course is to make the student

1. Understand physical techniques for studying the physical properties of biomaterials
2. Know the interaction of radiation with biomaterials
3. Develop the knowledge of measurement of viscosity and surface tension of biomaterials

Course Outcomes:

At the end of the course, the student will be able to

1. Apply the techniques for the measurement of some physical properties of biomaterials
2. Measure radiation absorption measurements
3. Study physical properties of blood
4. Measure absorption wavelengths in photosynthesis
5. Assess BP and physical state of the lungs

List of Experiments:

1. Determination of Blood Pressure at different postures using sphygmomanometer
2. Estimation of chlorophyll in the given leaves
3. Determination of mass absorption coefficient of the given biomaterial using GM counter
4. Determination of molecular weight of given polymer using Ostwald Viscometer
5. Study of osmotic fragility of blood
6. Determination of specific gravity of blood
7. Determination of size and shape of blood cells using laser diffraction technique
8. Determination of viscosity and dynamic surface tension of bio-liquid using capillary flow technique
9. Determination of peak flow rate using peak flow meter
10. Determination of inspired volume using sustained maximal inspiration technique
11. Determination of auto catalytic ion efflux constant for the process of germination of seeds using conductivity meter

Note: A student must perform a minimum of eight experiments

Suggested Reading:

1. Biophysics Manual by Department of Physics, CBIT, 2016
2. S.K. Gupta, Engineering Physics Practical, Krishna's Educational Publishers, 2014
3. O.P. Singh, V. Kumar and R.P. Singh, Engineering Physics Practical Manual, Ram Prasad & Sons Publications, 2009

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16CY C06

BIO ORGANIC CHEMISTRY LABORATORY

Instruction	2P Periods per week
Duration of End Examination	2 Hours
End Examination	35 Marks
Sessional	15 Marks
Credits	1

Course Objectives:

1. Understand the basic practical issues involved in the analysis of organic molecules.
2. To prepare a organic compounds and their derivatives
3. Chemistry majors will have a working knowledge of chemical instrumentation and laboratory techniques and be able to use those skills to design and conduct independent work
4. To find the structure and characterization of the basic organic functional groups.

Course Outcomes:

1. An ability to think critically and to analyze chemical analysis.
2. An ability to work effectively in a laboratory environment and to use modern chemical/biochemical instrumentation and procedures
3. Understand the basics of laboratory safety

I. Identification of Organic Functional Groups and Preparation of their Derivatives

1. Aldehyde functional group
2. Ketone functional group
3. Amine functional group
4. Monosaccharides
5. Carboxylic acid functional group
6. Phenol

II. Preparation of Organic Compounds

7. Preparation of nitro Benzene
8. Preparation of m-di nitro Benzene
9. Preparation of Acetanilide
10. Preparation of Aspirin
11. Preparation of soap
12. Preparation of phenol formaldehyde resin

Suggested Reading:

1. Vogel's text book of quantitative chemical analysis by J.Mendham and Thomas, Person education. Pvt. Ltd. New Delhi, 6th.ed, 2002.
2. Senior practical physical chemistry by B.D.Khosla, A.Ghulati,V.C.Garg;R.Chand and CD New Delhi

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Choice Based Credit System (CBCS)

Name of the Programme (UG): B.Tech

Syllabus for III - Semester and IV - Semester

With effect from 2017 - 2018

Specialization /Branch:Bio-Technology

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)
Choice Based Credit System
B.Tech (Bio-Technology)

SEMESTER – III

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
		THEORY						
1	16MT C06	Mathematics –III	3	-	3	30	70	3
2	16BT C05	Process Principles and Reaction Engineering	4	-	3	30	70	4
3	16BT C06	Biochemistry	4	-	3	30	70	4
4	16BT C07	Cell Biology	3	-	3	30	70	3
5	16BT C08	Microbiology	3	-	3	30	70	3
6	16BT C09	Genetics	3	-	3	30	70	3
		PRACTICALS						
7	16BT C10	Biochemistry Lab	-	3	3	25	50	2
8	16BT C11	Microbiology Lab	-	3	3	25	50	2
9	16EG C03	Soft Skills and Employability Enhancement Lab	-	2	2	15	35	1
TOTAL			**20**	**8**	-	**245**	**555**	**25**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

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Assessment Procedures for Awarding Marks

The distribution of marks is based on internal assessment (Sessional) by concerned teacher and the Semester end examination shall be as follows:

Course (in terms of credits)	CIE	Semester end Examination (Marks)	Remarks	Duration of Semester End Examination
Three(3) Credits/ Four(4) Credits	30*	70**	Theory Course/ Engg . Graphics	3 Hours
Two(2) Credits	20*	50***	Theory	2 Hours
Two(2) Credits	25	50	Lab Course/Workshop	3 Hours
One(1) Credit	15	35	Lab Course	2 Hours
Two(2) Credits	50	—	Project Seminar/Seminar	----
Six(6) Credits	50	100	Project	Viva
One(1) Credit	—	50***	Environmental Studies, Professional Ethics and Human values	2 Hours
One(1) Credit	50		Mini Project	-----

CIE: Continuous Internal Evaluation

* Out of 30/20 sessional marks(CIE), 10/5 marks are allotted for slip-tests(Three slips test will be conducted, each of 10/5 marks, best two average is considered) and the remaining 20/15 marks are based on the average of two tests, weightage for each test is 20/15 marks.

** The question paper will be in two parts, Part-A and Part-B. Part A is for Ten(10) questions and is compulsory, covers the entire syllabus, and carries 20 marks. Part-B carries 50 marks and covers all the units of the syllabus (student has to answer five out of seven questions)

***The question paper will be in two parts, Part-A and Part-B. Part A is for Ten(10) questions and is compulsory, covers the entire syllabus, and carries 15 marks. Part-B carries 35 marks and covers all the units of the syllabus (student has to answer five out of seven questions)

Note:A course that has CIE(sessional marks) but no semester end examination as per scheme, is treated as Pass/Fail for which pass marks are 50% of CIE.

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A candidate has earned the credits of a particular course, if he/she secures not less than the minimum marks/ grade as prescribed. Minimum pass marks for theory course is 40% of total marks i.e., CIE plus semester end examinations where as for the lab course/project is 50%.

16MT C06

MATHEMATICS-III

Instruction	3 Hours per week
Duration of End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: To learn

1. Identifying limit of functions which are in Indeterminate Forms.
2. Understand the basic concept of continuity, differentiability and geometric interpretation of mean value theorems.
3. Concept of partial differentiation, maximum and minimum.
4. Identifying vector, scalar addition, multiplication, geometrical interpretation in 2D, 3D space.
5. Understand the concept of scalar and vector point functions of divergence and curl of vector functions and its physical interpretations.

Outcomes: On the successful completion of the course, the student shall be able to

1. Solve the limit problems by using L-Hospital rule.
2. Solve the problems based on Mean value theorems.
3. Solve maxima and minima problems.
4. Solve vector and scalar triple product related problems.
5. Solve divergence and curl related problems.

UNIT-I

Indeterminate Forms: Types of Indeterminate forms L-Hospital's rule to evaluation of limits in indeterminate forms $\frac{0}{0};\frac{\infty}{\infty};\infty-\infty;1^{\infty};\infty^{0};0^{0};0\times\infty$, Maclaurin's series and Taylor's series (without proof) for single variable.

UNIT-II

Mean value theorems: Fundamental theorem, Continuity and differentiability- Rolle's Theorem, Lagrange's theorem, Cauchy's theorem, Geometrical interpretations-related problems (statements only).

UNIT-III

partial differentiation-Homogeneous functions-Euler's theorem on homogeneous functions, Taylor's series of two variable, maxima and minima of functions one variable.

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UNIT-IV

Vector Algebra : Addition of vectors, scalar multiplication, angle between two non zero vectors, linear combination of vectors, component of vectors in three dimensions, scalar product-geometrical interpretations- orthogonal projections, properties of dot product, angle between two vectors, vector product of two vectors and properties, scalar triple product, vectors triple products-results.

UNIT-V

Vector differentiation: Definitions- scalar and vector point functions, vector differential operator, Gradient, Divergence and Curl, Solenoidal and Irrational vectors, properties of gradient, divergence and curl (vector identities).

Text Books:

1. B.S.Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2015.
2. N P Bali and Manish Goyal, "A Text Book of Engineering Mathematics", 9th Edition, Laxmi publishers, 2016.
3. Narayan Shanti and Mittal P.K. ," Differential Calculus" , 30th edition, S Chand publishers, 2005.

Suggested Reading:

1. A.R.Vasistha, "Matrices" , 43rd edition, Krishna Prakashan Media (P) Ltd. 2014.
2. A.R.K Jain and S.R.K Iyenger, "Advance engineering mathematics",3rd edition, Narosa publications, 2007.
3. Joseph Edwards, "Differential Calculus For Beginners", arihant publishers, 2016.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley publishers, 2015.

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16BT C05

PROCESS PRINCIPLES AND REACTION ENGINEERING

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives:

1. The aim of the course is to impart knowledge of the basic chemical engineering principles and techniques used in analyzing a chemical process.
2. This course also aims to enable the students to evaluate material and energy balances in different units.
3. Through this course the students are given an understanding of application of principles of unit operations and unit processes in biotech Industries.
4. This course aims at analyzing the kinetics of chemical reactions.
5. The aim of the course is also to give the students an understanding of the theory of biochemical reactors and enhanced skill in formulation and analysis of different types of reactors used in biochemical engineering.
6. The aim of the course is to impart knowledge of the animal and plant cell reactor technology.

Course Outcomes:

1. At the end of the course student should be able to solve the problems encountered in the preparation of material and energy balances of the process.
2. Be able to determine the flue gas composition from fuel composition and vice versa.
3. Be able to develop generalized flow sheets for different chemical processes.
4. Be able to write rate equations for any given chemical reaction.
5. Be able to perform basic design calculations of various reactors.
6. Be able to identify the reasons for non ideality.

UNIT 1:

DIMENSIONS AND SYSTEM OF UNITS

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Fundamental quantities, derived quantities and conversions; SI and MKS system of Units; Basic Chemical Engineering calculations-Atomic, Molecular and Equivalent weights, molar concept, Concentration units for pure components, Vapor pressures, Moles, Mixers and solutions, Molarity, Molality, Normality and Partial pressures; Laws of Chemical Combination; Definition of Stochiometry; Composition of mixers and solutions; Weight fraction; Mole fraction; Volumetric composition; Density and Specific gravity, Ideal gas law; Ideal mixtures and solution; Dalton's law of additive pressures; Amagots law of additive volumes.

UNIT II:

UNIT OPERATIONS IN BIOPROCESSES

Application of principles of unit operations and unit processes in biotech Industries, Application of principles of transport phenomenon (momentum, mass and heat transfer) in bioprocessing. Outline of an integrated bioprocess and the various (upstream and downstream) unit operations involved in bioprocesses, generalized process flow sheets. Laws of conservation of mass, meaning of material balance and its applications, Process flow sheet, Drawing material balance on non reacting steady system, Conversion, yield, Limiting reactants, Excess reactants, Recycling, By-passing, Material balances on steady state reacting systems with recycling and By-passing.

UNIT III:

MATERIAL BALANCES

Law of conservation of energy, Meaning of energy balance and its importance, Inputs of energy balance, Specific heat and sensible heat, Latent heat and heats of transition, Sublimation, Enthalpy of solutions, Standard heats of formation, Standard heats of combustion, Standard heats of reaction, Bess's law, Kirchoffs law, Determination of heat of reaction at temperature other than standard temperature using specific heat relationships, Combustion calculations, Combustion air requirements, determination of flue gas composition from fuel composition and vice versa.

UNIT IV:

INTRODUCTION TO REACTION KINETICS

Concepts of Reaction Kinetics, Types of reaction, order of reaction, The effect of temperature and pH on reaction rate. Rate equations and Reaction mechanisms; Interpretation of batch reactor data, constant volume batch reactor, integral method of analysis of data for reversible and irreversible reactions. Searching for mechanism - Arrhenius equation - Growth Kinetics: Batch growth quantifying cell concentration, chemostat growth,

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UNIT V:

INTRODUCTION TO BIOREACTION ENGINEERING

ors; Classification of bioreactors; Reactor configurations; Description of a conventional bioreactor with all aspects; Design and construction criteria of a bioreactor; Residence time distributions, concentration, and temperature distributions; Models of non-ideal reactors.

Animal and plant cell reactor technology- Environmental requirements for animal cell cultivation, reactors for large-scale production using animal cells, plant cell cultivation.

Text Books:

1. Hougen and Watson K M and Ragatz R A, "Chemical Process Principles", 2nd Edition, Wiley, 1959.
2. Bhatt B I and S M Vora, "Stoichiometry", 4th Edition, Tata McGraw Hill 2006.
3. Chemical Reaction Engineering, Octave Leven Spiel.

Suggested Reading:

1. David M. Himmelblau, James B. Riggs, "Basic Principles and Calculations in Chemical Engineering", 8th Edition, Prentice Hall, 2012.
2. Dr.AVN.Swamy, "Fundamentals of Biochemical Engineering", BS Publications, 2007.
3. Warren Lee McCabe, Julian Smith, Peter Harriott, "Unit operations of chemical engineering", Mc-Graw Hill, 7th Edition 2005.
4. Pauline M. Doran, "Bio-process Engineering Principles", 2nd Edition, Academic press, 2013.

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16BT C06

BIOCHEMISTRY

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course objectives:

1. Students will learn structure, functions and metabolism of different biomolecules.

Course outcomes:

1. Recognize different biomolecules structures.
2. Describe the functions of various biomolecules.
3. Evaluate the energy yield from the catabolism of carbohydrates and lipids.
4. Reconstruct the anabolism of carbohydrates and lipids.
5. Outline steps involved in catabolism and anabolism of proteins.
6. Summarize steps involved in catabolism and anabolism of nucleic acids.

UNIT I:

BIOMOLECULES

Carbohydrates- classification, monosaccharide, disaccharides, polysaccharides, Glycoproteins; glycolipid; Classification and nomenclature of lipids; Amino acid - Classification and its structure, peptide bond- structure; protein structure - primary, secondary, tertiary and quaternary structure; Structure of nucleotides, nucleosides and nitrogenous bases; chemical structure of DNA and RNA;

UNIT II:

METABOLISM OF CARBOHYDRATES

Carbohydrate Metabolism- Glycolysis, HMP shunt, Citric Acid Cycle and Oxidative Phosphorylation, Metabolic Pathways- Biosynthesis of Glucose; Glycogen metabolism.

UNIT III:

METABOLISM OF LIPIDS

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Lipid Metabolism - Catabolism of Fatty Acids, Triglycerol and Cholesterol Metabolism; Metabolic Pathways- Biosynthesis of Saturated and Unsaturated Fatty Acids, Triglycerol, Phospholipids and Sphingolipids.

UNIT IV:

METABOLISM OF PROTEINS

Amino acids metabolism- Biosynthesis of aromatic amino acids, Peptides; Metabolic fate of Amino group; Nitrogen Excretion and Urea Cycle; Catabolism of aromatic and branched chain amino acids; Transamination, Oxidative Deamination and Oxidative Decarboxylation.

UNIT V:

METABOLISM NUCLEIC ACIDS

Nucleic Acid Metabolism- Biosynthesis of Purine and Pyrimidine, Ribonucleotides, synthesis of Deoxyribonucleiotides; Degradation of Purine and Pyrimidine Nucleotides.

Texts Books:

1. Eric E.Conn, Paul K Stumpf, George Bruening, Roy H Doi, "Outlines of Biochemistry", 5//E, John Wiely and Sons, 2006.
2. David Lee Nelson and Michael M. Cox, Lehninger "Principles of Biochemistry", 6th edition, W. H. Freeman, 2013.

Suggested Reading:

1. Donald Voet and Judith G. Voet, "Biochemistry", 4th edition, John Wiley & Sons, New York, 2011.
2. Reginald Garrett and Charles Grisham, "Biochemistry", 5th edition, Cengage Learning, 2012.
3. Jeremy M. Berg, John L. Tymoczko and Lubert Stryer, "Biochemistry", 6th Edition. W. H. Freeman and Company, 2010.
4. Robert Murray, David Bender, Kathleen M. Botham, Peter J. Kennelly, Victor Rodwell, P. Anthony Well, "Harpers illustrated Biochemistry", 29th edition, McGraw Hill Professional, 2012.

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16BT C07

CELL BIOLOGY

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Student is made to understand the basics of cell biology i.e. concept of cellular organelles and their functions.
2. Students are taught the structure of cytoskeleton, and how it maintains the cell structure integrity.
3. Student made to understand the structure of plasma membrane, and how it regulates the fluid balance.
4. Students are made aware of cell division and regulation of cell cycle.
5. Students are enlightened about cell signaling over being basis of cancer.
6. The concept of protein targeting is introduced to the students.

Course Outcomes:

1. Students able to understand the structure & functions of cell organelles.
2. Students enlightened about the transport of metabolites.
3. Explain the regulation of cell cycle and its control.
4. Analyze the importance of growth factors/ Receptors and their role in causing cancer.
5. Recognize the mechanisms in transport of proteins to destination.
6. Explain the advances in cell biology, protein degradation.

UNIT I: CELL STRUCTURE, ORGANELLES AND THEIR FUNCTIONS

Cell structure and organization in bacteria, plants and animal cells; structure and functions of cell wall, lysosomes, ribosomes, golgi complex, peroxisomes, glyoxysomes, mitochondria, plastids, endoplasmic reticulum, vacuoles, centrioles; cytoskeleton - composition, structure and functions of microtubules, microfilaments and intermediate filaments; nucleus, its ultra structure, (nuclear envelope, nucleoplasm, chromatin fibers).

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UNIT II: MEMBRANE TRANSPORT

Biomembrane - lipid composition and structural organization, protein components and basic function, transport across membrane - passive diffusion, facilitated diffusion, osmosis, active transport (Na^+/K^+ Pump), cotransport; uniport, antiport, symport.

UNIT III:CELL DIVISION AND CELL CYCLE

Cell Division: mitosis and meiosis- events and significance; meiosis and reproductive cycle.
Cell cycle: Different phases of cell cycle; check points of cell cycle; Regulation of cell cycle - cyclins and cyclin dependent kinases;

UNIT IV:CELL COMMUNICATION

Basic concepts of cell communication; bacterial cell communication - Quorum sensing; multicellular organisms- intercellular communication through channels (gap junctions and plasmodesmata, cell-cell junctions), chemical signals (autocrine, paracrine, hormonal); cell signaling-signal transduction pathway; signal receptor proteins- G protein linked receptors(Jak/stat kinases), tyrosine kinase receptors, secondary messengers (cAMP) signaling path ways in cancer (hedgehog signaling, frizzled signaling).

UNIT V:PROTEIN TARGETING/CELL DEATH

Targeting signals, targeting cytosolic proteins to mitochondria, chloroplast, nucleus; co-translational transport into RER, vesicle formation and transport, role of chaperones, applications of protein targeting, apoptosis, necrosis, senescence, proteasome degradation, mitochondrial degradation, Proteiostasis.

Text Books:

1. Geoffrey M. Cooper and Robert E. Hausman, "The cell: A molecular approach", 6th edition, Sinauer Associates, 2013.
2. Gerald Karp, "Cell and Molecular Biology": concepts and experiments, 6th edition, John Wiley & sons, 2009.
3. Benjamin Lewin, Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, "Lewin's Genes XI", Jones and Bartlett publishers,2014

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Suggested Reading:

1. Bruce Alberts, Dennis Bray, Karen Hopkin, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, "Essential Cell Biology", 4th edition, Garland Science, 2013.
2. Rastogi S.C, "Cell Biology", 3rd edition, New Age International, 2005.
3. Powar, C.B, "Cell Biology", Himalya Publishing house, 2006.

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16BTC08

MICROBIOLOGY

Instruction	3L Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives: Students are made to understand the following concepts during there course of time:

1. History and scope of microbiology.
2. Classification of different group of microorganisms.
3. Concepts of sterilization and preparation of culture media for growth of microorganisms.
4. Various methods of preservation of microorganisms and their importance.
5. Preparation of culture media for growth of microorganisms.
6. Assimilation of nutrients by microorganisms and importance of bacterial growth phases.
7. Microbial pathogens like V. cholera, HIV, rabies virus causing diseases in humans and multidrug resistance of pathogens like M. tuberculosis and Hepatitis B virus.

Course Outcomes:

1. Explain contributions made by different scientists in microbiology.
2. Identify General characteristics of microorganisms and types of Taxonomy.
3. Select Physical and chemical methods of sterilization.
4. Demonstrate the preparation and functions of different types of media.
5. List classification of nutrients and types of assimilation methods in micro organisms.
6. Outline the Life cycle of pathogens causing diseases in humans.

UNIT I:

HISTORYAND INTRODUCTION TO MICROBIOLOGY

History and scope of microbiology, contributions of Antony van Leuwenhoek Louis Pasteur, Robert Koch, Iwanowskii, Edward Jenner; prokaryotic cell structure - plasma membranes, cytoplasmic matrix - inclusion bodies, ribosome, bacterial chromosome and plasmids, cell wall, components external to cell wall - capsule, slime layer, pili, fimbriae, flagella, bacterial endospores and their formation. Importance of fixation and stains.

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UNIT II:

CLASSIFICATION OF MICROORGANISMS

General and colony characters of major groups of microorganisms - algae, fungi, protozoa, bacteria and virus; identification of microorganisms by major taxonomical characteristics (morphological, physiological, ecological, cultural, metabolic/biochemical, immunological and genetic). classification of microorganisms - concept of classification; taxonomic groups; Haeckel's three kingdom concept, Whittaker's five kingdom concept, three domain concept of Carl Woes.

UNIT III:

MICROBIOLOGICAL TECHNIQUES

Methods of culturing of microorganisms in lab and industry - culture media, (liquid, semi-solid and solid media, synthetic media and complex media), isolation of pure cultures (streak, spread and pour plate methods). Serial dilution. concept of sterilization - methods and their application- physical methods (heat, filtration and radiation), chemical methods (phenolics, alcohols, halogens, heavy metals, dyes, quaternary ammonium compounds, aldehydes, gaseous agents), methods of preservation of microorganisms and their importance (Bacterial cultures).Biosafety cabinet.

UNIT IV:

MICROBIAL PHYSIOLOGY AND GROWTH

Nutrition in microorganisms and assimilation of major nutrients: active and passive transport. Facilitated diffusion and group translocation. Microbial growth - growth curve, mathematical expression of growth, measurement of microbial growth (cell numbers and cell mass), importance of growth phases of microorganisms; balanced and unbalanced growth, synchronous growth, factors affecting bacterial growth (solutes, water activity, pH, temperature, oxygen concentration, osmotic pressure, radiation).

UNIT V:

MEDICAL MICROBIOLOGY

Virulence factors ; air borne diseases (Tuberculosis), water borne diseases (Vibrio cholera, Hepatitis), zoonotic infections(rabies), extracellular pathogens , staphylococcus, streptococcus; facultative intracellular pathogen -obligate intracellular pathogen - rickettsia, chlamydias; sexually transmitted disease - syphilis; viral diseases - influenza, measles and HIV., Multidrug resistance (Mycobacterium tuberculosis, hepatitis B virus).

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Text Books:

1. Pelczar Michael J., Krieg Noel R., Chan, E.C., "Microbiology", 5th edition, McGraw Hill higher education1993.
2. Michael T. Madigan, John M. Martinko, Kelly S. Bender, Daniel H. Buckley, David A-Stahl and Clark, "Brock Biology of Microorganisms", 13th edition, Prentice Hall International Inc, 2010.
3. R.Ananth Narayan, "Text Book of Microbiology", 7th edition, Universities Press, 2009.

Suggested Reading:

1. Powar C.B. and Daginawala H.F., "General Microbiology - Vol I & II", 2nd edition, Himalaya publishing house, 2005.
2. Arti Kapil, Ananthanarayan and Paniker's "Text book of Microbiology", 9th edition, Orient Blackswan, 2013.
3. Roger Y Stanier, "General Microbiology", 5th edition, Palgrave Macmillan Limited, 1999.

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16BT C09

GENETICS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Student is made to understand the basics of genetics, ie. Concept of how genes are responsible for inheritance of characteristics.
2. Students are taught the structure of chromosome, and how it stores genetic information.
3. Importance of chromosome taught by showing the effects of mutations on chromosomes.
4. Students are enlightened about crossing over being the basis of genetic diversity.
5. Students are made aware of chromosome related genetic disorders.
6. The concept of extra chromosomal inheritance is introduced to the students.

Course Outcomes:

1. Apply to real life situations, the principles of human heredity.
2. Incorporate the fundamentals of gene in order to understand how they impact humans.
3. Be able to describe the chromosomal basis of inheritance and how alterations in chromosome number or structure may arise during mitosis and meiosis.
4. Be able to describe the main modes of Mendelian and non-Mendelian inheritance.
5. Be aware of the role of both genetic and environmental factors in multifactorial Conditions such as, cancer, diabetes and psychiatric disorders.
6. Be able to take a family history and construct and interpret a pedigree.

UNIT I:

PHYSICAL BASIS OF HEREDITY

Mendel's laws of inheritance - segregation, independent assortment, modification of mendelian principles: co-dominance, incomplete dominance, multiple alleles, gene interactions, epistatic interactions, pleotropism. Interaction of genotype and environment: penetrance, expressivity, phenocopy.

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UNIT II:

CHROMOSOME STRUCTURE AND ABBERATIONS

Eukaryotic chromosome structure, function, karyotyping; specialized chromosomes: gaint chromosomes - polytene and lamp brush chromosomes; chromosomal aberrations- structural aberrations (deletions, duplication, inversion and translocation), numerical aberrations (aneuploidy, euploidy, auto polyploidy and allopolyploidy). Mutations - spontaneous, induced; physical and chemical mutagens; lethal mutation (characteristics and types), AMES test, applications of mutations.

UNIT III:

LINKAGE AND CROSSING OVER

Concept of linkage and crossing over, cytological basis of crossing over (in Drosophila and Maize), factors affecting recombination frequency, linkage maps; mechanism of recombination - model involving single strand breaks and double strand break in DNA duplex, significance of Crossing over. Two point and three point test cross. Interference. Tetrad analysis.

UNIT IV:

SEX DETERMINATION, SEX LINKED AND GENETIC DISORDERS

Sex chromosomes, sex determination, mechanism of sex determination in animals (insects and humans) and plants, sex determination by genic balance and Y-linked genes. Dosage compensation, Maryleon's hypothesis; sex linkage, non disjunction of x chromosomes, sex linked disorders and autosomal disorders in human beings. Garrod's inborn errors of metabolism, one gene one enzyme hypothesis, one gene one polypeptide hypothesis.

UNIT V:

EXTRA CHROMOSOMAL INHERITANCE AND QUANTITATVE GENETICS

Extra chromosomal inheritance - inheritance of mitochondrial and chloroplast genes, maternal inheritance(CMS, nuclear petites in yeast, Mirabilus jalapa. Transgressive segregation, quantitative characters, Gene frequency, gene pool, Hardy- Weinberg Law, equilibrium, Fitness and selection Goodness of fit : Chi-square-test.

Text Books:

1. Singh, B.D. "Genetics - 3rd edition", Kalyani Publications , 2004.
2. Snustad, D.Peter, Simmons Michael, "Principle of Genetics 6th edition", Wiley publication, 2011.
3. Gardner, E. J., Simmons, M. J., Snustad, D. P. and Snustad, "Principles of Genetics", John Wiley and Sons, Inc. 1985.

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Suggested Reading:

1. Verma, P. S. and V. K. Agrawal.. "Cell Biology, Genetics, Molecular Biology, Evolution and Ecology". S. Chand & Company Ltd., New Delhi, 2004.
2. Cummings Michael R, Charlotte A. Spencer, Michael A. Palladino Concepts of Genetics . Pearson Education. ISBN 0321754352, 9780321754356, 2012.
3. Krebs JE., Goldstein E.S and Kilpatrick S.T., "Lewin's Genes XI", Jones Bartlett publishers, 2014.
4. Gupta PK, "Genetics", 4^{th} Rev Edition (2nd Reprint) Rastogi Publications, 2011.
5. Hartl L, Daniel and Ruvolo MGenetics, "analysis of genes and genomes", Eight edition, Jonnes and Bartlett Learning Books. USA, 2012.

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16BT C10

BIOCHEMISTRY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course objectives:

1. Students will learn the laboratory safety and standard operating procedures.
2. Students will learn how to estimate and analyze different biomolecules.

Course outcomes:

1. Learn and apply the laboratory safety and standard operating procedures.
2. Prepare the solutions and biological buffers.
3. Estimate and analyze carbohydrate by different methods.
4. Estimate and analyze amino acids and proteins by different methods.
5. Estimate and analyze lipids and compare the acid value, saponification value and iodine valve of various lipids.
6. Estimate and analyze nucleic acids.

List of Experiments:

1. Introduction to Biochemistry Lab: Units, Volume / Weight measurements, concentration units.
2. Preparation of Solutions - percentage solutions, molar solutions, normal solutions and dilution of stock solution.
3. Measurement of pH.
4. Preparation of buffers and reagents.
5. Titration curve of amino acid and calculation of pK and pI values.
6. Estimation of Carbohydrates by Anthrone method.
7. Estimation of Amino acids by Ninhydrin method.
8. Estimation of Proteins by Biuret method.
9. Estimation of Proteins by Lowry method.
10. Determination of Acid value, Saponification value and Iodine Number of Fat.
11. Estimation of Cholesterol by Liebermann - Burchard method.
12. Estimation of DNA by Diphenyl amine method.
13. Estimation of RNA by Orcinol method.

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Suggested Reading:

1. David, T. Plummer, "An introduction to Practical Biochemistry", 3rd edition, Tata McGraw Hill, 1988.
2. Beedu Sashidhar Rao and Vijay Deshpande, "Experimental Biochemistry - A student companion", Anshan Pub, 2006.
3. Sharma R.K., "Basic technique in Biochemistry and Molecular Biology", I.K. International Pvt. Ltd., New Delhi, 2008.

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16BT C11

MICROBIOLOGY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: Students are made to understand the following experiments during their course of time:

1. Proper handling and focusing of Bright Field microscope.
2. Physical and chemical sterilization methods for control of microorganisms.
3. Preparation of culture media.
4. Techniques for the isolation of pure cultures.
5. Simple and Gram staining techniques.
6. Antibiotic sensitivity test by Disc Diffusion Method.

Course Outcomes

1. Outline of Magnification, Resolution, Refractive index of Microscope.
2. Operate the physical sterilization equipments.
3. Prepare the basic culture media for the growth of microorganisms.
4. Perform streak plate, spread plate and pour plate techniques.
5. Identify type of bacteria (Gram positive or Gram negative).
6. Evaluate sensitivity of microorganisms against different organisms.

List of Experiments:

1. Calibration of Microscope and Measurement of Microorganisms-Microtome.
2. Staining and Identification of microorganism: (a) Simple and Differential staining techniques.
3. Sterilization techniques (Autoclaving, Hot Air Oven, Radiation and Filtration).
4. Preparation of culture media (a) broth type of media (b) Agar.
5. Culturing of microorganism (a) broth (b) pure culture techniques-Streak plate, Pour plate.
6. Isolation and preservation of bacterial culture.

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7. Antibiotic tests- Disc diffusion method, minimum inhibitory concentration.
8. Biochemical tests- IMIVC test, Catalase, Coagulase test,

Gelatinase test, Oxidase.

9. Factors affecting the bacterial growth and study of growth curve.
10. Measurement of Microbial Growth (Viable Count and Turbidometry) and enumeration of bacterial numbers by serial dilution.
11. Coliform tes .

Suggested Reading:

1. Gopal Reddy M, M.N. Reddy, D.V.R. Sai Gopal and K.V. Mallaiah, "Laboratory Experiments in Microbiology", 3rd edition, Himalaya Publishing House Pvt. Ltd., 2008,
2. Gunasekaran P., "Laboratory manual in Microbiology", 3rd edition, New Age International Publ., New Delhi, 2007.
3. Kannan N., "Laboratory manual in General Microbiology", 1st edition, Panima Publishing Corp., New Delhi, 2002.
4. Alfred E. Brown, "Benson's Microbiological Applications: Laboratory manual in general microbiology", 12th edition, McGraw hill Education, 2011.

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16EG CO3

SOFT SKILLS AND EMPLOYABILITY ENHANCEMENT LAB

Instruction	2 hours per week
Duration of Semester End Examination	2 Hours
Semester End Examination	35 Marks
Continuous Internal Evaluation	15 Marks
Credits	1

Course Objectives: To help the students

1. Participate in group discussions and case studies with confidence and to make effective presentations. Also to learn the art of communication.
2. With- resume packaging, preparing and facing interviews.
3. Build an impressive personality through effective time management & goal setting, self confidence and assertiveness.
4. Understand what constitutes proper grooming and etiquette in a professional environment. Also to understand academic ethics and value systems.
5. To understand the elements of research and hone their soft skills through a live, mini project.

Course Outcomes: The students will be able to

1. Be effective communicators and participate in group discussions and case studies with confidence. Also be able to make presentations in a professional context.
2. Write resumes, prepare and face interviews confidently.
3. Be assertive and set short term and long term goals. Also learn to mange time effectively and deal with stress.
4. Make the transition smoothly from Campus to Corporate. Also use media with etiquette and know what academic ethics are.
5. To do a live, mini project by collecting and analyzing data and making oral and written presentation of the same.

Exercise 1

Group Discussion and Case studies: Dynamics of group discussion, intervention, summarizing, modulation of voice, body language, relevance, fluency and coherence.

Elements of effective presentation, Structure of presentation, Presentation tools, Body language, Creating an effective PPT.

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Exercise 2

Interview Skills: Resume writing, structure and presentation, planning, defining the career objective, projecting ones strengths and skill-sets.

Interview Skills: concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews.

Exercise 3

Personality Development: Effective Time Management, setting realistic goals, self confidence and assertiveness, stress management, moral values.

Exercise 4

Corporate Culture: Grooming and etiquette, communication media etiquette,
Academic ethics and integrity

Exercise 5

Mini Project: General/Technical, Research, developing a questionnaire, data collection, analysis, written report and project seminar.

Suggested Reading:

1. Dr. Shalini Verma, "Body Language- Your Success Mantra", S Chand, 2006.
2. Ramesh, Gopalswamy, and Mahadevan Ramesh, "The ACE of Soft Skills", New Delhi: Pearson, 2010.
3. Covey and Stephen R, "The Habits of Highly Effective People", New York: Free Press, 1989.

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CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY(A)
Choice Based Credit System
B.Tech (Bio-Technology)

SEMESTER – IV

S.No	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration of SEE in Hours	Maximum Marks		
			L/T	P/D		CIE	SEE	
THEORY								
1	16BT C12	Chemical and Biochemical Thermodynamics	4	-	3	30	70	4
2	16BT C13	Molecular Biology	3	-	3	30	70	3
3	16BT C14	Immunology	3	-	3	30	70	3
4	16BT C15	Instrumental Methods in Biotechnology	3	-	3	30	70	3
5	16BT C16	Industrial Biotechnology	3	-	3	30	70	3
6	16MB C01	Engineering Economics and Accountancy	3	-	3	30	70	3
PRACTICALS								
7	16BT C17	Immunology Lab	-	3	3	25	50	2
8	16BT C18	Instrumental Methods in Biotechnology Lab	-	3	3	25	50	2
TOTAL			**19**	**6**	-	**230**	**520**	**23**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE - Semester End Examination

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Assessment Procedures for Awarding Marks

The distribution of marks is based on internal assessment (Sessional) by concerned teacher and the Semester end examination shall be as follows:

Course (in terms of credits)	CIE	Semester end Examination (Marks)	Remarks	Duration of Semester End Examination
Three(3) Credits/ Four(4) Credits	30*	70**	Theory Course/ Engg . Graphics	3 Hours
Two(2) Credits	20*	50***	Theory	2 Hours
Two(2) Credits	25	50	Lab Course/Workshop	3 Hours
One(1) Credit	15	35	Lab Course	2 Hours
Two(2) Credits	50	—	Project Seminar/Seminar	----
Six(6) Credits	50	100	Project	Viva
One(1) Credit	—	50***	Environmental Studies, Professional Ethics and Human values	2 Hours
One(1) Credit	50		Mini Project	-----

CIE: Continuous Internal Evaluation

* Out of 30/20 sessional marks(CIE), 10/5 marks are allotted for slip-tests(Three slips test will be conducted, each of 10/5 marks, best two average is considered) and the remaining 20/15 marks are based on the average of two tests, weightage for each test is 20/15 marks.

** The question paper will be in two parts, Part-A and Part-B. Part A is for Ten(10) questions and is compulsory, covers the entire syllabus, and carries 20 marks. Part-B carries 50 marks and covers all the units of the syllabus (student has to answer five out of seven questions)

***The question paper will be in two parts, Part-A and Part-B. Part A is for Ten(10) questions and is compulsory, covers the entire syllabus, and carries 15 marks. Part-B carries 35 marks and covers all the units of the syllabus (student has to answer five out of seven questions)

Note: A course that has CIE(sessional marks) but no semester end examination as per scheme, is treated as Pass/Fail for which pass marks are 50% of CIE.

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A candidate has earned the credits of a particular course, if he/she secures not less than the minimum marks/ grade as prescribed. Minimum pass marks for theory course is 40% of total marks i.e., CIE plus semester end examinations where as for the lab course/project is 50%.

16BT C12

CHEMICAL AND BIOCHEMICAL THERMODYNAMICS

Instruction	4 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	4

Course Objectives

1. Course aims at developing to reason so that students can apply thermodynamic principles in the solution of practical problems.
2. The aim of the course is also to give students an understanding of equilibrium conditions of chemical and biochemical extractions.
3. The course aims to give students the concepts of the transfer of chemical species between phases.
4. The course aims to facilitate students to apply I and II law of thermodynamics to open and closed systems to turbines and heat engines.
5. The course aims to give students the knowledge to calculate oxygen consumption and heat evolution in aerobic cultures.

Course Outcomes

1. Students will be able to measure heat and work increments for closed systems and cyclic processes.
2. Students will be able evaluate nozzle , turbine and compressors based on the principles of I-law of thermodynamics.
3. Students will be able to calculate coefficient of performance of heat engines and heat pump.
4. Students will be able predict the extent of various reactions by Gibbs and Duhem equation.
5. Students will be able to calculate separation processes like distillation based on vapour liquid equilibrium for binary systems.
6. Students will be able to calculate equilibrium conversions and yields of bio reactions.

UNIT I:

INTRODUCTION TO THERMODYNAMICS

System: Definition and Classification of system - closed and open system based on number of components, exchange of mass and heat. State and Path Functions, equilibrium, Phase rule. Thermodynamic Properties of fluids. Forms of energy, classification of properties. I-Law of Thermodynamics, application of I-law to closed, systems.

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Volumetric Properties of Fluids: PVT behaviour of pure fluids. Real and Ideal Gas. Equations of state - Ideal gas law, Virial equations of state (restricted to first two terms). Cubic equations of state - Van der Waals and Redlich kwong. Processes involving ideal gases (isochoric, isobaric, isothermal, adiabatic, polytropic - simple applications).

UNIT II:

THE SECOND LAW OF THERMODYNAMICS

Second law of thermodynamics: Limitations to I-law, qualitative statement of Kelvin Plank and Clausius versions of II-law, entropy - definition, entropy and heat calculations for ideal gases. Maxwell relations - problems not included, Residual properties - definition (V^R, H^R, S^R, G^R - basic property relations for ideal gases, problems not included).

UNIT III:

SOLUTION THERMODYNAMICS

Partial molar properties - definition and simple applications involving calculation of partial molar properties for binary systems using analytical methods (no graphical method). Concepts of Chemical potential and fugacity (for pure species and species in solution). Lewis Randall rule, Raoult's law, Henry's law - Definition and simple applications. Excess properties - definition and fundamental relation for excess Gibbs free energy, (problems not included). Activity and activity coefficients, correlations to calculate activity coefficients - Margules, Van Laar and applications involving binary systems.

UNIT IV:

PHASE EQUILIBRIAAND CHEMICAL REACTION EQUILIBRIA

Phase Equilibria: Vapor-liquid equilibrium calculations for binary systems - P-x-y ,T-x-y diagrams, using simple Raonlt's law to binary mixture.

Chemical Reaction Equilibria: Equilibrium criteria for homogenous chemical reactions. Standard Gibbs energy change of reaction, Reaction co-ordinate -definition. Evaluation of equilibrium constant - numerical problems not included. Effect of pressure and temperature on equilibrium constant - qualitative treatment, simple problems involving temperature dependence of equilibrium constant. Calculation of equilibrium conversions and yields for single reactions.

UNIT V:

BIOENERGETICS

Energetics of Metabolic Pathways, Energy coupling (ATP & NADH). Y. Rajasri Stoichiometry and energetic analysis of Cell Growth and Product Formation. Thermodynamics of microbial growth. Oxygen consumption and heat evolution in aerobic cultures. Energy balance equation for cell culture.

Text Books:

1. J.M.Smith, H.C.Van Ness and M.M.Abbott, "Introduction to Chemical Engineering Thermodynamics", 6th ed, TMH, 2003.
2. J.A.Roels, "Energetics and kinetics in biotechnology" , Elsevier, 1983.
3. Y.V.C.Rao, Revised edition, "An introduction to thermodynamics", Universities Press, 2004.

Suggested Reading:

1. Robert A.Alberty, "Biochemical Thermodynamics: Applications of Mathematica", John Wiley and Sons, 2006.
2. Stanley I. Sandler, "Chemical and Engineering Thermodynamics", 3rd Edition, Wiley, 1999.
3. K.V.Narayanan, "A Textbook of Chemical Engineering Thermodynamics", PHI Learning Pvt. Ltd, 2004.

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16BT C13

MOLECULAR BIOLOGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Student is made to understand the basics of molecular biology, i.e. concept of structure of DNA and how that lengthy DNA strands packaged in Prokaryotes & Eukaryotes.
2. Students are taught the Replication of DNA and how it repairs after damage.
3. Students are enlightened about the mechanism of transcription by RNA polymerases.
4. Students are made aware of concept of Ribozyme. (Slicing and maturation of RNA).
5. Students are taught the structure of RNA's and Ribosome's, and how it translates the genetic information.
6. Students are made to understand the regulation of gene expression and Transposons.

Course Outcomes

1. Be able to describe the structure & functions of genetic material.
2. Be able to explain the how the DNA is packaged into chromosomes.
3. Be able to correlate the types of DNA damage & repair.
4. Be able to describe the mechanism of transcription and maturation of RNA to initiate translation.
5. Be able to describe the translation of genetic information into polypeptide.
6. Be able to describe the regulation of gene expression.

UNIT I:

STRUCTURE AND ORGANIZATION OF GENETIC MATERIAL

Structure of DNA - Watson and Crick's model; types of DNA - A-DNA, B-DNA, Z-DNA; difference between DNA and RNA; denaturation and renaturation of DNA, DNA packing - prokaryotes (nucleoid model), eukaryotes (nucleosome solenoid model), euchromatin, heterochromatin, role of histone and non histone proteins in structural organization of chromosomes; telomere and its importance; repetitive DNA, satellite DNA, pseudo genes, overlapping and split genes.

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UNIT II:

DNA REPLICATION AND REPAIR

Replication of DNA - semi conservative replication and its experimental evidences, enzymology of replication, continuous and discontinuous DNA synthesis, complex replication apparatus, unidirectional replication, bi-directional replication, rolling circle replication; DNA damage and repair: Types of DNA damages- deamination, alkylation, pyrimidine dimmers; DNA Repair mechanisms- photo reactivation, Excision repair, mismatch repair, recombination repair, SOS repair.

UNIT III:

MECHANISM OF TRANSCRIPTION

Structure of promoters- RNA polymerases of prokaryotic and eukaryotic organism; transcription- initiation, elongation and termination; post transcriptional processes of eukaryotic RNA; structure and functions of RNA- (rRNA, mRNA, tRNA, Sn RNA), prokaryotic and eukaryotic transcription. Processing of t-RNA, r-RNA, m-RNA splicing; concept of ribozyme, inhibitors of transcription.

UNIT IV:

MECHANISM OF TRANSLATION

Ribosome- structural features of prokaryotic and eukaryotic ribosome; genetic code-triplet code, cracking of genetic code, features of genetic code, wobble hypothesis; protein synthesis: translation in prokaryotes and eukaryotes- initiation of translation, elongation of polypeptide chain, termination of translation. post translation modification, inhibitors of protein synthesis.

UNIT V:

REGULATION OF GENE EXPRESSION AND TRANSPOSABLE ELEMENTS

Operon concept of prokaryotic gene regulation, inducible operon - lac operon, repressible operon - trp operon, attenuation, negative and positive control of transcription. Britten Davidson model for eukaryotic gene regulation, eukaryotic gene regulation - transcriptional level, processing level, translational level; transposable elements - insertion sequences, composite transposons, transposable elements of eukaryotes (Ac-Ds in Maize, Ty elements in Yeast and P elements in Drosophila).

Text Books:

1. David Freifelder, "Molecular Biology", 2nd edition, Narosa Publication, 2007.
2. Harvey F. Lodish, "Molecular Cell Biology", 7th edition, W. H. Freeman., 2012.

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Reference Books:

1. Burton E. Tropp, "Molecular Biology: Genes to proteins", 4th editions, Jones & Bartlett publishers, 2012.
2. Benjamin Lewin, Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick, "Lewin's Genes XI",
   Jones and Bartlett publishers, 2014.
3. Rastogi S.C., "Cell and Molecular Biology", 2nd edition, New Age International, 2006.

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16BT C14

IMMUNOLOGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

1. Students learn about the basic components and responses of Immune system.
2. Knowledge of Antigen and antibody and the application of Antigen and antibody reaction.
3. Importance of Antigen Processing and Presentation is emphasized.
4. Students understand significance of complement system and hypersensitivity.
5. The immunological basics for diseases is taught to the students.
6. Role of immunology in cancer therapy and vaccine is emphasized upon.

Course Outcomes

1. Identify Immune system components and how they work in a coordinated way.
2. Graduates apply the application of antigen-antibody interactions in development of medical diagnostic kits.
3. Analyze the Immune system related underlying causes in Allergies, Asthma and other hypersensitive reactions.
4. Graduate is acquainted with the diseases caused due to Immune system malfunctioning.
5. Explain to the Students, the Immune system related medical complications in transplantation and Cancers.
6. Graduates identify the role of immunology in vaccines development.

UNIT I:

IMMUNE SYSTEM

Introduction to immunity, t pes of immunity - innate and adaptive immunity, humoral and cell mediated immune response, hematopoiesis, cells of the immune system, organs of immune system - primary (bone marrow and thymus) and secondary (lymph node, spleen, MALT, GALT), molecules of immune system (cytokines, interleukins, interferons, chemokines).

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UNIT II:

ANTIGEN, ANTIBODY AND ITS INTERACTION

Antigen - immunogenicity and antigenicity, factors influencing immunogenicity, haptens and adjutants, epitopes; Immunoglobulin - structure, classes and function, antigenic determinants of immunoglobulin - isotype, allotype, idiotype, generation of antibody diversity, production of monoclonal antibodies by hybridoma technology and its applications. Strength of antigen antibody interaction, affinity, avidity, cross reactivity, precipitation, agglutination, immunoelectrophoresis, RIA, ELISA, western blotting, immunoprecipitation, immunofluorescence, FACS.

UNIT III:

ANTIGEN PROCESSING AND PRESENTATION

Major histocompatibility complex (MHC) - organization, classes and function; Antigen processing and presentation - role of antigen presenting cells, endogenous antigens (cytosolic pathway), exogenous antigens (endocytic pathway), presentation of nonpeptide antigen.

UNIT IV:

THE COMPLEMENT SYSTEM AND HYPERSENSITIVITY

Complement system - components, function, activation (classical and alternative pathway); Hypersensitive reactions - Type I (IgE mediated hypersensitivity), type II (antibody mediated cytotoxic hypersensitivity), type III (Immune complex mediated hypersensitivity), type IV (delayed type hypersensitivity).

UNIT V:

MEDICAL APPLICATIONS OF IMMUNOLOGY

Autoimmunity - organ specific (insulin dependent diabetes mellitus, Graves' disease, myasthenia gravis) and systemic (systemic lupus erythematosus, multiple sclerosis, rheumatoid arthritis) autoimmune diseases, treatment of autoimmune diseases; Transplantation - immunological basis of graft rejection, immunosuppressive therapy (general and specific), immunoprophylaxis (attenuated, inactivated and DNA vaccines), immunology of cancer- tumour antigens, immune response to tumour, cancer immunotherapy.

Text Books:

1. Judith A. Owen, Jenni Punt, Sharon A.Stranford, "Kuby Immunology", 7th edition, W.H. Freeman, 2013.
2. Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt, "Roitt's Essential Immunology", 12th edition, John Wiley & Sons, 2011.

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Suggested Reading:

1. Kenneth Murphy, "Janeway's Immunobiology", 8th edition, Garland Science, 2011.
2. Abdul K. Abbas, Andrew H. Lichtman, Shiv Pillai, "Cellular and Molecular Immunology 7th edition", Elsevier Health Sciences, 2011.
3. Sunil Kumar Mohanty and K. Sai Leela, "Text book of Immunology", 2nd edition, JP Medical Ltd, 2014.

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16BT C15

INSTRUMENTAL METHODS IN BIOTECHNOLOGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives

Students are made to understand the following concepts during their course of time:

1. Types of Analytical methods and Instruments used for Analysis, Importance of microscopy.
2. Types of Instruments used for isolation of Biomolecules and Sub cellular organelles.
3. Types of centrifuges like low speed, high speed, ultra centrifuges.
4. Types of Chromatographic Techniques.
5. Charge based separation Techniques.
6. Spectrometric identification Techniques.

Course Outcomes

1. Solve the Analytical problems in instruments by Detection & sensitivity limits.
2. Assess the merits and demerits of instruments.
3. Discuss Principle, procedure and applications of different types of centrifugation.
4. Summarize Principle, Procedure and applications of chromatography's like TLC, paper.
5. Explain Principle procedure and applications of different electrophoresis like SDS, Agarose.
6. State the basic concepts of spectroscopy, Beers Lamberts law, Colorimeter, Nephlometry.

UNIT I:

ANALYTICAL METHODS AND MICROSCOPY

Types of Analytical Methods - Instruments for Analysis - Uncertainties in Instrumental measurements - Sensitivity and detection limit, accuracy and precision for instruments. Principle, procedure and applications of Bright field, Dark field, fluorescent and electron microscopy.

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UNIT II:

INSTRUMENTS FOR ISOLATION TECHNIQUES

Cell disruption by French press, sonication, freeze thaw technique, use of liquid N2 and chemical approaches involved in cell disruption. Isolation of Biomolecules and cell organelles. centrifugation: basic principles of sedimentation, sedimentation coefficient, Svedberg Unit. Various types of centrifuges, their uses, rotors, fixed angle, vertical, swing bucket, zonal rotors. Preparative centrifugation, differential density gradient centrifugation, analytical ultra centrifugation. Materials used in preparation of density gradient- sucrose & cesium chloride.

UNIT III:

SEPARATION TECHNIQUES

Partition coefficient, partition chromatography, adsorption chromatography, Paper, TLC& GLC, adsorption media, solvent, continuous and gradient elution, fraction collection and detection of pure molecules. Methods based on size: Gel permeation chromatography, principle application- Molecular weight determination. Dialysis and its significance. Affinity chromatography, application & technique for purification of proteins and nucleic acids.

UNIT IV:

CHARGE BASED SEPARATION TECHNIQUES

Principle and application of Ion exchange chromatography, use of ion exchange- cation & anion exchangers, pH and salt gradients for elution of proteins, amino acids and nucleotides. Electrophoresis: Migration of charged molecules in electric field-moving boundary, paper, cellulose acetate, starch gel electrophoresis, SDS PAGE, Determination of molecular weight. Identification of specific proteins by western blotting. Agarose gel electrophoresis-separation of DNA recovery of DNA fragments from agarose gels, southern & northern blot techniques and their significance, pulse field gel electrophoresis.

UNIT V:

SPECTROMETRIC IDENTIFICATION TECHNIQUES

Basic concepts of spectroscopy, Visible & UV spectroscopy Beer l mberts law. Principles and application of Colorimetric & Flame photometry, Nephlometry. Principles and applications of Atomic absorption Spectrophotometer. Principles & applications of IR, ESR NMR & Mass spectroscopy.

Text Books:

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1. Keith Wilson and John Walker, "Principles and Techniques of Biochemistry and Molecular Biology", 6th edition, Cambridge University Press, 2005.

2. Sivasankar, "Instrumental Methods of Analysis", Oxford higher education, OUP, India, 2012.

Suggested Reading:

1. GW Ewing, "Instrumental Methods of Chemical Analysis", 4th edition, Mc Graw Hill, 1985.
2. D. Muralidhara Rao, A V N Swamy, Dhaneeswar Reddy, "Instrumental Methods of Analysis", CBS Publishers, 2013.
3. Skoog DA, "Fundamentals of Analytical Chemistry", Thomson Brooks/Cole, 2004.

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16BT C16

INDUSTRIAL BIOTECHNOLOGY

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
CIE	30 Marks
Credits	3

Course Objectives:

1. Student is made to discuss the scope and development of biotechnology and its products and made realized about the role of bioprocess engineer in biotechnological industries.
2. Students are taught the concepts, tools and techniques used in biotechnology.
3. Students are enlightened about fermenter and its process controls.
4. Students are taught about the production of primary and secondary metabolites used in day today life from different microorganisms.
5. Students are taught about the productions of commercial bioproducts such as beverages, enzymes, recombinant proteins having industrial and diagnostic importance.
6. Students are taught about the bioproducts that are used in agricultural, food and pharma ceutical industries.

Course Outcomes:

1. Student will be able to analyze the scope and evaluate development of biotechnology and its products.
2. Student will be able to use the concepts, tools and techniques for designing the solutions for complex biological problems.
3. Be able to use fermenter for the production of bioproducts.
4. Be able to apply the theoretical knowledge of production procedures for producing the bioproducts practically.
5. Be able explain the applications of different bioproducts.
6. Be able to apply the knowledge to face the challenges when placed in industry.

UNIT I:

INTRODUCTION TO BASICS OF BIOTECHNOLOGY

A historical overview on scope and development of biotechnology and products; biotechnology as an interdisciplinary enterprise; a brief survey of organisms, processes, products; areas of application of biotechnology.

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UNIT II:

INTRODUCTION TO INDUSTRIAL BIOPROCESSES

Role of a bioprocess engineer in the biotechnology industry; introduction, development and maintenance and characterization of industrial microorganisms; primary and secondary screening of inoculum, starter and industrial cultures, analysis of microbial fermentation processes; batch and continuous fermentations, solid state fermentation; an overview of aerobic and anaerobic fermentation processes.

UNIT III:

PRODUCTION OF MICROBIAL METABOLITES

A brief outline of processes for the production of some commercially important organic acids (e.g. citric acid and lactic acid); amino acids (glutamic acid and lysine); alcohols (ethanol, and n-butanol). Production of beverages (beer, wine) Study of production processes for various classes of low molecular weight secondary metabolites-" antibiotics -classification of antibiotics, production of penicillins.

UNIT IV:

PRODUCTION OF MICROBIAL ENZYMES AND RECOMBINANT PROTEINS

Production of commercially important industrial enzymes-proteases, amylases, lipases, cellulase, pectinase, and isomerase, production of recombinant proteins: insulin, interleukins, tumor necrosis factor and interferons.

UNIT V:

PRODUCTION OF MICROBIAL PRODUCTS

Bio-pesticides; bio-fertilizers and plant growth factors; natural biopreservatives (nisin); biopolymers (Xanthan gum and PHB); single cell protein; high fructose corn syrup;

Text Books:

1. Crueger W and Crueger A, Biotechnology: Text Book of Industrial microbiology. 2nd edition, Panima Publisher, 2005.
2. Casida L. E., Industrial Microbiology, 1st edition, New Age International, 2006.
3. Patel A.H., Industrial Microbiology, 6th edition, Mc Millan India ltd, 2007.

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Suggested Reading:

1. Samuel Cate Prescott, Cecil Gordon Dunn, "Industrial Microbiology", edition 2, Agrobios, India, 2009.
2. Bhatia S.C., "Industrial Biotechnology, Vol-I", Shree Publishers & distributors, 2011.
3. A V N Swamy, T.Md. Munawar "Basics of Industrial Bio-Technology", Lambert, 2013.

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16MB C01

ENGINEERING ECONOMICS AND ACCOUNTANCY

Instruction	3 hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives: The Objectives of the course are:

1. to introduce managerial economics and demonstrate its importance in managerial decision making.
2. to develop an understanding of demand and relevance of its forecasting in the business.
3. to provide the basics of market structure and the concept of equilibrium in different market structures.
4. to examine the economic analysis of production process, types of inputs and to explain different costs and their relationship with the output.
5. to understand the importance of project evaluation in achieving a firm's objective.
6. to explain the concept of Accountancy and provided knowledge on preparation and analysis of Final accounts.

Course Outcomes: After completion of the course, student will be able to:

1. apply fundamental knowledge of Managerial economics concepts and tools.
2. understand various aspects of demand analysis and forecasting.
3. understand price determination for different markets.
4. study production theory and analyze various costs & benefits involved in it so as to make best use of resources available.
5. analyze different opportunities and come out with best feasible capital investment decisions.
6. apply accountancy concepts and conventions, Final accounts and financial analysis.

UNIT-I:

Introduction to Managerial Economics

Introduction to Economics and its evolution - Managerial Economics - its scope, importance, Its usefulness to engineers - Basic concepts of Managerial economics.

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UNIT-II:

Demand Analysis

Demand Analysis - Concept of demand, determinants, Law of demand, its assumptions, Elasticity of demand, price, income and cross elasticity, Demand Forecasting - Types of Market structures. (Simple numerical problems).

UNIT-III:

Production and Cost Analysis

Theory of Production - Firm and Industry - Production function - input-out relations - laws of returns - internal and external economies of scale. Cost Analysis: Cost concepts - fixed and variable costs - explicit and implicit costs - out of pocket costs and imputed costs - Opportunity cost - Cost output relationship - Break-even analysis. (Theory and problems).

UNIT-IV:

Accountancy

Book-keeping, principles and significance of double entry book keeping, Journal, Subsidiary books, Ledger accounts, Trial Balance concept and preparation of Final Accounts with simple adjustments.

UNIT-V:

Capital Budgeting

Introduction to capital budgeting, Methods: traditional and discounted cash flow methods. Introduction to Working capital management. (Numerical problems).

Text Books:

1. Mehta P.L., "Managerial Economics - Analysis, Problems and Cases", Sultan Chand & Son's Educational publishers, 2013.
2. Maheswari S.N. "Introduction to Accountancy", Vikas Publishing House, 2013.
3. Panday I.M. "Financial Management", Vikas Publishing House, 11th edition, 2015.

Suggested Readings:

1. Varshney and KL Maheswari, Managerial Economics, Sultan Chand, 2014.
2. M.Kasi Reddy and S. Saraswathi, Managerial Economics and Financial Accounting, Prentice Hall of India Pvt Ltd, 2007. P. Rajasri
3. A.R.Aryasri, Managerial Economics and Financial Analysis, McGraw-Hill, 2013.

16BT C17

IMMUNOLOGY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives:

1. Students identifies significance of blood grouping.
2. The applications of Antigen antibody agglutination are demonstrated.
3. The applications of Antigen antibody Precipitation are demonstrated.
4. Students learn about diagnostic kits based on immunology.
5. Students learn to interpret results.
6. Students understand the significance of immunology and its application in medical arena.

Course Outcomes

1. Students are demonstrated how Antigens and Antibody interact.
2. The practical aspects of agglutination and precipitation are identified.
3. Student interprets the results based on the results of the antigen-antibody interaction.
4. Students analyze the importance of different Immunological techniques developed.
5. The importance of blood group matching in blood transfusions and other cases are practically demonstrated.
6. Graduates apply the practical implications of immunological based diagnostic kits.

List of Experiments:

1. ABO Blood Grouping and Identification of Rh typing.
2. Quantitative Precipitin Assay (QPA)(Rocket immuno electrophoresis).
3. Ouchterlony Double Diffusion for Antigen Antibody Patterns (ODD).
4. Immuno-electrophoresis (IEP).
5. Radial Immune Diffusion test (RID).
6. Widal test.
7. VDRL tests.

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8. Total and Differential count of RBC & WBC by Micropipette method.
9. Erythrocyte sedimentation rate.
10. Enzyme Linked Immunosorbent Assay (ELISA) for Antigen capture and Antibody capture.
11. Estimation of Immunoglobullins by Precipitation with Saturated Ammonium Sulphate

Suggested Reading:

1. Arti Nigam and Archana Ayyagari, Lab Manual in Biochemistry, "Immunology and Biotechnology", Tata McGraw Hill Education, 2007.
2. S. Ramakrishna and K.N. Sulochana, "Manual of Medical Laboratory Techniques", 1st edition, J.P. Medical Ltd, 2013.
3. Kanai L. Mukherjee and Swarajith Ghosh, "medical Laboratory Techniques, (Vol-I): Procedure Manual for Routine Diagnostic tests", 2nd edition, Tata McGraw Hill education.

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16BT C18

INSTRUMENTAL METHODS IN BIOTECHNOLOGY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
CIE	25 Marks
Credits	2

Course Objectives: Students are made to understand the following concepts during their course of time:

1. Demonstrate the pH meter and its function.
2. Verification of Beers Lamberts law using visible spectrophotometer.
3. Estimation of concentration of protein by Biuret method.
4. Separation of amino acids by TLC and Paper chromatography.
5. Demonstrate the Biosensors (Glucometer) and its function.
6. Separation of proteins in an unknown sample mixture by SDS-PAGE.

Course outcomes:

1. Adjust the pH of any analytical sample solution by using pH meter.
2. verify Beers Lamberts law using potassium di chromate solution.
3. Determine the concentration of unknown protein sample using visible spectrophotometer.
4. Separate and identify amino acids present in a sample mixture.
5. Demonstrate random blood glucose levels by using Accu-check Active Glucometer.
6. Separate the proteins present in sample mixture based on molecular weight.

List of Experiments:

1. The calibration of pH meter and measurement of pH for different solutions.
2. Estimation of Ascorbic acid by colorimetric assay.
3. Estimation of unknown samples by using conductivity meter.
4. Estimation of different macromolecules by visible spectrophotometer.
5. Verification of Lambert - Beers law by UV -VIS spectrophotometer.
6. Estimation of proteins and nucleic acids by U.V method.
7. Estimation of turbidity using Nephlometer.
8. The separation of different macromolecules by Paper, Thin layer chromatography.

9. The separation of different macromolecules by Paper, PAGE, SDS-PAGE.
10. Estimation of minerals by Flame photometry.
11. Estimation of Thiamine and Riboflavin by Fluorimetry.
12. Preparation of Standard curve using UV-VIS & Flame Photometry.
13. Fractionation of Plasma Proteins by Electrophoresis.
14. Subcellular fractionation studies by differential centrifugatio .

Suggested Reading:

1. Sivasankar, "Instrumental Methods of Analysis", Oxford higher education, OUP, India. 2012.
2. Dr.A.V.N.Swamy,D.Dharaneeswara Reddy, D.Muralidhara Rao, "Instrumental Methods of Analysis", CBS Publishers & Distributors Pvt. Ltd., Delhi, India, 2013.

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With effect from the academic year 2015-16

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY
DEPARTMENT OF BIOTECHNOLOGY
B.Tech III – Year (R13 V sem)

SEMESTER – I

THEORY						
S.no.	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	MT 311	Biostatistics	4	-	-	3
2	BT 311	Fluid Mechanics and Heat Transfer	4	-	-	3
3	BT 312	Protein Engineering and Enzyme Technology	4	-	-	3
4	BT 313	Bioreactor Engineering	4	-	-	3
5	BT 314	Genetic Engineering and rDNA Technology	4	-	-	3
6	CE 31X	Human Values and Professional Ethics	2	-	-	1
PRACTICALS						
7	BT 315	Fluid Mechanics and Heat Transfer Lab	-	-	3	2
8	BT 316	Enzyme Technology Lab	-	-	3	2
9	BT 317	Genetic Engineering Lab	-	-	3	2
10	EG 221	Soft Skills and Employability Enhancement	-	-	2	1
Total			**22**	**0**	**11**	**23**

SEMESTER – II (R13 VI SEM)

THEORY						
S.no.	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	BT 321	Fermentation Technology	4	-	-	3
2	BT 322	IPR, Regulatory Affairs and Clinical Trials	4	-	-	3
3	BT 323	Bioinformatics	4	-	-	3
4	BT 324	Environmental Biotechnology	4	-	-	3
5	BT 325	Mass Transfer Operation	4	-	-	3
6	 BT 351 BT 352 BT 353 BT 354	**Elective –I** 1. Virology 2. Phyto Chemicals and Herbal Products 3. Spectroscopic Analysis of Biomolecules 4. Medical Biotechnology	4	-	-	3
PRACTICALS						
7	BT 326	Bioprocess Lab	-	-	3	2
8	BT 327	Bioinformatics Lab	-	-	3	2
9	BT 328	Mass Transfer Operation Lab	-	-	3	2
10	BT 329	Industry Visit		-	2	-
Total			**24**	**0**	**11**	**24**

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MT 311

BIO-STATISTICS

Instruction	4 Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

UNIT – I

DESCRIPTIVE STATISTICS: Types of data – Methods of collection of data-Graphical representation of data-Histogram-frequency polygon-Pie chart. Frequency distribution-Measures of central tendencies - Measures of dispersion (mean deviation and standard deviation) coefficient of variation and its significance

Measures of dispersion-Skewness- Kurtosis-Boweyls coefficient-Karl Pearson's coefficient of skewness- correlation-Lines of regression- applications of Biotechnology.

UNIT - II

PROBABILITY: Classical approach- Axiomatic approach of probability. Basic theorems - addition and product theorem, conditional probability- Baye's theorem- applications to Biotechnology

UNIT - III

PROBABILITY DISTRIBUTIONS: Random variable- types of Random variable-probability mass function-probability density functions-Expectation, variance, co variance and their properties.
Probability function-Moment generating function (mgf), Cumulant generating function(cgf) and Characteristic function C(t).Discrete Distributions- Binomial distribution, Poison distribution-their expectation, mgf, cgf and C(t)
Continuous distributions: Normal Distribution- mean, variance, m.g.f and c.g.f.
Properties of Normal distribution

UNIT- IV

INFERENCIAL STITISTICS: Estimation-Hypothesis-Testing of Hypothesis-Types of Errors. Testing the single sample mean (σ known), Testing of single sample mean (σ unknown).
Testing the single sample proportion- single sample variance
Testing the differences between two means, two proportions and two variances

UNIT-V

Testing of many proportions- χ^2 – test independent of attributes-r x c-tables. Analysis of variance-CRD

Text Books:

1. Introduction to Bio-Statistics and Research Methods, by P.S.S Sunder Rao and J.Richard; fifth edition, PHI Learning Pvt. Ltd.2012
2. Fundamentals of Applied Statistics by S.C.Gupta and Dr.V.K.Kapoor, tenth edition, Publishers: Sultan Chand & Sons

Reference Books:

1. Methods in Bio-Statistics by Mahajan, Japee Brothers Publishers,2002
2. Text Book of Bio-Statistics; by A.K.Sharma Discovery Publishing House, 2005-Edition
3. Fundamentals of Mathematical Statistics A Modern Approach, by S.C.Gupta and Dr.V.K.Kapoor, tenth edition, Publishers: Sultan Chand & Sons

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BT 311

FLUID MECHANICS AND HEAT TRANSFER

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. This course aims at providing knowledge on basic concepts in flow of fluids, flow field, flow past immersed bodies.
2. The course is designed to give an understanding on measurement of viscosity, flow measuring devices.
3. The course also deals with basic concepts in heat transfer, evaporation and condensation.

Course Outcomes

1. The learning outcomes are assessed through mid semester exams, quiz or a slip test and a final exam.
2. At the end of the course the students should
    a. Be able to measure viscosity of different fluids
    b. Explain the functions of different flow measuring and monitoring devices.
    c. Explain the operation of various, evaporators, condensers, heat exchange equipment.
    d. Calculate the heat transfer area, overall heat transfer co-efficient required for various processes.

UNIT-I BASIC CONCEPTS IN FLOW OF FLUIDS

Introduction, Nature of fluid, Rheology of fluids -Newton's law of viscosity. Concept of Newtonian and non-Newtonian fluids-Different types of non-Newtonian fluids with examples in bioprocessing. Measurement of viscosity using extrusion rheometer, plate and cone viscometer, coaxial cylinder viscometer etc.

UNIT-II FLOW FIELD

Friction losses in laminar flow through a circular tube (Hagen-Poiseuille equation), Friction losses in turbulent flow (Fanning equation), Pumping of fluids flow through pipes, average velocity, flow regimes, boundary layer concept. Laminar and turbulent flow -characterization by Reynold's number, pressure drop due to skin friction and form friction, friction factor chart, Hagen - Poiseuille equation.

UNIT-III FLOW PAST IMMERSED BODIES

Definition of drag and drag coefficient. Friction in flow through beds of solids, Brief introduction to flow of compressible fluids. Flow measuring and monitoring systems- valves, bends, elbows, prevention of leaks, mechanical seals, stuffing box. Flow measuring devices-manometers, orifice-meter, venturimeter and rotameter. Brief description of Pumps and Blowers

UNIT-IV BASIC CONCEPTS IN HEAT TRANSFER

Introduction and Mechanisms of heat transfer; Conduction heat transfer (through slab, cylinder & Sphere); Conduction through solids in series, Forced convection heat transfer inside pipes, Introduction to radiation heat transfer, Chilling and freezing of food and Biological materials. Heat transfer correlations, and calculations, basic heat exchange equipment

UNIT-V BASIC CONCEPTS IN EVAPORATION AND CONDENSATION

Introduction, Types of evaporation equipment and operation methods; Overall heat transfer coefficients in evaporators; simple material balances. Calculation methods for single effect evaporators, Evaporation of biological materials. Types of condensation, numerical problems and condensation equipment.

Text books:

1. W L McCabe and JC Smith, "Unit operations in Chemical Engineering", 6th edition., McGraw Hill Intl. Ed, 2005
2. Christie J. Geankoplis, "Transport Processes and Unit Operations", 3rd edition, Prentice Hall India Pvt. Ltd.

Suggested Reading:

1. Kothandaraman CP and Rudramoorthy. R, "Basic Fluid Mechanics", New Age International Publishers, New Delhi, 1998
2. Sachdeva RC, "Fundamentals of Engineering Heat and Mass Transfer", New Age International Publishers, New Delhi, 1996

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BT 312

PROTEIN ENGINEEERING AND ENZYME TECHNOLOGY

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. The course aims at providing knowledge about structure and functions of proteins.
2. To understand the biosynthesis of proteins and analytical techniques for protein structure prediction.
3. To learn the commercial applications of enzymes in diverse fields namely medicine, food industry, diagnostic industries.
4. To understand the methods of enzyme immobilization and its mass transfer kinetics.

Course Outcomes:

1. The learning outcomes are assessed through mid semester exams, slip test and end exam.
2. At the end of the course the students able to draw the structure of proteins,
3. And be able to isolate and purify the given protein.
4. Be in a position to explain the advantages and disadvantages of immobilized enzyme.

UNIT- I PROTEIN STRUCTURE AND FUNCTIONS

Peptide bond- Structure, functions, physical and chemical properties, chemical synthesis of peptides; liquid phase and solid phase techniques; Proteins-classification and Biological functions; Physico-chemical properties, forces stabilizing protein structure-primary structure and its determination, α-helical, β-pleated structure; Ramachandran plot; super secondary structure, tertiary and quaternary structure; Myoglobin Lysozyme, Ribonuclease A, Hemoglobin; structure and functional relationship; Fibrous protein (Collagen).

UNIT- II PROTEIN BIOSYNTHESIS AND STRUCTURE PREDICTION

Methods of protein isolation, purification and Quantification; large scale synthesis of proteins, design and synthesis of peptides, use of peptides in biology, methods of detection (peptide mass fingerprinting, MALDI-TOF) and analysis of proteins; examples of engineered proteins, protein design and examples. Random, site directed catalytic affectivity; Structure prediction and modeling of proteins.

UNIT- III PRODUCTION AND APPLICATIONS OF ENZYMES

Enzyme nomenclature and classification of enzymes; Production and purification of crude enzyme extracts from plant, animal and microbial sources; Methods of characterization of enzymes; development of enzymatic assays; Applications of commercial enzymes; Proteases; Amylases; Lipases; Cellulases; Pectinases; Isomerases in food, pharmaceutical and other industries; Enzymes for analytical and diagnostic purposes; Design of enzyme electrodes and their application as biosensors in industry, health care and environment.

UNIT- IV MECHANISMS AND KINETICS OF ENZYME ACTION

Mechanisms of enzyme action; Concept of active site and energetics of enzyme substrate complex formation; Specificity of enzyme action; Kinetics of single substrate reactions; Turn over number; Estimation of Michaeli-Menten parameters; Multi substrate reaction mechanisms and kinetics; Types of inhibition - Allosteric regulation of enzymes; Deactivation of kinetics.

UNIT - V ENZYME IMMOBILIZATION & MASS TRANSFER EFFECTS IN IMMOBILISED ENZYME SYSTEMS

Physical and chemical techniques for enzyme immobilization - adsorption, matrix entrapment, encapsulation, cross-linking, covalent binding etc., examples; Advantages and disadvantages of different immobilization techniques; Overview of applications of immobilized enzyme systems; Analysis of Film and pore Diffusion Effects on kinetics of Immobilized Enzyme Reactions; Formulation of dimensionless groups and calculation of Effectiveness Factors.

Text Books:

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1. Lenhinger, David Nelson, “Principles of Biochemistry”, W H Freeman, 2006
2. Palmer Trevor, “Enzyme Technology”, E.W.P, 2004
3. J.L. Jain, “Fundamentals of Biochemistry”, Chand (S.) & Co Ltd , India,1999
4. Voet and Voet Biochemistry- J.G, 2nd edition, John C.Wiley and Sons (1994).
5. James M. Lee, Gerald Reed , Steve Taylor , “Biochemical Engineering”, eBook Version 2.2. ii Academic Press, 3rd Ed, 2001
6. Enzymes by Paul R. Mathewson Eagan Press Handbook Series (1998)
7. Biocatalysis - Fundamentals and Applications Edited by Bommarius, Andreas Sebastian; Riebel, Bettina R. Wiley-VCH (2004).

BT 313

BIOREACTION ENGINEERING

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1.This course aims at providing an insight into the kinetics of chemical reactions. The aim of the course is also to give the students an understanding of the theory of biochemical reactors and enhanced skill in formulation and analysis of different types of reactors used in biochemical engineering.

Course Outcomes

1. The learning outcomes are assessed through mid semester exams, quiz or a slip test and a final exam.
2. The students are able to write rate equations for any given chemical reaction and are able to understand the basic design calculations of various reactors.

UNIT-1 INTRODUCTION TO REACTION KINETICS

Concepts of Reaction Kinetics, Types of reaction, order of reaction, The effect of temperature and pH on reaction rate. Rate equations and Reaction mechanisms; Interpretation of batch reactor data, constant volume batch reactor, integral method of analysis of data for reversible and irreversible reactions.

UNIT- II REACTION MECHANISM AND GROWTH KINETICS

Searching for mechanism - Arrhenius equation - Batch reactor analysis for kinetics, (synchronous growth and its application in product production).

Growth Kinetics: Batch growth quantifying cell concentration, growth profiles and kinetics in batch culture, fed batch growth, continuous growth and their growth kinetic quantification, chemostat growth, semi-continuous / exponential feeding strategy.

UNIT- III BIOREACTOR SYSTEMS

Definitions, Differences and similarities between chemical and bioreactors; Classification of bioreactors; Reactor configurations; Description of a conventional bioreactor with all aspects; Design and construction criteria of a bioreactor; Residence time distributions, concentration, and temperature distributions; Models of non-ideal reactors.

UNIT- IV DESIGNING OF BIOREACTORS

Design equations for enzyme reactors, batch growth of microorganisms, Design equation of a plug flow reactor; Design of CSTR with washout concept; Stirred tank reactors with recycle of biomass; Continuous stirred tank fermentors in series without and with recycle of biomass; Estimation of kinetic parameters.

UNIT- V MULTIPHASE BIOREACTORS:

Different types of reactors: Cell lift reactor, Multipurpose tower reactor, Liquid impelled loop reactor, Pumped tower loop reactor, Fluidized-bed reactor, Packed bed reactor, Bubble-column reactors, Airlift reactors.

Animal and plant cell reactor technology- Environmental requirements for animal cell cultivation, reactors for large-scale production using animal cells, plant cell cultivation.

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Text books:

1. Harvey W Blanch, Douglas S Clark “Biochemical Engineering”, 1st Edition, 1997
2. James E Bailey, David F Ollis, “Biochemical Engineering Fundamentals: Solutions Manual” McGraw-Hill Education, 1979.

Suggested Reading:

1. Scheper T, “Advances in Biochemical Engineering Biotechnology”, Vol. 74. ed. Berlin: Springer-Verlag, 2002
2. Biochemical Engineering and Biotechnology Handbook, by Bernard Atkinson Ferda Mavituna, Grove's Dictionaries; 2nd Edition (1992) .
3. Bioreactor Systems for Tissue Engineering Series: Advances in Biochemical Engineering / Biotechnology , Vol. 112 Kasper, Cornelia; van Griensven, Martijn; Pörtner, Ralf , Springer. (2009).
4. S.Aiba, A.E. Humphrey and N.R. MHH, "Bio-chemical Engineering", Second Edn. Academic Press, 1973.

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With effect from the academic year 2015-16

BT 314

GENETICS ENGINEERING AND rDNA TECHNOLOGY

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. To provide theoretical concepts and principles in understanding the techniques in nucleic acid isolation, quantification and various enzymes and tools used in rDNA technology.
2. To understand the theoretical principles, various techniques and tools involved in construction of cloning vectors from various sources, detection and analysis of cloned genes.
3. To understand expression of recombinant gene in various host system
4. To know the applications of Genetic engineering tools in medicine, agriculture and human research.

Course Outcomes

1. The undergraduate students will be able to understand the basic principles and tools used in rDNA research starting from isolation of nucleic acid, restriction digestion, ligation, sequencing, amplification of DNA fragments using PCR technology,
2. The students gains theoretical knowledge on various cloning vectors their use in genetic transformation and analysis of recombinant protein using SDS PAGE
3. The undergraduates will be able to implement their theoretical concepts and knowledge while handling the practical experiments in their course work.

UNIT-I: GENERATION OF DNA FRAGMENTS

Isolation and purification of nucleic acids (DNA & RNA); Host controlled restriction and modifications; Enzymes used in cloning - restriction endonuclease (classification, nomenclature, target sites), polymerases, ligases, phosphatases, kinases, nucleases; Restriction mapping; Blotting techniques – Southern, Northern and Western Blotting.

UNIT- II: CLONING VEHICLES

Essential features of cloning vectors, plasmid vectors, pBR 322, pUC 18/19; Phage vectors - λgt11, λZAP, λEMBL4; M13 derived vectors –M13mp18; Phagemids- Blue script vectors; Cosmids – strategies to generate genomic library, artificial chromosomes - BAC, YAC, PAC, expression vectors - pET vectors, Animal Viral vectors - SV40, retroviral vectors, Plant vectors – Ti and Ri Plasmid.

UNIT- III: POLYMERASE CHAIN REACTION AND MOLECULAR MARKERS

PCR – Principle, Designing of primers, PCR Methodology, RT-PCR, Multiplex PCR, PCR for site directed mutagenesis, Identification of PCR products, Applications of PCR; Molecular marker – RFLP, RAPD, AFLP, gene chip, and micro array.

UNIT- IV: CLONING STRATEGIES

Construction of genomic and cDNA libraries; Basic concept of blunt end and cohesive end ligation, homopolymer tailing, use of linkers, adaptors, T/A cloning of PCR products. Introduction of cloned genes into hosts- Transformation, Transfection, packaging phage DNA *In vitro*, Particle Bombardment; Detection of clones with desired gene; Methods of gene sequencing: - Maxam-Gilbert method, Sanger's dideoxy chain termination method, Pyrosequencing, automation of DNA sequencing.

UNIT- V: EXPRESSION OF RECOMBINANT PROTEINS AND APPLICATIONS OF DNA TECHNOLOGY: High level expression of proteins in different host systems *(E. coli,* yeast, Insect, mammalian cells); Applications of Gene cloning and r-DNA Technology in Medicine (Recombinant Insulin, Human Growth Hormone, Recombinant Factor VIII), Agriculture (BT plants, Golden rice); Transgenic animals; Gene silencing (RNAi) Introduction to Gene therapy (*Ex vivo* & *In vivo*), case study of ADA as an example. Safety guidelines for rDNA research.

Text books:

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1. Brown TA, “Gene Cloning and DNA Analysis: An Introduction”, 6th edition., Wiley Blackwell , A John Wiley & Son Ltd publications, UK, 2010
2. Primrose SB and Twyman RM, “Principles of Gene manipulation and Genomics”, 7th edition, Blackwell Publishing. 2006

Suggested Reading:

1. Glick BR, Pasternak JJ and Patten CL, “Molecular Biotechnology: Principles and applications of Recombinant DNA”, 4th edition, ASM Press, 2009
2. Desmond S T Nicholl, “An Introduction to Genetic Engineering”, 3rd edition, Cambridge University Press, 2008
3. Richard J. Reece, “Analysis of Genes and Genomes”, Wiley, 2004

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BT315

FLUID MECHANICS AND HEAT TRANSFER LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives

1. This lab course is designed to understand the mechanics of fluid flow, analysis of various processes viz., Flow measuring devices (Venturimeter, Mouth piece, and Triangular notch.), heat exchangers.

Course Outcomes

1. Course outcomes are based on a continuous evaluation basis, like viva voce, calculations etc., and a final exam.
2. Students must be able to demonstrate various experimentation methods with skill and precision

LIST OF EXPERIMENTS

1. Determination of discharge coefficient for orifice meter and venturi meter and their variation with Reynolds number
2. Determination of weir meter constant K for v-notch and rectangular notch
3. Calibration of rotameter and study of variation of flow rate with tube to float diameter
4. Determination of viscosity of Glycerol - water solutions at different temperatures
5. Determination of friction factor for flow of water through annulus using Farmings and Davos equations.
6. Determination of friction factor for flow through straight pipes of different diameters and study of variation of friction factor with Reynolds number.
7. Determination of friction losses in pipe fittings
8. Determination of Thermal conductivity of homogeneous wall insulating powder under steady state conditions.
9. Determination of interface temperatures in composite wall under steady state conditions.
10. Determination of heat transfer coefficient in Natural convection.
11. Determination of overall heat transfer coefficient in unsteady state heat transfer
12. Determination of inside heat transfer coefficient in coil heat exchangers
13. Determination of overall heat transfer coefficient and effectiveness in a Double pipe heat exchange
14. Determination of heat transfer area in a 1-2- shell and tube heat exchanges
15. Determination of heat transfer coefficient on a single tube by film wise and drop wise condensation.

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Chaitanya Bharathi Institute of Technology
Gandipet, Hyderabad-500 075.

BT 316

ENZYME TECHNOLOGY LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives

1. The course aims at providing knowledge about the preparation of buffers and chemicals for isolation and purification of enzymes.
2. The students understand the methods of immobilization of enzymes and their kinetics.

Course Outcomes

1. Course outcomes are assessed through conducting viva-voce, mid exams and end practical exam.
2. The students able to analyze the effect of various physical parameters and Michelis-Menten kinetics (K_s, V_{max}) activity of enzyme.
3. The students able to choose the suitable methods for immobilization of enzymes.

LIST OF EXPERIMENTS

1. Preparation of buffers
2. Isolation and extraction of enzymes (Microbial, plant and animal source).
3. Effect of pH on enzyme activity.
4. Effect of temperature on enzyme activity.
5. Effect of substrate concentration on enzyme activity.
6. Effect of time interval on enzyme activity.
7. Development of Enzyme Assay
8. Evaluation of Michelis Menten kinetic parameters.
9. Kinetic studies of enzyme inhibition.
10. Determination of growth curve of a supplied microorganism and to determine substrate degradation profile.
11. Studies on immobilization of enzyme/cell by gel entrapment method.
12. Comparative study of activities of free and immobilized enzyme systems.

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Dept. of Bio-Technology
Chaitanya Bharathi Institute of Technology
Gandipet, Hyderabad-500 075.

With effect from the academic year 2015-16

BT 317

GENETIC ENGINEERING LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	3

Course objectives

1. To provide an opportunity to experimentally verify the concepts of genetic engineering and rDNA technology already studied.
2. To provide hands on training to students to practically prove the theoretical concepts studied with respect to isolation, quantification, amplification, sequencing of DNA genome /fragments and analysis of recombinant protein from transformed bacterial cultures

Course outcomes

1. The students will be able to individually isolate nucleic acids, subject to restriction digestion, ligate, amplify it using PCR technology.
2. The students can sequence DNA fragments, handle experiments in transforming bacterial cells with recombinant plasmids and analyze the recombinant proteins using SDS –PAGE techniques

LIST OF EXPERIMENTS

1. Isolation of bacterial genomic DNA
2. Isolation of plasmid DNA.
3. Visualization of Genomic and Plasmid DNA on Agarose gels
4. Restriction digestion
5. Restriction mapping of DNA fragments.
6. Gel elution.
7. DNA ligation.
8. Preparation of competent cells.
9. Genetic transformation and screening for recombinant bacterial cells.
10. Blotting techniques- southern blotting.
11. Amplification of DNA fragments by Polymerase Chain Reaction (PCR).
12. DNA sequencing- Sanger's Method
13. Analysis of Recombinant Proteins using SDS-PAGE

Suggested Reading:

1. Sambrook J and Russell DW, “Molecular Cloning-A laboratory manual”, Vol I, II and III, Cold spring Harbor Laboratory Press, 2001

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Gandipet, Hyderabad-500 075.

BT 321

FERMENTATION TECHNOLOGY

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. The course aims at providing knowledge to students on scope and chronological development of fermentation technology.
2. To understand the types of fermentation process and design of fermentation.
3. To learn about the ancillaries of fermentor and its applications.
4. To gain in-depth knowledge about the working principles and operation of fermentors.

Course Outcomes

1. The learning outcomes are assessed through mid semester exams, slip tests and end exam.
2. At the end of the course the student
   a. Be able to explain the types of fermentation media and media design.
   b. Explain the control of fermentation by various physical and chemical process parameters.
   c. Explain the scale up of fermentors and working principles.

UNIT-I INTRODUCTION TO FERMENTATION PROCESSES

The range of fermentation processes; the chronological development of fermentation industry; Industrial applications; Future trends in fermentations; Aseptic transfer of spore suspension; Transfer of inoculums from seed tank to Fermentor.

UNIT- II FERMENTATION PROCESSES AND MEDIA DESIGN

General requirements of fermentation processes, Basic design and construction of fermentor and ancillaries, Main parameters to be monitored and controlled in fermentation processes; Typical media, Media formulation, energy resources, carbon and nitrogen components. Solid-substrate, slurry fermentation and its applications.

UNIT- III AERATION AND AGITATION IN FERMENTATIONS

Basic Mass transfer concepts; Oxygen transfer from gas bubble to cells; Oxygen transfer in fermentations; Bubble aeration and Mechanical agitation; Correlations for mass transfer coefficients; Gas Hold up; Power consumption concepts; Determination of oxygen transfer rates, K_La values; Other Factors affecting the values of mass transfer coefficients in fermentation vessels.

UNIT- IV SCALE UP AND RHEOLOGY IN FERMENTATIONS

Scale up of fermentation processes; Principles, theoretical considerations and techniques used; Scale down methods; The Rheology of fermentation broths; Rheological models; Measurement of rheological parameters; Rheological Control of fermentations; Mixing concepts, power requirement for mixing and improvement of mixing in fermentations.

UNIT - V FERMENTORS

Batch, Fed-batch and Continuous Fermentation systems; Dual and multiple fermentations; Comparison between batch and continuous fermentations; Steady state, unsteady state continuous fermentation theories; Examples of continuous fermentation; Practical problems with continuous operations. Monitoring and Control of fermentations, behavior of microbes in different reactors (air lift, fluidized, batch, and continuous fed batch condition).

Text books:

1. Stanbury PF, Whitaker A and Hall S J, "Principles of Fermentation Technology" 2nd edition, Elsevier, 2013,
2. Bailey JE and Ollis DF, "Biochemical Engineering Fundamentals", 2nd edition, McGraw Hill, 1986
3. Pauline M. Doran, "Bioprocess Engineering Principles", Academic press, 1995

Suggested Reading:

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1.Shuler M and Kargi F, Bioprocess Engineering, Prentice Hall of India Pvt. Ltd., New Delhi, 2002
2.Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering" 1st edition, CRC, 1997
3.Srivastava ML, "Fermentation Technology", Narosa Publishing House, 2008
4.Brian McNeil and Linda Harvey, " Practical Fermentation Technology" Wiley, 2008
5.Crueger W and Crueger A, "Biotechnology: A Text Book of Industrial Microbiology", 2nd Edition, Panima Publishing Corporation, New Delhi, 2000

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With effect from the academic year 2015-16

BT 322

IPR, REGULATORY AFFAIRS AND CLINICAL TRIALS

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course objectives

1. Intellectual property rights and their importance, National and international regulatory affairs, GCP &ICH guidelines.
2. A comprehensive introduction to Regulatory Affairs as typically practiced by Regulatory Affairs professionals in medical device and biopharma companies.
3. Current trends in Clinical research and regulations

Course outcomes

1. Students will know the importance of IPR and how to apply for a patent.
2. Students will have the knowledge of ICH, GCP, FDA guidelines
3. Understand the phases of clinical trials and the basis of approval of new drugs, their outcome in new drug discovery and have the comprehensive knowledge on clinical trials.

UNIT- I INTELLECTUAL PROPERTY RIGHTS

Intellectual property rights, and intellectual property protection, patents and methods of application of patents, trade secret, copy rights, trade marks, legal implication, trade related aspects (TRIPS), farmers rights, plant breeder's rights.

UNIT – II REGULATORY AFFAIRS - INDIA

Indian contest- requirements and guidelines of GMP, understanding of Drugs and Cosmetic Act 1940 and rules 1945 with reference schedule M, U & Y. The Narcotics Drugs and Psychotropic Substances Act. Medicinal and Toilet Preparations (Excise Duties) Act, 1955. The Pharmacy Act, 1948. Types of ANDA filing (Para I, II, III, IV filing), Clinical trial approval by Drug Controller General of India (DCGI). Exclusivities (NCE, NS, NP, NDF, PED, ODE, PC)

UNIT – III REGULATORY AFFAIRS - GLOBAL

Introduction to FDA, WHO, Code of federal Regulations, ICH Guidelines, Related quality systems- objectives and guidelines of USFDA, WHO & ICH, European Medicines Agency and its responsibility, EU clinical trial directive. Requirement of GLP: Guidance and recommendation on Dissolution and Bio-equivalence requirement. Hatch Waxmann Act.

UNIT – IV DOCUMENTATION AND PROTOCOLS

Documentation: Types related to pharmaceuticals industry, protocols, harmonizing formulation development for global fillings, NDA, ANDA, IND, BLA, CTD, DMF, Dealing with post approval changes- SUPAC, handling and maintenance including electronic documentation, 510K device application.

UNIT – V INTRODUCTION TO CLINICAL RESEARCH

History, Importance and Scope, stake holders in clinical research, Framework of clinical research, Declaration of Helenski, 2000 amendment, medical and clinical research terminology, Principles of GCP, Roles and responsibilities in clinical research according to ICH GCP, Sponsor, Investigator, IRB/IEC, Essential documentation, Confidentiality issues. Clinical data management system, Double data entry.

Text Books

1. Good Clinical Practices, Central Drugs Standard Control Organization, Govt. of India
2. Drugs and Cosmetics Act, 1940
3. Dominique PB and Gerhardt Nahler, International Clinical Trial, Volume 1&2, , Interpharm Press, Denver, Colorado

Suggested readings:

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1. Code of Federal Regulations by USFDA-Download
2. ICH-GCP Guidelines-Download
3. Fleming DA, Hunt DL, "Biological Safety Principles and Practices", 3rd edition, ASM Press, Washington, 2000

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BT 323

BIOINFORMATICS

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. To provide elementary knowledge in bioinformatics and biological information available to biologist on the web and learn how to use these resources on their own
2. To learn fundamentals of biological databases and sequence alignment
3. To understand evolutionary relationship among organisms
4. To learn methods for determining the order of the nucleotide and to predict gene
5. To aid in understanding structural bioinformatics and biochemical databases

Course Outcomes

1. Graduates will have the knowledge of basics of bioinformatics
2. Graduates will be able to use bioinformatics search tools on the internet for data mining, pair wise and multiple sequence alignments, genome sequencing, predict gene and protein structure, evolutionary tree and biochemical databases.

UNIT-I INTRODUCTION TO BIOINFORMATICS AND BIOLOGICAL DATABASES

Need of Computers in Biotechnology Research, Elementary commands and protocols, ftp, telnet, http; Bioinformatics-Introduction, Scope of Bioinformatics, Applications; Introduction to biological databases, types of biological database, file formats for biological sequence (NCBI, EMBL, SWISSPROT, FASTA); Information retrieval from biological Databases.

UNIT- II SEQUENCE ALIGNMENTS AND DATAMINING

Sequence Alignment-Local, Global alignment; Methods of pairwise sequence alignment; Multiple Sequence alignment methods; Comparison of pair wise and multiple alignment; Sequence database search- FASTA, BLAST, various versions of BLAST and FASTA; Amino acid substitution matrices- PAM and BLOSUM; Data Mining and Visualization.

UNIT- III PHYLOGENETIC ANALYSIS

Understanding Evolutionary process; Origin of Molecular Phylogenetics; Relationship of phylogenetic Analysis to sequence alignment; Concept of evolutionary trees; Methods of Phylogenetic analysis, Tree Evaluation, Problems in Phylogenetic Analysis, Automated Tools for Phylogenetic Analysis; Ultrametric trees.

UNIT-IV GENOME MAPPING AND GENE PREDICTION

DNA sequencing- Map assembly, Genome Mapping; Genome sequencing, cDNA sequencing, Genome sequence assembly, Comparative Sequence Analysis; Gene Annotation; Human Genome Project (HGP); Basis of Gene Prediction, Gene predictions in Microbial genomes and eukaryotes, Gene Prediction Methods, Other Gene Prediction Tools.

UNIT V STRUCTURAL BIOINFORMATICS AND BIOCHEMICAL DATA BASES

Protein structure basics, protein structure classification, visualization and comparison, protein secondary structure prediction and protein tertiary structure prediction; Introduction to Biochemical databases- KEGG, BRENDA. Molecular Modeling Databases (MMDB)

Text books:

1. David Mount, "Bioinformatics Sequence and Genome Analysis", 2nd edition, CBS Publishers and Distributors Pvt. Ltd., 2005
2. Rastogi SC, Mendiratta N and Rastogi P, "Bioinformatics: Methods and Applications Genomics, Proteomics and Drug discovery", 3rd edition, PHI Learning Private Limited, New Delhi, 2010

Suggested Reading:

Y. Rajani

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1. Baxebanis AD and Francis Ouellette BF, “Bioinformatics a practical guide the analysis of genes and proteins”, 2^{nd} edition, John Wiley and Sons, Inc., Publication, 2001
2. Vittal R Srinivas, “Bioinformatics: A modern approach. PHI Learning Private Limited”, New Delhi, 2009
3. Ji Xiong, “Essential Bioinfomatics”, Cambridge University Press, 2006

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4. **BT 324**

ENVIRNOMENTAL BIOTECHNOLOGY

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. To provide theoretical concepts and a comprehensive knowledge on bioremediation methods, bio leaching etc.
2. To impart theoretical basics on various methods used in treatment of waste water.
3. To update the students with the available information on biotechnological applications in hazardous waste management

Course Outcomes

1. The undergraduates will have the theoretical knowledge in bioremediation methods for its applications in practice
2. The students will be able to apply the theoretical concepts and principles studied in the treatment of waste water, environmental pollution, in hazardous waste management and also in recovering useful materials.

UNIT – I: BIOREMEDIATION

Introduction; Constraints and priorities of Bioremediation, Biostimulation of naturally occurring microbial activities.
Bio-augmentation; *In situ, Ex situ*, Intrinsic and Extrinsic Bioremediation; Solid phase bioremediation- Land farming, Prepared beds, Soil pipes, Phyto-remediation, Liquid phase bioremediation.

UNIT – II: METAL BIOTECHNOLOGY AND BIOFUELS

Mining and metal biotechnology; Microbial transformation; Accumulation and concentration of metals; Metal leaching; Metal Extraction and future prospects.
Microorganisms and their role in energy requirements of mankind. Role of carbon credits in Industries, present scenario around the world. Production of non-conventional fuels: Methane (Biogas), Hydrogen Alcohols and Algal Hydrocarbons.

UNIT – III: BIOLOGICAL WASTE WATER TREATMENT

Biological processes for domestic and industrial waste water treatment. Usage of algae and bacteria for waste water treatment. Aerobic systems – Activated sludge process, trickling filters, Biological filters, Rotating biological contractors (RBC), Fluidized bed reactor (FBR), Expanded bed reactor, Inverse fluidized bed bio-film reactor (IFBBR), Packed bed reactors. Anaerobic biological treatment-Contact digesters, Packed column reactors, UASB.

UNIT- IV: DEGRADATION OF XENOBIOTIC COMPOUNDS

Introduction- Xenobiotic compounds; Recalcitrants- hazardous wastes. Biodegradation of Xenobiotics present in Environment. Decay behavior and degradative plasmids; Hydrocarbons, and substituted Hydrocarbons. Oil Pollution and Bioremediation of Contaminated soils. Biological Detoxification, Cyanide detoxification; Detoxification of Toxic Organics- Phenols.

UNIT- V: HAZARDOUS WASTE MANAGEMENT

Biotechnological applications to hazardous waste management. Examples of Biotechnological applications to hazardous waste management; Global Environmental problems and Biotechnological approaches for management. Treatment of nuclear wastes.

Text books:

1. Foster CF, John Ware DA, “Environmental Biotechnology”, Ellis Horwood Ltd. 1987.
2. Karnely D, Chakrabarthy, Omen GS, “Biotechnology and Biodegradation, Advances in Applied Biotechnology” series Vol-4 –, Gulf publications co., London, 1989.
3. John T, Cookson Jr, “Bioremediation Engineering: Design and application”, McGraw Hill, Inc., 1985.

Suggested readings

1. Stanier RY Ingram JL., Wheelis ML & Painter RR “General Microbiology” Mcmillan Publications, 1989

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2. Environmental Biotechnology By Priv.-Doz. Dr.Hans-Joachim Jördening, Prof. Dr. Josef Winter, Wiley-VCH Verlag GmbH & Co. KGaA. 2005.
3. John. T. Cookson “Bioremediation Engineering: Design And Application” by, Jr. Mc Graw Hill, Inc. 1995

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BT 325

MASS TRANSFER OPERATIONS

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. This course aims at providing the students with knowledge about various unit operations such as absorption, distillation, extraction, leaching.
2. It also gives insight about various membrane separation processes such as adsorption, Ion-exchange, dialysis and the application of these unit operations in commercial aspects of biotechnology.

Course Outcomes

Course outcomes are evaluated by mid semester internal exams, slip test and an external exam. At the end of the course student should

1. Explain Molecular diffusion in solids. liquids and gases
2. Be able to determine the number of trays needed for the separation
3. Carry out material balances accurately.
4. Explain the principles of the various separation processes involved in the downstream processing of products, especially those of biological origin
5. Explain the principles and application of membrane separation processes.

UNIT- I PRINCIPLES OF MASS TRANSFER

Introduction to Mass transfer and Diffusion, Molecular diffusion in Gases, Molecular diffusion in Liquids, Molecular diffusion in Biological solutions and gels, Molecular diffusion in Solids, Inter phase mass transfer and Mass transfer coefficients.

Gas - Liquid operations: Equilibrium relations between phases, Mass transfer between phases, Choice of solvent for absorption, Single stage and multi stage co current and counter current operations, Estimation of Mass transfer coefficient, Calculation of HTU, NTU concepts, equipments mechanically agitated vessels, packed columns and plate columns.

UNIT- II PRINCIPLES OF VLE FOR BINARY SYSTEM

Phase rule and Raoult's law, Boiling point diagrams and x-y plots, Relative volatility, Flash distillation, Differential distillation, Simple steam distillation.

Distillation with reflux and McCabe - Thiele method. Special Cases for rectification using McCabe -Thiele; Stripping column distillation, Enriching Column distillation, Rectification with direct steam injection, Rectification with single side stream.

UNIT- III LIQUID - LIQUID EXTRACTION AND LEACHING

Introduction to Extraction process: Equilibrium relations in extraction, Analytical and graphical solutions for single and multi stage operations co-current and counter current operations without reflux. Equipments for liquid-liquid extraction: mixer-settlers for extraction, Plate and Agitated Tower Contactors for Extraction, Packed and spray Extraction towers.

Introduction to leaching process :Equilibrium diagrams for leaching, analytical and graphical solutions for single and multi stage counter current operations.

UNIT - IV BASIC CONCEPTS IN DRYING OF PROCESS MATERIALS

Methods of drying, Equipment for drying; Free moisture content of materials; Concept of bound and unbound moisture content of biological materials; Rate of drying curves; Calculation methods for constant-rate & falling rate drying methods; Freeze drying of biological materials.

UNIT- V ADSORPTION AND MEMBRANE SEPARATION PROCESS

Theory of adsorption, Industrial adsorbents, Adsorption equilibria, Frendlich equation-single and multiple operations- processing variables and adsorption cycles.

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Introduction and Types of Membrane separation process: Principles of ion exchange. Dialysis, Gas permeation membrane processes, types of membranes and permeability's for separation of gases, Introduction to types of flow in gas permeation.

Text books:

1. C J Geankopolis, "Transport Processes in chemical Operations", 4th edition, Prentice Hall India
2. Robert ETreybal, "Mass Transfer operations", 3rd edition. McGraw-Hill
3. Warren L, McCabe, Julian C. Smith, Peter Harriot, "Unit operations of Chemical Engineering", 5th Edition, McGraw-Hill

Suggested Reading:

1. Jaime Benitez, "Principles and Modern Applications of Mass Transfer Operations", 2nd edition, 2009
2. J M Coulson and J F Richardson, "Chemical Engineering", Vol-II, 3rd edition, Pergamom Press.
3. Sahay K M and KK Singh, "Unit operation of Agricultural Processing", Vikas Publishing House Pvt. Ltd, New Delhi, 1994
4. Earle RL, "Unit operation in Food processing", Pergamon Press, Oxford, 1996
5. Mc Cabe WL, Smith JC and Harriot P, "Unit operations of chemical engineering", 3rd edition, McGraw Hill ,1993

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With effect from the academic year 2015-16

BT 351

VIROLOGY
(ELECTIVE –I)

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course objectives

1. To study a brief account on the properties, types and cultivation studies of viruses
2. Structural and the taxonomical studies and the diseases of animal and plant viruses

Course outcomes

1. The student will get a comprehensive knowledge about various properties, types, morphological properties of animal and plant viruses
2. The students get the knowledge about the classification and diseases caused by plant and animal viruses

UNIT- I INTRODUCTION TO VIROLOGY

Brief outline of discovery of Viruses; Properties of Viruses; Morphology of Viruses-Structure, Capsid Architecture, Envelopes and peplomers; Chemistry of Viruses- Viral Proteins, Genome- Structure and Types; Study of sub viral agents- Brief account on Diseases caused by Viroids- PSTV, Cadang cadang; Prions- Scrape, Cruetzfeldy jakob. Satellite viruses; Satellite RNA's.

UNIT- II CULTIVATION OF VIRUSES I

General methods of cultivation of viruses- in embryonated eggs, cultivation of animal and plant viruses; Isolation and purification of viruses- plant viruses, animal viruses; Criteria of purity, Maintenance and preservation of infectivity; Characterization of viruses- Electron microscopy, X-ray crystallography, sedimentation analysis;

UNIT- III CULTIVATION OF VIRUSES II

Enumeration viruses- By electron microscopy, plaque assay, acid end point method, Haemagglutinin assay; Detection of viruses- By serological characterization, detection of viral antigen, detection of viral nucleic acid; chemical determination Ultra structure and life cycles of Bacteriophages- Ml3, Mu, T3, T4 & lambda

UNIT- IV PLANT VIRUSES

Taxonomy; Symptoms of diseases caused by plant viruses (Morphological, Physiological and Histological); Ultra structure and life cycles of TMV and CaMV; transmission of plant viruses- Mechanical and biological (vector and non-vector); Basic control measures of plant diseases- vector and chemical control.

UNIT- V ANIMAL VIRUSES

Taxonomy; Detailed structure and brief account on life cycles of RNA viruses- Polio, Influenza, Measles, Rota virus and HIV; Ultra structure and brief account on life cycles of DNA viruses- Vaccina, HSV, Adeno, SV40 and Hepatitis Virus; Viral vaccines- types and preparation of conventional vaccines

Text Books

1. Dimmock NJ and Primrose SB, "Introduction to Modern Virology", 4th edition, Blackwell Scientific Publications, 1994.
2. Matthews REF "Fundamentals of Plant Virology". Academic Press, San Diego, 1992

Suggested books

1. Carter J and Saunders V "Virology: Principles and Applications" John Wiley and Sons ltd, 2007
2. Morag C, Timbury M, Chrchill Livingstone, "Medical Virology", London, 1994

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With effect from the academic year 2015-16

BT 352

PHYTOCHEMICALS AND HERBAL PRODUCTS
(ELECTIVE –I)

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course objectives

1. To impart knowledge on medicinal plants and extraction of crude drugs.
2. To provide a comprehensive knowledge on analysis, types and detection of phytochemicals and adulterants.
3. To impart knowledge on the applications of various phytochemicals and herbal products.

Course outcomes

1. The undergraduates will know the sources of various crude drugs and their medicinal values.
2. The students will understand the procedures involved in the detection, extraction and analysis of crude drugs and adulterants.
3. The undergraduates will be able to implement their theoretical concepts and knowledge of extraction and their applications in herbal preparation for implementing the same practically.

UNIT I: CRUDE DRUGS, MEDICINAL AND AROMATIC PLANTS

Crude Drugs - Scope and Importance, Classification (Taxonomical, Morphological Chemical, Pharmacological); Collection and processing of Crude Drugs. Utilization of Medicinal and Aromatic Plants in India. Genetics as applied to Medicinal herbs. Biogenesis of Phytopharmaceuticals.

UNIT II: ANALYSIS OF PHYTOCHEMICALS

Methods of Drug evaluation (Morphological, Microscopic, Physical and Chemical). Preliminary screening, Assay of Drugs - Biological evaluation / assays, Microbiological methods, Chemical Methods of Analysis and Detection of Adulterants: Chemical estimations. Drug adulteration - Types of adulterants.

UNIT III: TYPES OF PHYTOCHEMICALS

Carbohydrates and its derived products- Structures, types and extraction methods : Glycosides - Digitalis, Aloe, Dioscorea ; Volatile Oils - Clove, Mentha; Alkaloids - Taxus, Papaver, Cinchona; Flavonoids-and Resins. Tannins (Hydrolysable and Condensed types).

UNIT IV: APPLICATIONS OF PHYTOCHEMICALS

Application of phytochemicals in industry and healthcare; Biocides, Bio-fungicides, Biopesticides.

UNIT V HERBAL PRODUCTS

History, Scope, and Current aspects of herbs and herbal medicines; Classification of active components of therapeutic plant and herbal products; Preparation of standardized extracts of Garcinea, Forskolin, Garlic, Turmeric and Capsicum.

Text books:

1. Kokate CK, Purohit AP and Gokhale SB, "Pharmacognosy", 4th edition, Nirali Prakashan, 1996.
2. Trease and Evans WC Evans, " Pharmacognosy" , 14th edition, Harcourt Brace & Company. 1989.
3. Hornok L, "Cultivation & Processing of Medicinal Plants" Chichister, U. K: J. Wiley & Sons.1992

Suggested Reading:

1. Natural Products in medicine: A Biosynthetic approach Wiley. 1997
2. Chaudhri RD, "Herbal Drugs industry, A practical approach to Industrial Pharmacognosy" Eastern publishers, 2nd reprint, New Delhi. 1999.

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With effect from the academic year 2015-16

BT 353

SPECTROSCOPIC ANALYSIS OF BIOMOLECULES
(ELECTIVE –I)

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. To understand selected biochemical techniques to determine bimolecular structure and function as well as spatial distribution of biomolecules and molecular complexes in cells.

Course Outcomes

1. Graduates are able to detect and characterize biomolecules by various spectroscopic techniques

UNIT- I INTRODUCTION TO SPECTROSCOPY AND IR SPECTROSCOPY

Interaction of radiation with matter, Definitions- Frequency, Wavelength, Wave Number; Types of Electromagnetic radiation, Interparticle forces and energies; energy levels; Population of energy levels, Scattering, Absorption and Emission.

Measurement of Infrared spectrum; Physical basis of infrared spectra. Infrared of polyatomic molecules; Biological examples; Infrared of oriented samples.

UNIT- II ULTRAVIOLET AND VISIBLE SPCTROSCOPY

Electronic energy levels; Electronic transitions; Selection regime, Absorption range of biological chromophores; Transition metal d-d transition; Charge transfer spectra; Application of UV spectra to proteins; Properties associated with the transition dipole moment and interaction between them, Measurement of molecular dynamics by Fluorescence spectroscopy.

UNIT- III NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

The Phenomenon, Magnetization-Measurement; Spectral Parameters in NMR, Intensity, Chemical Shift, Spin-spin coupling, Tl and T2 relaxation times, Line widths, Nuclear over Hauser effect, Chemical exchange paramagnetic centers, Applications of NMR in Biology, assignment in NMR, Studies of Macromolecules, Ligand binding, lionization studies and pH kinetics, Molecular Motion.

UNIT-IV ELECTRON PARAMAGENTIC RESONANCE SPECTROSCOPY

Introduction- Resonance condition; Measurement- Spectral Parameters; Intensity of g values; Spectral Anisotropy, Time scale of EPR, Spin labels, Transition metal ions, Spin trapping.

UNIT V MASS SPECTROMETRY

Mass spectroscopy: introduction, theory and instrumentation (components and their significance). Mass spectrum, molecular-ion peak, types of fragmentation, rearrangement and nitrogen rule. Chromatography combined mass spectroscopy techniques like Combined gas chromatography - mass spectrometry (GC/MS), High performance liquid chromatography-mass spectrometry (HPLC/MS). Theory and principle of Electro-spray mass spectroscopy (ES-MS), Chemical ionization mass spectrometry (CMS), Field ionization mass spectroscopy (FTMS) and Fast atom bombardment mass spectroscopy (FAS). Applications of the above techniques for characterization of biomolecules.

Text books:

1. Campbell I D, Dwek R A, “Biological Spectroscopy”, Benjamin Cummins and Co., 1986
2. Gordon G. Hammes, “Spectrocopy for the Biological Sciences”, John Wiley & Sons, 2005

Suggested Reading:

1. Rodney F Boyer, “Biochemistry Laboratory: Modern Theory and Techniques”, 1st edition, Prentice Hall, 2005
2. Laskin Julia Lifshitz Chava, “Principles of Mass Spectrometry Applied to Biomolecules”, Wiley-Interscience.

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3.Robin Jon Hawes Clark, Ronald E Hester, “Biomolecular spectroscopy”, Wiley & Sons, 1993

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With effect from the academic year 2015-16

BT 354

MEDICAL BIOTECHNOLOGY
(ELECTIVE –I)

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. To understand the scope and importance of tools used in medical biotechnology.
2. The course aims at providing knowledge about the working principles and types of advanced materials used in medical field.
3. To gain the in-depth knowledge about the clinical applications of stems cells &banking
4. To understand the differences between the normal cells and cancer cells and various diagnostic methods used in cancer detection.
5. To learn current molecular therapies and controversial issues

Course Outcomes

1. The learning outcomes are assessed through mid semester exams, slip test and end exam.
2. At the end of the course the students should
   a. Be able to use the tools for the diagnosis of diseases
   b. Be in a position to design the prototype of medical instruments.
   c. Explain the potentiality of stem cells and purpose of banking.
   d. Explain about the uses of molecular therapies and how which led to controversy in society.

UNIT - I INTRODUCTION TO MEDICAL BIOTECHNOLOGY

Introduction, scope and importance of medical biotechnology; The genetic basis of the disease; chromosomal disorders; single gene disorders-modes of inheritance, Thalassemia, sickle cell anaemia, cystic fibrosis, Tay sachs disease, Fragile –X- syndrome; polygenetic disorders; Alzheimers disease,Type-1diabetis and mitochondrial disorders (neurological disorders).

UNIT - II MEDICAL INSTRUMENTATION AND DIAGNOSTICS

Concepts in Biomedical Engineering; principle, properties and applications of different types of biomedical devices; pacemakers, drug coated stents, knee replacement implants, dental implants, prosthetics, Molecular diagnosis by immunological approaches to detect protein biomarkers of the disease (types of ELISA), DNA approaches (Taq MAN approach, RT-PCR, epigenetic markers, detection of SNP by mass spectrometry; Applications of biosensors in medicine.

UNIT- III STEM CELL TREATEMENT

Cellular therapy, stem cells- definition, types, properties and uses of stem cells; sources of embryonic and adult stem cells; concept of tissue engineering; role of scaffolds; clinical applications of stem cells; stem cell banking and ethical issues.

UNIT- IV MEDICAL ONCOLOGY

Cancer types; Normal cells vs. cancer cells; cancer genetics; oncogenes and their proteins; tumor suppressor genes and their functions, diagnosis of cancer, Treatment of cancer; Radiation therapy, chemotherapy.

UNIT - V MOLECULAR THERAPEUTICS AND BIOETHICAL ISSUES

Types of molecular therapies; Gene therapy (*ex vivo* and *in vivo*); protein therapy by recombinant MAB, Enzymes (DNase-1, Alpha -1 antitrypsin), Lactic acid bacteria by Leptin, antisense therapy, immunotherapy by immunotoxins and recombinant vaccines.

Bioethical issues in IVF, surrogacy and cloning technologies.

Text books:

1. Judith Pongracz, Mary Keen, “Medical Biotechnology”, illustrated edition, Elseiver health sciences, 2009

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2. Bernard R Glick, Cheryl L.Patton, Terry L.Delovitch, “Medical biotechnology”, 1st edition, ASM press,2013

Suggested reading:

1. Truepenny PD, Emerys “Elemental Medical Genetics”, 14th edition, Churchill Livingstone, 2012
2. Strachnan and Reed, “Human Molecular Genetics”, 3rd edition, Garland publishing Inc, US, 2003
3. R.J.B.King, Robins, “Cancer biology”, 3rd edition, Prentice Hall, 2006
4. Subdery, “Human Molecular Genetics”, 2nd edition, Prentice Hall, Pearson education.

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BT 326

BIOPROCESS LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives

1. The course aims at providing knowledge about the methods of sterilization of cells and Thermal death kinetics of spores.
2. The students understand the types of reactors and its instrumentation.

Course Outcomes

1. Course outcomes are assessed through conducting viva, mid exams and end practical exam.
2. The students acquire the knowledge and precision about the operation and design of fermentor.

LIST OF EXPERIMENTS

1. Sterilization techniques (chemical, physical and filter methods) and thermal death kinetics.
2. Media optimization (placket- Burman design)
3. Bioreactor instrumentation and its control.
4. Microbial production of fine chemicals (Eg: citric acid and alcohol).
5. Study of growth substrate utilization.
6. Product formation kinetics in shake flask cultures.
7. Fed batch fermentation kinetics.
8. Measurement of K_La by sodium sulphite (Na_2SO_3) oxidation method.
9. Estimation of residence time distribution in tubular reactor.
10. Studies on immobilized enzyme/cells in packed bed reactor.
11. Estimation of rheological parameters in fermentation broths.

Suggested Reading:

1. Gunasekharan P, Laboratory manual in Microbiology, 2009
2. Chellapandi P, Laboratory manual in Industrial Biotechnology, Pointer publishers, 2007

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BT 327

BIOINFORMATICS LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives

1. To provide practical instructions to the students on using the specific databases and learn how to use these resources on their own

Course Outcomes

1. Graduates are able to explore bioinformatics search tools on the internet on their own

LIST OF EXPERIMENTS

1. Searching Bibliographic databases for relevant information.
2. Sequence retrieval from DNA and Protein databases.
3. BLAST services.
4. FASTA services.
5. Pair wise comparison of sequences (Local and global alignment).
6. Multiple Sequence Alignment.
7. Evolutionary studies/Phylogenetic Analysis.
8. Protein Databank retrieval and visualization.
9. Structure Exploration of Proteins.
10. Restriction Mapping.
11. Identification of Genes in Genomes.
12. NCBI ORF Finder.
13. Primer Design.

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Gandipet, Hyderabad-500 075.

With effect from the academic year 2015-16

BT 328

MASS TRANSFER OPERATION LAB

Instruction	3P Periods per week
Duration of university Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives

1. This lab course is designed to understand and study the behavior of different reactors. Eg: Batch, CSTR, PFR, analysis of various processes viz., Diffusion, Distillation VLE

Course Outcomes

1. Course outcomes are based on a continuous evaluation basis, like viva voce, calculations etc., and a final exam.
2. Students must be able to demonstrate various experimentation methods with skill and precision

LIST OF EXPERIMENTS

1. Diffusion of organic vapor in air
2. Liquid - liquid diffusivity
3. Surface evaporation
4. Wetted wall column
5. Simple distillation
6. Steam distillation
7. Packed bed distillation
8. Liquid - liquid equilibrium
9. Liquid - liquid extraction
10. Vapor liquid equilibrium
11. Batch reactor
12. Continuous stirred tank reactor
13. Saponification in a tubular reactor
14. Mixed flow reactors in series
15. Temperature dependency
16. Flow control system
17. Level control system.
18. Temperature control system

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DEPARTMENT OF BIOTECHNOLOGY
B.Tech IV – Year

SEMESTER – I

THEORY						
S. No.	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	BT 411	Downstream Processing	4	-	-	3
2	BT 412	Bioprocess Dynamics and Control	4	-	-	3
3	BT 413	Plant Biotechnology	4	-	-	3
4	BT 414	Animal Biotechnology	4	-	-	3
5	MB 216	Principles and Practice of Management	4	-	-	3
6		Elective – II				
	BT 461	Developmental Biology				
	BT 462	Cancer Biology	4	-	-	3
	BT 463	Genomics and Proteomics				
	BT 464	Pharmaceutical Biotechnology				
PRACTICALS						
7	BT 415	Downstream Processing Lab	-	-	3	2
8	BT 416	Tissue culture Lab	-	-	3	2
9	BT 417	Project Seminar	-	-	3	1
Total			**24**	**0**	**9**	**23**

L: Lecture, T: Tutorial, P: Practical

SEMESTER – II

THEORY						
S.no.	**Code**	**Subject**	**L**	**T**	**P**	**Credits**
1	BT 421	Computer Applications in Bioprocess Industries	4	-	-	3
2	BT 422	Bioprocess Economics and Plant Design	4	-	-	3
3		Elective – III				
	BT 471	Molecular Modeling and Drug Design				
	BT 472	Immunodiagnostics	4	-	-	3
	BT 473	Tissue Engineering				
4		Elective-IV				
	BT 481	Bioprocess Validations and Current good manufacturing Practices				
	BT 482	Food Biotechnology	4	-	-	3
	BT 483	Nanobiotechnology				
	ME 464	Entrepreneurship				
5	BT 423	Seminar	3	-	-	1
6	BT 901	Project	6	-	-	9
Total			**25**	**-**	**-**	**22**

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Gandipet, Hyderabad-500 075.

L: Lecture, T: Tutorial, P: Practical

DOWNSTREAM PROCESSING

BT 411

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Student is made to understand the role and, importance of downstream processing.
2. Students are taught the various techniques of cell disruption and the principles of solid liquid separation processes, filtration and centrifugation
3. Students are made to understand the principles of membrane based separations and their applications.
4. Students are enlightened about chromatographic separations, types and their importance in product purification.
5. Students are made to study the principle of crystallization, drying and lyophilisation.
6. The students are made to understand the choice and sequence of bioseparations by case studies.

Course Outcomes:

1. Student will be able to know the key aspects of Downstream Processing from both a technical and economic perspective.
2. Be able to learn the various techniques of cell disruption and unit operations for separation of insolubles
3. Student will be able to design mineral water plant
4. Be able to design and select chromatographic separation process for different bioproducts and scale up
5. Be able to learn various techniques of product polishing and formulation.
6. Be able to analyze and summarize scientific results from real examples and use them to choose the best operational conditions for a particular unit operation.

UNIT- I: ROLE OF DOWNSTREAM PROCESSING IN BIOTECHNOLOGY

Role and Importance of Downstream Processing in Biotechnological Processes; Characterization of Biomolecules and fermentation broths; Physico-Chemical basis of Bio-separations; Characteristics of Bio-separations; Process design criteria for bioproducts; Downstream process economics.

UNIT- II: PRIMARY SEPARATION ANDRECOVERY PROCESSES

Cell Disruption methods for intracellular products- Mechanical, Chemical and Enzymatic Methods; Removal of Insolubles, Biomass separation techniques; Flocculation; Sedimentation; Centrifugation; Filtration: Theory, Equipment-Depth filters, Plate and frame filters, Pressure leaf filters, Continuous rotary drum filters, filter media and filter aids, Problems on specific resistance of the cake, time taken for filtration and, compressibility of cake.

UNIT- III: PRODUCT ENRICHMENT OPERATIONS

Membrane-based separations-Types of membranes, solution diffusion model, capillary flow model; Types of flow-Cross flow, Tangential flow and mixed flow; Types of membrane based separations: Micro-filtration, Ultra-filtration, Dialysis, Electro dialysis, Reverse Osmosis; Theory, design and configuration of membrane separation equipment, Applications; Aqueous Two-phase extraction of proteins; Precipitation of proteins with salts and organic solvents; Adsorption processes.

UNIT- IV: PRODUCT PURIFICATION AND POLISHING

Chromatographic separations- Principles, Classification, General description of column chromatography; IMAC, Bio-affinity Chromatography; Design and selection of chromatographic matrices; Design of large-scale chromatographic separation processes

UNIT- V: NEW AND EMERGING TECHNOLOGIES:

Pervaporation, super critical fluid extraction; Electrophoretic Separations; Final Product Polishing- Crystallization: nucleation, crystal growth, Industrial crystallizers, Drying: drying terminologies, drying curve, Industrial dryers Lyophilization: principles and applications; Formulation Strategies; Case studies (Citric acid / Penicillin and Low volume high value product like recombinant proteins).

Text Books:

1. Bio-separations: Principles And Techniques (2008)Prentice-hall Of India Pvt Ltd
2. Separation processes in Biotechnology by Sivasankar B,J M Asenjo, Marcel-Dekker, (1993).
3. Bio-separations- Downstream Processing for Biotechnology- Paul A Belter, E L Cussler, Wei-shouHu, Wiley Inter-science Publications, 1988.

4. Principles and Techniques of Practical Biochemistry by Keith Wilson, John Walker, John M. Walker 5th edition Cambridge University Press, (2000).

Suggested Reading:

1. Product Recovery in Bioprocess Technology- BIOTOL series, Butterworth Heinmann, (1992).
2. Separations for Biotechnology- M S Verall, M J Hudson, Ellis Harwood Ltd. (1990).
3. Bio-separations Science and technology Roger Todd Rudge Petreides Process Biotechnology Fundamentals by SN Mukhopadhya, Wankat PC. Rate controlled separations, Elsevier, (1990).
4. Bioseparations by Belter PA and Cussler E., Wiley (1985).
5. Product Recovery in Bioprocess Technology, BIOTOL.' Series, VCH, (1990).
6. Separation processes in Biotechnology Asenjo J.M., (1993), Marcel Dekkere Inc.
7. Downstream Process Technology by Nooralabettu Krishna Prasad PHI publications.
8. Bioseparations by Siva Shankar PHI publications.

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BT 412 **BIOPROCESS DYNAMICS AND CONTROL**

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sectionals	25 Marks
Credits	3

Course Objectives:

1. The course aims at providing dynamics of system process, flow, level and temperature etc.
2. The course aims at incorporating with concepts of response of first order system for non interacting and interacting systems.
3. The course aims at providing knowledge the design of control system for open and close loop control.
4. The course aims at inculcating concepts of the control of pH of process and biochemical reactions.

Course Outcomes:

1. Students will use the knowledge of dynamics in the process control of level, temperature, flow etc in biotechnology industries.
2. Students will apply this expertise of first order system of non interacting and interacting system in biotech industries.
3. Students will incorporate the knowledge of open and close loop system for control of Bioreactors in biotechnology industries.
4. Students will adopt the skill set of fine tuning the process variable in biotech industries.
5. Students will exhibit the knowledge of control wall sizing in the design of control valve system in bioprocess units.
6. Students will apply the knowledge of controlling of pH of bioreactor in bioprocess industry for achieving good product conversions.

UNIT I: PROCESS DYNAMICS

Process variables, Dynamics of simple processes – Flow, level, Temperature, Pressure and Concentration; Transfer function – Properties, response of simple processes for Step, Impulse and Sinusoidal Forcing functions.
Concept of Time Constant, Linearization, Response of first order systems in series - Non-interacting and Interacting systems.

UNIT II: CONTROL ACTIONS AND CONTROLLERS

Controller and Control system – measuring and final control elements, Open and Closed loop control, Negative and Positive feedback control, Servo and Regulatory problems.
Ideal transfer functions –Control valve, Controllers, Proportional, Integral and derivative actions – P+I. P+D and P+I+D controls.
Block diagram- Development of block diagram, Description of system, reactor transfer function, effect of time delay Over all Transfer function for single loop system, overall transfer function for change in set point.

UNIT III: OPTIMUM CONTROLLER SETTINGS

Controller Tuning – Evaluation criteria with l/4th decay ratio, IAE. ISE, ITAE.
Tuning - process reaction curve method, Continuous cycling method, damped oscillation method. control of processes with a time delay.

UNIT IV: FINAL CONTROL ELEMENT

I/P Converter– pneumatic, electric and hydraulic actuators. Control valves – Construction, valve sizing, valve characteristics, valve positioner. Control of Globe, Butterfly and Diaphragm valves.

UNIT V: ADVANCED CONTROL STRATEGIES

Feed forward control, Ratio control, Cascade control.
Dynamics and Control of pH process and Biochemical reactor.

Text Books:

1. Sarkar PK, “Process Dynamics and Control”, PHI, 2013.
2. Seborg, Edgar, Mellichamp, Doyle, “Process Dynamics and Control”, 3rd edition John Weily and Sons, 2010
3. Harriott P, “Process control”, Tata McGraw-Hill publishing Co., New Delhi, Reprint 1991.

Suggested Reading:

1. Principles of Process Control by Patranabis D, 2nd ed., Tata McGraw-Hill publishing Co., New Delhi, Reprint 1997.
2. Automatic process control, Eckman D.P., Wiley Eastern Ltd., New Delhi, (1993).
3. Process Systems Analysis and Control, Donald R.Coughanowr, 2nd ed., McGraw Hill Inc., 1991.

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BT 413 **PLANT BIOTECHNOLOGY**

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. The students should be able to understand explicitly the basic concepts of Plant Tissue culture.
2. To understand the developmental pathways of callus induction and plant regeneration.
3. To understand the techniques for production of secondary metabolites in *in vitro* using plant cell and tissue culture
4. To understand the methods of gene transfer in plants for production of transgenics.
5. To understand the various strategies and sources of trangenes for crop improvement.

Course Outcomes:

1. Provides opportunity to understand the theoretical concepts behind establishment of *in vitro* techniques.
2. Enables student to understand the importance and applications of various in vitro techniques
3. The course enables to exploit plant tissues for production of biologics at commercial scale.
4. Helps to understand the transgenes utilized in the production of trangencis resistant to biotic, abiotic stress resistant and improved quality etc.
5. The course enables the students to understand the appropriate vectors and gene transfer methodology for production of transgenics
6. Course enables the student to overall get an insight in to the basic concept and advances in plant biotechnology field

UNIT I: INTRODUCTION TO PLANT TISSUE CULTURE

Introduction to cell and tissue culture: History, Totipotency, Cell Theory, Tissue culture media (composition, preparation); Initiation and maintenance of callus and cell suspension culture, Organogenesis and Embryogenesis and their applications.

UNIT II TISSUE CULTURE IN CROP IMPROVEMENT

Micropropagation for virus-free plants, Somaclonal variation, Haploids in plant breeding, Germplasm conservation (Cryopreservation). Protoplast isolation, culture and fusion: Somatic hybridization.

UNIT III MOLECULAR FARMING & INDUSTRIAL PRODUCTS

Application of Plant biotechnology for the production of quality oil, Industrial enzymes, Antigens, Edible vaccines. Production of secondary metabolites from plant cell cultures using Cell suspension cultures, Immobilized cell systems Precursor feeding (elicitation) and hairy roots. Bioreactor systems and models for mass cultivation of plant cells.

UNIT-IV PLANT GENETIC ENGINEERING –I TECHNIQUES

Agrobacterium mediated gene transfer and cloning; Types of plant vectors and their use in genetic manipulation; and their application. Direct gene transfer methods; chemical methods, electroporation, microinjection, particle bombardment. Transient gene expression.

UNIT-V PLANT GENETIC ENGINEERING –II PRODUCTIVITY PERFORMANCE

Transgenics in crop improvement: Biotic Stress resistance: Herbicide,Insect, Disease, virus etc., Abiotic stress tolerance: Drought, Temperature, Salt. Transgenics for improved nutrional quality, storage, longer shelf life.

Text Books:

1. Bhojwani SS and Razdan, Plant Tissue Culture Theory and Practice, Elsevier Science, 2004
2. Chawla HS, Introduction to Plant Biotechnology, 4th edition, Oxford and IBH publishers, (2002

Suggested Reading:

1. Surabh Bhatia, Kiran Sharma, Randhir Dahiya and, Tanmoy Bera, Modern applications of Plant Biotechnology in Pharmaceutical Sciences, Elsevier publication, Academic press, 2015

BT 414 **ANIMAL BIOTECHNOLOGY**

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. The students are expected to understand the technical procedure involved to culture animal cells.
2. Students will learn various steps involved in the establishment of primary culture and their maintenance
3. Students will know about cell viability and cytotoxicity
4. Students are expected to know about stem cells and their applications
5. Students will describe embryo transfer, cloning and gene transfer methods for generation of transgenic animals and its applications
6. To know various application of animal cell culture in different fields

Course Outcomes:

1. The students will learn the animal cell culture requirements and procedure
2. Students are able to learn how to establish and maintain animal cell culture
3. Students will describe the procedure used to know the cell viability and cytotoxicity
4. Students are able to learn about stem cells and their applications
5. Students will know various methods for embryo transfer, cloning and generation of transgenic animals and their applications
6. Students will come to know various applications of animal biotechnology.

UNIT- I ANIMAL CELL TISSUE CULTURE

History and scope of animal cell tissue culture, advantages and disadvantages of tissue culture; laboratory facilities for animal tissue culture; aseptic techniques; the substrate on which cells grow; treatment of substrate surfaces; Feeder layers on substrates; Culture media for cells and tissues; Culture procedures; Tissue culture Slide, Flask and test tube cultures, Organ culture, Whole embryo culture.

UNIT- II PRIMARY CULTURE AND CELL LINES

Isolation of tissue, Disaggregation (Enzymatic and Mechanical) of tissue and Primary culture. Culture cells and evolution of cell lines. Maintenance of cultures- Cell lines, Cell separation, Cell synchronization; Cloning of cell lines. Cell transformation, Bioreactors for animal cell culture; Scaling-up of animal cell culture, large scale cultures in Biotechnology.

UNIT- III STEM CELLS, CELL VIABILITY AND TOXICITY

Stem cells, types of stem cells, embryonic stem cells and their applications; measurement of cell viability and cytotoxicity, Measurement of cell death; Senescence, Apoptosis, necrosis.

UNIT- IV EMBRYO TRANSFER, CLONING AND TRANSGENIC ANIMALS

Artificial insemination, *in vitro* fertilization and embryo transfer, nuclear transplantation; cloning of animals - Reproductive cloning, therapeutic cloning; Gene transfer or Transfection methods; targeted gene transfer; Transgenic animals- Mice, Sheep, Pig, Rabbit, Goat, Cow and fish.

UNIT - V APPLICATIONS OF ANIMAL BIOTECHNOLOGY

Application of animal cell culture; Mammalian cell products; viral vaccines produced from animal cell cultures. Three dimensional culture and tissue engineering, Somatic cell genetics.

Text Books:

1. Ian Freshney, "Culture of Animal Cells: A manual of basic technique and specialized applications" seventh edition, John Wiley and Sons, 2015
2. John Masters, " Animal Cell culture: A practical approach" OUP Oxford, 2000

Suggested Reading:

1. Gupta PK, "Biotechnology and Genomics" Rastogi Publications, 1st edition, 6th reprint, 2013
2. A.K. Srivastava, R.K. Singh, M.P. Yadav, "Animal Biotechnology" Oxford & IBH Publishing Co. Pvt. Ltd., 2005.
3. Ranga MM, "Animal Biotechnology", 3 reprint, Agrobios, India, 2010.

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MB 216 **PRINCIPLES AND PRACTICE OF MANAGEMENT**

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives: This course helps the students to understand:
1. Basic principles, concepts and functions of management in industry.
2. Key competencies and skills required for problem-solving and decision-making in managerial situations.
3. The different organizational designs and structures.
4. Materials, operations and marketing management.
5. The role and functions performed by HR managers.

Course Outcomes: At the end of the course, student will be able to apply the
1. Managerial skills for managing a Unit / Branch.
2. The different operations / functional areas to process industry as an organization.
3. Assess the situations in an organization by critical examination and provide better decisions.
4. Dynamics of business and sense to formulate the direction of change.
5. Purchasing objects and principles to material management
6. Concept of marketing management to a global scenario.

UNIT - I
Management definition, Administration Vs Management Principles and Functions of Management, levels of management - System and Contingency approach to management - steps in Planning - Decision making process - organization: Definition, Line, staff, functional and matrix type organization, span of control (Graicuna`s Formulae), Centralization Vs Decentralization.
UNIT - II
Communication - Process, Grapevine, Networks and Barriers of communication - Managerial grid, Theory of X, Y and Z; Job Enrichment Vs Job enlargement - Control process - Introduction to Personnel Management: Functions, staffing process, need for HRD, Training & Development (TWI Programme)
UNIT - III Measurement of Morale - Job Design -Industrial Relations: Human relation Vs Industrial relations, Trade Unionism, Industrial Unrest, Wage and Incentive concepts - Role of ILO - MIS in industry - Management of public enterprises.
UNIT - IV Introduction to Financial Management : Sources of Finance, Capital & its Structure (CFS & FFS) Financial statements, cost sheet - Introduction to Purchase & Material management Purchasing objects and principles,types of purchasing, Vendor selection, rating, evaluation & Development - Inventory control, ABC analysis, stores organization and pricing of issues - concept of Warehousing.
UNIT - V Production and marketing Management: Types of Production, Quality control (Tools used), PPC, Maintenance management - Marketing management ; Definition and concept of marketing, functions of marketing, market research, Types of markets, Sales Forecasting, Promotion mix - Pricing - Product Identification - A brief note on International Marketing.

Text Books:
1. Harold Koontz and Heinz Weihrich, “Essentials of Management-An International Perspective”, 9th Ed., Tata McGraw-Hill Edu Pvt. Ltd, 2012.
2. Khan & Jain, “Financial Management”, 7th Ed., Tata McGraw-Hill Edu Pvt. Ltd, 2014.

Suggested Readings:
1. David A. DeCenzo, David A, Robbins, Stephen P, “Fundamentals of Human Resource Management”, 11th Ed, John Wiley and Sons Inc, 2015.
2. Elwood S Buffa, Rakesh K. Sarin, “Modern Production/Operations Management”, 8th Ed, Wiley India Pvt. Ltd., 2007.
3. Jennifer George and Gareth Jones “Understanding and Managing Organizational Behavior”, Published by Pearson Education Inc., 2013.
4. I. M. Pandey, “Financial Management”, 10th Ed. Vikas Publishing House, 2013.
5. Gary Dessler, “Human Resources Management”, 11th Eastern Economy Ed., 2011.

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Elective-II

DEVELOPMENTAL BIOLOGY

BT 461

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Students are made to understand the basic concepts of developmental biology.
2. Students are taught the structure of gametes, and how they are generated.
3. Students are taught the influence of genes on body axis formation in Drosophila and Mammals.
4. Students are enlightened about the later embryonic developments i.e Organogenesis.
5. Students are made aware of sex determination in Drosophila and Mammals.
6. The concept of Ramifications of developmental biology is introduced to the students.

Course Outcomes:

1. Students understand the basic concepts of Developmental Biology.
2. Students understand the Anatomy of gametes and Biochemistry in its recognition.
3. Analyze the role of genes in the body axis formation of Drosophila and Mammals.
4. Understand the importance and differentiation of germinal layers in to different organs.
5. Compare the role of genes in the sex determination of Drosophila and Mammals.
6. Be able to explain the genetic anomalies leads to diseases.

UNIT-I INTRODUCTION TO DEVELOPMENTAL BIOLOGY

The Anatomical approach to developmental biology: Mathematical modeling for development: The frog life cycle: Evidence for Genomic equivalence (Potency of cells), Specification (Autonomous, Conditional and Morphogenic Gradients: Commitment, Induction (Paracrine Factors) and Competence.

UNIT-II EARLY EMBRYONIC DEVELOPMENT (Gametogenesis and Fertilization)

Structure of Gametes, Spermatogenesis and oogenesis in Mammals, Recognition of egg and sperm: Mammalian Fertilization (Fusion of Gametes and prevention of Polyspermy), External Fertilization in Sea urchin.

UNIT-III LATER EMBRYONIC DEVELOPMENT (Morphogenesis)

Cleavage and gastrulation in Drosophila and Mammals: Early Drosophila developments: Genes that pattern the Drosophila body axis: The generation of dorsal, ventral polarity: The origin of anterior, Posterior polarity: Segmentation genes (Gap Genes, pair rule genes and segment polarity genes), The homeotic selector genes: The anterior and posterior axis formation in Mammals.

UNIT-IV ORGANOGENESIS AND SEX DETERMINATION

The emergence of Ectoderm-The Central nervous system and epidermis development: the function of mesoderm – osteogenesis and myogenesis: Lateral plate mesoderm and endoderm – the development of heart, blood cells, digestive and respiratory systems, Sex determination in Drosophila and Mammals: regeneration of liver in Mammals.

UNIT-V RAMIFICATIONS OF DEVELOPMENTAL BIOLOGY

Medical Implications of Developmental biology, genetic errors of human development, infertility, *in vitro* fertilization (IVF) and teratogenesis (disruptors of teratogenesis): Developmental biology and future of medicine.

Text Books:

1. Jam PC, “Elements of Developmental Biology”, Vishal Publications, New Delhi, 1998.
2. Manju Yadav, “Molecular Developmental Biology” Discovery Publishing, September, 2008.
3. Scott F Gilbert, Michael JF Barresi. “Developmental Biology”, 10th edition, Sinauer Associates, Inc, 2013.

Suggested Reading:

1. Raven, P, “Developmental Physiology”, 1st edition, Pergamon Press, Newyork, 1959.
2. Snustad P, Simmons and Jenkins, “Principles of Genetics”, 2nd Edition, John Wiley Publications, 1999.
3. P.C.Jain , “Elements of Developmental Biology” International Publications, 2013.

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Elective-II
CANCER BIOLOGY

BT462

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:
1. Student is made to understand the role of cell cycle and diet in cancer.
2. Students are taught the Molecular aspects of cell cycle control.
3. Importance of physical and chemical carcinogens taught by showing effects of mutagens on cell cycle.
4. Students are enlightened about discovery of proto-oncogenes and their activation.
5. Students are made to understand the diagnosis and treatment of cancer.
6. The concept of cancer pharmacology is introduced to the students.

Course Outcomes:
1. Apply to real life situations, the concept of diet and cell cycle.
2. Incorporate the fundamentals of cell biology and Molecular biology to under stand how they are responsible for cancer.
3. Be able to explain the types of carcinogens and the effect of mutagens on cell cycle.
4. Be able to describe the structure of retrovirus and how they led to discover the oncogens.
5. Be aware of no of stages of cancer, detection of cancer and treatment of cancer.
6. Be in a position to explain the ADME properties of anticancer drugs.

UNIT- I: FUNDAMENTALS OF CANCER BIOLOGY
Definition and hall marks of cancer, Cell cycle control, regulation of the cell cycle by cyclins, cyclin-dependent kinases, cdk inhibitors, Mutations that cause changes in signal molecules, Effects on receptor, Signal switches, Tumor suppressor genes, Different forms of cancer(Case studies for carcinoma ex: breast cancer and stomach cancer), Diet and cancer.

UNIT- II: PRINCIPLE S OF CARCINOGENESIS
Natural History of Carcinogenesis, Types of Carcinogenesis, Chemical Carcinogenesis, Metabolism of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, Ionizing radiation and UV radiation mechanism of Carcinogenesis.

UNIT- III: PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER
Oncogenes, Identification of Oncogenes, Retroviruses and Oncogenes, Detection of Oncogenes, Growth factor and Growth factor receptors that are Oncogenes, Activation of protooncogens to oncogens. Growth factors related to transformations.

UNIT- IV: CANCER METASTASIS AND TREATEMENT
What is Metastasis, Classic theory of tumor Metastasis, Clinical significance of invasion, Heterogeneity of metastatic phenotype, Three-step theory of invasion (Basement Membrane disruption, role of Proteinases in tumor invasion and tumor cell locomotion).Diagnosis of cancers, Advances in Cancer detection(Biomarkers technology and nanotechnology), Different forms of therapy- Chemotherapy, Radiation therapy and immunotherapy.

UNIT- V:PRINCIPLES OF CANCER PHARMACOLOGY:
Pharmacokinetics and pharmacodynamics of antineoplastic drugs. Metabolism of anticancer drugs, inter individual differences in response to anticancer drugs, mechanisms of anticancer drug resistance. Molecular targets for drug development, mechanism of gene silencing (antisense, ribozymes, RNAi) and chemoprevention studies.

Text Books:

1. Franks LM and N.M.Teich , "Introduction to Cellular and Molecular Biology of Cancer", 2nd edition, Oxford Medical Publications, 1991.
2. Raymond W. Ruddon "Cancer Biology", 3rd edition, Oxford University Press, USA 1995.
3. King, Roger J B, Robins, Mike W, "Cancer Biology", 3rd edition, Prentice Hall, USA.2003.

Suggested Reading:

1. Fiona Macdonald, Christopher Ford, Alan Casson, "Molecular Biology of Cancer", 2nd Edition, Taylor & Francis, 2004.
2. Robert A. Weinberg, "The Biology of Cancer", 5th edition, Garland Science.2006.

3. Robin Hesketh, “Introduction to Cancer Biology” Cambridge University Publishers, Jan, 2013. Y. Rajani

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Elective-II
GENOMICS AND PROTEOMICS

BT 463

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Student is made to understand the fundamentals of genome
2. Students are taught about the transposable elements and their importance.
3. Students are made to understand DNA sequencing and various DNA sequencing methods.
4. Students are enlightened about construction and screening of cDNA libraries.
5. Students are made to understand the basics of proteomics, tools for proteomics and protein modifications
6. The concepts of metabolomics and pharamacogenomics are introduced to the students.

Course Outcomes:

1. Be able to know about genomes, types of genomes and the advanced techniques used for analysing genome.
2. Be able to explain the occurrence of genome variations due to the implication of transposable elements in the genome.
3. Be able to start self-employment from the knowledge obtained from various DNA sequencing methods.
4. Be able to construct cDNA libraries and explain the importance of cDNA libraries in the identification of functional genes in the genome
5. Be able to modify proteins for better use
6. Be able to design personalized medicines and explain their uptake, action and metabolism.

UNIT- I: STRUCTURAL GENOMICS
Overview of genome-Types, analysis of genomes; comparative homologies; evolutionary changes; Genetic analysis: Linkage mapping and analysis, High resolution chromosome maps, Physical mapping, YAC, BAC, Hybrid mapping strategies, microarrays, Sequence specific tags(SST),Sequence tagged sites(STS),FISH, RFLP and RAPD

UNIT- II: TRANSPOSABLE ELEMENTS
Transposable elements: General features of transposable element, Bacterial transposable elements: IS elements, composite transposons, Tn3 elements; Eukaryotic Transposable elements: AC/DC elements of corn, Ty elements of Yeast, P elements in drosophila, Human retro transposons; Transposition-mechanism; Implication of Transposable elements in the genome, Genome variation.

UNIT- III: FUNCTIONAL GENOMICS
Construction and screening of cDNA libraries; cDNA microarrays, Gene disruptions, Serial analysis of gene expression (SAGE), SAGE Adaptation for Downsized Extracts (SADE); Applications of DNA arrays

UNIT- IV: PROTEOMICS AND TOOLS USED FOR PROTEOMICS
Protein structure, Protein databases, data mining, Sequence alignment, Algorithms in proteomics, Applications of proteomics: proteome mining, protein expression profiling, protein-protein interactions, protein modifications; Protein digestion techniques; Mass spectrometry: MALDI-TOF, Mass analyzers, peptide Mass Fingerprinting, Protein arrays.

UNIT- V: METABOLOMICS AND PHARMACOGENOMICS
Metabolomis-Basics; Pharmacogenomics-Basics, Diseased genes and their identification; Drug uptake an metabolism; Drug targets; Designer medicine; Genomics perspective of bioterrorism; Ethical and legal implications.

Text Books:

1. Sahai S, “Genomics and Proteomics-Functional and Computational Aspects”, Plenum Publications, 1999.
2. Rastogi SC, Mendiratta N, Rastogi P, “Bioinformatics-Methods and Application, Genomics, Proteomics, and drug discovery”, 2nd edition, Prentice Hall of India, New Delhi, 2003.
3. Lieber DC, “Introduction to Proteomics, Tools for the new biology”, Humana Press, UK, 2000
4. Hunt SP, Levessy FJ, “Functional genomics” Oxford University Press, UK, 2000

Suggested Reading:

1. Proeomics in practice,A laboratorymanualof proteome analysis by JohnWiley-YCH,UK1999
2. ‘Genomics’by cantor, CR, Joohn Wiley, UK 1999

Elective-II

BT464 PHARMACEUTICAL BIOTECHNOLOGY

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

Students are made to understand the following concepts during there course of time:

1. Origin, Scope and importance of pharmaceutical biotechnology.
2. ADME of Drugs. Pharmacokinetics and Pharmacodynamics of drugs.
3. Materials and Formulations of pharmaceuticals.
4. Collection, processing and storage of whole human blood.
5. Ideal requirements of Poly vinyl Pyrollidine and Dextran 40.
6. Steroidal and Nonsteroidal drugs, Antacids, Alkaloids and Biological extracts.

Course Outcomes:

After completion of the course students gain knowledge in the following concepts:

1. Types of microorganisms for production of secondary metabolites used as drugs.
2. Types of drug delivery systems like oral, parenteral, transdermal etc
3. Types of excepients. Labelling, preservation and release of drugs in to the market.
4. Fractionation of human RBC, dried human plasma, HPPF, from whole human blood.
5. Control of blood transfusion products to avoid infectious diseases (HepatitisB, HIV)
6. Therapeutic activity and dosage of drugs to treat the diseases.

UNIT- I: FUNDAMENTALS OF BIOPHARMACEUTICALS

Pharmaceutical Biotechnology: An introduction, Origin, definition, Scope and Importance. Human protein replacements, Therapeutic agents for human diseases: Tissue Plasminogen activator, Interferon, Recombinant vaccines. Methods of Biotechnology and their applications of Gene transfer, Biotechnology production of Secondary Plant Metabolites.

UNIT- II: DRUG METABOLISM AND PHARMACOKINETICS

ADME properties- Mechanism and Physiochemical properties of Drug Absorption, Distribution, metabolism (Biotransformation) and Excretion. Pharmacokinetics and Pharmacodynamic Basic considerations. Drug interactions, Surgical supplies, Oral, Parenteral, Transdermal, Ophthalmic, Intravaginal and Intrauterine Drug Delivery systems.

UNIT- III: THE DRUG MANUFACTURING PRACTICES

Types of Tablets and capsules. Materials and Formulations for Manufacture of Tablets, Capsules. Excepients and its ideal properties, Parenteral solutions, Oral liquids, Emulsions, Ointments, Suppositories, Aerosols.

UNIT-IV: BLOOD AND PLASMA SUBSTITUTES

Blood grouping, Rh Compatibility, Collection, processing and storage of whole human blood, concentrated human RBC, dried human plasma, Human plasma protein fraction, Dried human serum, Human fibrinogen, Human thrombin, Human normal Immunoglobulin, Plasma substitutes- Ideal requirements, PVP, Dextran 40, control ofBlood products, Transfusion products

UNIT-V: PHARMACEUTICAL PRODUCTS

Fundamentals of Therapeutic categories such as Analgesics, Antipyretic, Anti-inflammatory drugs, Anesthetics, Antacids, Alkaloids, Glycosides, Anti-neoclassic drugs, Biologicals (Immunizing agents and allergenic extracts), Chemoterapy of Tuberculosis and Urinary tract infections.

Text books:

1. Brahmankar DM and Sunil B Jaiswal, “Biopharmaceutics and Pharmacokinetics- A Treatise”, Vallabh Publications, Prakashan, 2006,
2. Purohit SS, Kakrani HN and Saluja AK., “Pharmaceutical Biotechnology”, Student Edition Jodhpur, 2003
3. Cooper and Guns, “Pharmaceutics”, CBS publishers, 1989

Suggested Reading:

1. David B Troy and Paul Beringer, “Remington’s:The Science and practice of Pharmacy”, Vol 1 and 2, Lippincott Williams & Wilkins Publications, 2006
2. Tripathi, K.D. "Essentials of Medical pharmacology", Jaypee Brothers Medical Publishers 6th Edition , John Wiley, New Delhi,2000.

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BT 415 **DOWNSTREAM PROCESSING LAB**

Instruction	3L Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. To provide an opportunity to experimentally verify the theoretical concepts studied.
2. To give extensive exposure to various unit operations of downstream processing.
3. Students are explained how to design protocol for separation of bioproduct based on characteristics

Course Outcomes:

1. Be able to understand the fundamentals of downstream processing for biochemical product recovery.
2. Be able to calculate operating parameters for a given downstream processing unit operation.
3. Be able to develop their skills in the purification of bioproducts from fermentation broths.
4. Be able to design chromatographic separation process for a given compound.
5. Be able to arrange unit operations into an appropriate sequence for the purification of a given type of biological product.
6. Be able to analyze and summarize scientific results

LIST OF EXPERIMENTS:

1. Cell Disruption of microorganism using sonicator.
2. Cell Disruption of microorganisms using lysozyme.
3. Homogenization of microbes / plant material using pestle and mortar.
4. Recovery of bulk proteins by Aqueous Two Phase Extraction.
5. Separation of solids from liquid by Sedimentation
6. Separation of micro organisms from fermentation broth by Microfiltration.
7. Separation of solute particles by Dialysis.
8. Separation of alpha amylase by Ammonium Sulphate Precipitation.
9. Isolation and quantification of casein from milk by Isoelectric Precipitation.
10. Separation of biomolecules by Gel Exclusion Chromatography.
11. Purification of lysozyme from chicken egg white extract by Ion Exchange Chromatography.
12. Purification of proteins by Affinity Chromatography.
13. Determination of purity and molecular weight of proteins by SDS-PAGE
14. Extraction of Enzymes.
15. Extraction of Ethanol.

Text books:

1. David Plummer, "An introduction to Practical Biochemistry" 3rd edition, John Wiley & Sons
2. Principles and Techniques of Biochemistry and Molecular Biology by Keith John Walker John Walker,Cambridge University Press; 6 edition (2005).
3. Laboratory Manual in Biochemistry By J. Jayaraman, Kunthala Jayaramanj, New Age International

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BT416 TISSUE CULTURE LAB

Instruction	3L Periods per week
Duration of University Examination	3 Hours
University Examination	50 Marks
Sessionals	25 Marks
Credits	2

Course Objectives:

1. The students should be able to understand explicitly the concepts of Plant Tissue culture and Animal tissue culture.
2. Develop their skills in plant tissues culture techniques.
3. Get extensive exposure to various techniques of plant cell and tissue culture.
4. To develop a protocol for genetic transformation using *Agrobacterium* strains.
5. The students will handle animal cell culture.

Course Outcomes:

1. Provides an opportunity to experimentally verify the theoretical concepts studied.
2. The course helps in gaining hands on training in developing protocols for various in vitro techniques: callus cultures, cell and suspension cultures etc.
3. The course experiences the students to establish *in vitro* techniques of micropropagation of crop/horticulture and medicinal plants.
4. The course enables student to establish a system of genetic transformation using Agrobacterium strains.
5. The handling experience of Protoplast isolation and culture helps them to produce somatic hybrids.
6. The course enables student to handle animal cell culture.

LIST OF EXPERIMENTS

1. Preparation of Plant tissue Culture Media
   i. Preparation of MS stock solutions
   ii. Preparation of MS callus induction media
2. Surface sterilization
3. Callus induction: Embryo Culture.
4. Meristem tip culture
5. Micro propagation of horticultural/medicinally important plants
6. Cell suspension cultures initiation and establishment.
7. Organogenesis and Embryogenesis.
8. Production of synthetic seeds.
9. Protoplast isolation (demo)
10. *Agrobacterium* mediated gene transfer: induction of Hairy roots
11. Preparation of Animal cell culture media
12. Preparation of cheek epithelium cells
13. Preparation of Primary cell lines
14. Cell counting and viability
15. Staining of animal cells
16. Preservation of cells

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BT 417 **PROJECT SEMINAR**

Instruction	3L Periods per week
Sessionals	25 Marks
Credits	1

The objective of the project seminar is to actively involve the student in the initial work required to undertake the final year project. Dealing with a real time problem should be the focus of the under graduate project.

It may comprise of

- Problem definition and specifications.
- A broad understanding of the available techniques to solve a problem of interest.
- Presentation (Oral & written) of the project.

The department should appoint a project coordinator who will coordinate the following.

- Grouping of students as project batch(a maximum of 3 in group)
- Allotment of projects and project guides
- Project monitoring at regular intervals.

Each project group/batch is required to

1. Submit a one page synopsis of the seminar to be delivered for display on notice board.
2. Give a 30-40 minute's presentation followed by 10 minutes discussion.
3. Submit a technical write up on the talk delivered.

Three (3) teachers will be associated with the evaluation of the project seminar for the award of the sessional marks which should be on the basis of performance on all the three items stated above.

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BT 421 **COMPUTER APPLICATIONS IN BIOPROCESS**

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. This course aims at providing knowledge on basic concepts in software development processes, Algorithm design and Process Models.
2. The course is designed to give an understanding on obtaining. solutions of differential equations by Euler`s, Modified Euler`s, Runge-Kutta methods
3. This course aims at providing an insight into the solution of set of simultaneous equations by Gauss elimination, Gauss Jordan and Gauss Seidel methods.
4. The aim of the course is also to give the students an understanding of obtaining solutions of numerical methods.

Course Outcomes:

At the end of the course student should

1. Be able to distinguish between different process models
2. Be able to formulate process models leading to set of ordinary differential equations and solution procedures numerical methods.
3. Be able to formulate process models leading to set of linear simultaneous equations and solution procedures.
4. Be able to formulate process models leading to transcendental and polynomial equations and solution procedures.
5. Understand the steps involved in optimization that are a prerequisite for the development of process flow sheets.
6. Be able to optimize biochemical process.

The Programs are to be written in "C" only

UNIT-I Computers and Software

Computers and Software: Computing environments, The software development processes, Algorithm design, Program composition, Quality Control, Documentation, Storage and •Maintenance, Software strategy. Process Models: Uses, Distributed & Lumped parameter models, Linear and Nonlinear models, Steady state and Dynamic models, Continuous and Discrete models, Empirical models. Formulation of Process Models: Momentum, mass and energy balances, constitutive rate equations, transport rate equations, biochemical kinetic rate expressions, thermodynamic relations. Review on "C" Language Fundamentals.

UNIT-II Function Approximation

Function Approximations by Linear and nonlinear least square analysis, Formulation Process Models leading to set of ordinary differential equations and solution procedures by Eulers, Modified Eulers and Runge Kutta methods.

UNIT-III Formulation of Process Models

Formulation of Process Models leading to set of linear simultaneous equations and solution procedures by Method of determinants, Gauss Elimination, Gauss Jordan, Jacobi and Gauss-Seidel methods.

UNIT-IV Process Models Leading to Transcendental and Polynomial Equations

Formulation of Process Models leading to transcendental and polynomial equations and solution procedures by Bi-section, Reguli-falsi, Newton Raphson, Richmond, Muller's and Bairstow methods

UNIT-V

Process Optimization **:**Nature and organization, basic concepts and elements of Optimization, single variable functions, direct, indirect and random search methods – with and without acceleration Elimination methods for unrestricted and exhaustive search, Fibonacci search, Dichotomous search, Golden-section (gradient) search methods.**Text Books:**

1. Higher engineering mathematics by DR. B.S. Grewal, Khanna publishers (1998)
2. Numerical methods for Engineersby Steven C. Chapra and Raymond P Canale, 2nd edition, MCGraw Hill International edition, 1988.

Suggested books:

1. Computer Applications in Bioprocessing by Henry R. Bungay Volume 70/(2000) Springer.
2. Edger T.E., and Himmelbau D.M., “Optimization of chemical processes”, McGraw Hill international edition, 1988
3. Bioprocess engineering Enrique Galindo and Octavio T. Ramírez Volume 16, Issue 7, (1998).

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BT422 **BIOPROCESS ECONOMICS & PLANT DESIGN**

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:
1. To provide the students with knowledge about basic concepts in Interest, capital investment tax and depreciation;
2. Measures of economic performance.
3. This course aims at providing an insight into capital, overhead and manufacturing costs estimation
4. The course is designed to give an understanding of process design development and general design considerations.
5. This course aims at providing knowledge on design of batch and continuous sterilizers**,** Design calculations for immobilized enzyme kinetics.
6. To give insight about various types of valves, pumps, steam traps, spargers and impellers used in biotech industries.

Course Outcomes:

At the end of the course student should
1. Be able to carry out interest calculations and prepare balance sheets for business transactions.
2. Be able to determine the economic analysis of bioprocesses.
3. Carry out cost estimations for different industrial productions.
4. Develop process design, flow diagrams.
5. Carry out material and energy balances accurately
6. Be able to design filters for air sterilization, batch and continuous sterilizers, valves etc.

UNIT-I ECONOMIC EVALUATION

Capital cost of a project; Interest calculations, nominal and effective interest rates; basic concepts in tax and depreciation; Measures of economic performance, rate of return, payout time; Cash flow diagrams; Cost accounting-balance sheet and profit loss account; Break even and minimum cost analysis.

UNIT- II BIOPROCESS ECONOMICS

Bio-Products regulations; Economic analysis of bioprocess; Capital, overhead and manufacturing costs estimation; Case studies of antibiotics (Penicillin and Streptomycin), recombinant products, single cell protein, anaerobic processes and other fine chemicals.

UNIT- III INTRODUCTION TO PLANT DESIGN

Process design development: design procedures, design information and flow diagrams, material and energy balances, comparison of different process and design specifications; Optimization; General design considerations: Health and safety hazards, Environment protection, plant location and plant layout, plant operation and control;

UNIT- IV BASIC DESIGN PROBLEMS

Design examples on continuous fermentation, aeration, and agitation; Design calculation of filter for air sterilization; Design of batch and continuous sterilizers; Design calculations for immobilized enzyme kinetics; Practical considerations in designing of Bioreactor/Fermentor construction.

UNIT- V

Introduction to different types of valves, pumps, steam traps, spargers and impellers used in fermentation industries; Design exercise on trickle flow fermentor; Problems associated with design equations.

Text Books:

1. Plant Design and Economics for Chemical Engineers, 5/e
   Max S. Peters, Ronald E. West, (2003) McGraw-Hill Higher,
2. Biochemical Engineering -Humphrey, A. E.; Millis, JSTOR 1966.
3. Biochemical Engineering, by Harvey W. Blanch, Douglas S. Clark CRC; 1st edition (1997).
4. Biochemical Engineering Fundamentals by James; Ollis, David F. Bailey,1977, McGraw-Hill.

Suggested Reading:

1. Biochemical Engineering and Biotechnology Handbook by Bernard Atkinson, Ferda MavitunaGrove's Dictionaries; 2 edition (1992).
2. Bioprocess Engineering:Basic Concepts. Michael L. Shuler / Fikret Kargi, Reihe:Prentice ,(2001) Hall.
3. Plant Design and Economics for Chemical Engineers" by M. Peters and K. Timmerhaus, McGraw-Hill.
4. Bioprocess and Biosystems Engineering Dirk Weuster-Botz, ISSN: 1615-7591 Journal no. 449, Springer.

Y. Rajani

Elective-III

MOLECULAR MODELING & DRUG DESIGN

BT 471

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Empirical force fields and Hydrogen bonding in different molecules.
2. Simulation methods to calculate Thermodynamic properties of molecules.
3. Molecular dynamics simulation of molecules by simple and continuous potential.
4. Practical aspects in setting and running the molecular dynamics simulation.
5. Montecarlo simulation method for rigid and flexible molecules.
6. QSAR between different protein ligand interactions.

Course Outcomes:

After completion of the course students gain knowledge in the following concepts:

1. Calculate Total energy of molecule by using force field potentials.
2. Calculate Internal energy, Heat capacity, Temperature, pressure.
3. Hard sphere potential, Continuous potential by Finite differential method.
4. Choosing the initial configuration and analyzing the results of computer simulation.
5. Simulation of polymers by Random walk method, Self avoiding walk method.
6. Classification of Drug Design. CADD to treat Alzheimer's and Tuberculosis diseases

UNIT- I: EMPIRICAL FORCE FIELDS AND MOLECULAR MECHANICS

Introduction to Molecular Mechanics, Coordinate system, Molecular graphics, Force fields, Bond stretching, Angle bending, Torsions, Out of plane bending motions, Electrostatic interactions, Vanderwalis interactions, Effective pair potentials, Hydrogen bonding.

UNIT- II: COMPUTER SIMULATION METHODS

Calculation of Thermodynamic properties, Phase space, Practical aspects of computer simulation, Periodic boundary condition, Boundaries monitoring Equilibrium, Truncating the potential and minimum image convention, Long range process, Analyzing results of simulation and estimating errors**.**

UNIT- III: MOLECULAR DYNAMICS SIMULATION METHODS

Molecular Dynamics using simple modules, Molecular Dynamics with continuous potentials: Finite difference methods and Predictor corrector integration method, Constraint Dynamics, Transport properties, Time dependent properties, Molecular Dynamics at constant Temperature and Pressure.

UNIT-IV: MONTECARLO SIMULATION METHODS

Metropolis methods, Importance of Hamiltonian equation, Montecarlo simulation of Rigid and Flexible molecules, Montecarlo simulation of Polymers: Lattice model & continuous polymer model, calculating chemical potential, Differences between Molecular dynamics & Montecarlo simulation method.

UNIT-V: APPLICATIONS OF MOLECULAR MODELING AND DRUG DESIGN

Production of Drugs in Pharmaceutical companies, CADD: Strucure Based Drug Design and Ligand Based Drug Design, Quantiative Structural Activity Relationship (QSAR) studies in Protein- Ligand interactions, Case studies of Alzheimers disease, Tuberculosis and Cancer etc.

Text books:

1. Molecular modeling principles and Applicatios AR Leach, Longman, (1996).
2. Molecular Dynamics simulation -Elementary Methods- John Wiley and Sons, (1997).

Suggested Reading:

1. Protein Engineering - Moody PCE and AJ Wilkinson. IRL press.
2. Introduction to protein structure by C. Brandon and J. Tooze, Garland, 2nd edition, (1998).
3. Essentials of Drug Designing V. Kothakar, Dhruv publications

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Elective-III

BT472 **IMMUNODIAGNOSTICS**

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. The students will learn the basic principles, procedures and applications of immunodiagnostic tests.
2. The students are introduced to engineer antibody by using rDNA technology
3. The students are illustrated to the steps involved in the develop, production and applications of monoclonal antibody technology
4. The students will learn the development of preventive agents such as vaccines
5. The students also learn the novel methods used for immunodiagnostics
6. Students will be introduced to immunoproducts IPR and its patenting.

Course Outcomes:

1. Students will demonstrate competence in diagnosing various diseases by using different types of immunodiagnostic tests.
2. Students can explain the concepts of validation and quality control as applied to antibody-based analytical systems.
3. Students will learn about development of monoclonal antibodies diagnosis, treatment and prevention of disease by using monoclonal antibody.
4. New methods of treating various diseases are being explored by vaccine development
5. The course is helpful to learn the novel techniques used in immunodiagnostics.
6. Students will learn what is patenting and how immunoproducts are patented

UNIT I INTRODUCTION

Principles of immunodiagnostic tests and their development, classification of immunodiagnostic tests, Immunodiagnostics techniques – Precipitation, Immunoelctrophoresis, Agglutination, RIA, ELISA, Fluoroimmunoassay, Luminescent immunoassay, Immunofluorescence, Cell separation techniques, Western blotting, Selection and preparation of reagents, Assay design, Antibody engineering, Catalytic antibodies, Applications of nanoparticles in immunodiagnostics.

UNIT II HYBRIDOMA TECHNOLOGY

Immunodiagnostics and preparation of tools: Hybridoma technique, monoclonal antibodies production, choice of host for immunization and myeloma cells, choice of immunogen, preparation of antigen for immunization, growth of myeloma cell lines, preparation of cells for fusion, cell fusion, selection and Screening of Hybridoma, purification and application (biochemical research, clinical diagnosis and treatment) of monoclonal antibodies.

- **UNIT III VACCINES**
- Whole organism Vaccines, Subunit vaccines - Herpes Simplex virus, Foot and Mouth disease, SARS, Peptide vaccines - Foot and Mouth disease, Malaria, Live recombinant vaccines- Cholera, Salmonella, Vector vaccines - directed against viruses and bacteria, Purified vaccines, Conjugate polysaccharide vaccines, DNA vaccines, Antifertility vaccines.

UNIT IV NOVEL TECHNIQUES IN IMMUNODIAGNOSTICS

Imaging as an Immunodiagnostic Tool, Multicolor Flow Cytometry, Immunoglobulin and Free-light Chain Detection, Methods for Autoantibody Detection, Immunodiagnostic of Allergy, Multiplex Analysis of Cytokines, Immunomonitoring of Clinical Trials, Immunological Assays Used in Vaccine Clinical Trials

UNIT V IPR ON IMMUNO PRODUCT

Intellectual Property Rights, Patenting, General Agreement on Trade and Tariff, Application of transgenic organisms for the production of immune product, Patenting of biological material.

Text books:

1. Edwards R, “Immunodiagnostics: A practical approach” Oxford University Press, 1999.
2. Rastogi SC, “Immunodiagnostics Principles and Practice” New Age Publishers, 1996

Suggested Reading:

1. Thomas J. Kindt, Barbara A. Osborne, Richard Goldsby, W. H. Freeman, “ Kuby Immunology”, 6th edition, 2006.
2. Ralph M. Aloisi Lea & Febiger Principles of Immunology and Immunodiagnostics by, 1988.

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Elective-22

BT 473 TISSUE ENGINEERING

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Understand the fundamental principles and elements of tissue engineering.
2. Get insight into the roles of cells, tissue organization and matrix in tissue engineering.
3. To learn the practical approach of carrying out tissue culture.
4. Learn about the different materials use as biomaterials.
5. Understand the role of stem cells in tissue engineering.
6. Gain knowledge into the medical applications of tissue engineering.

Course Outcomes:

1. Graduates are aware of the upcoming concept of tissue engineering.
2. The importance of the cell matrix in tissue engineering is highlighted to the graduates.
3. The graduates learn about in vitro culturing and the parameters of importance.
4. Students are able to discuss the potential of stem cells in tissue engineering for wound healing.
5. Graduates understand the need of compatible biomaterials to support growth and differentiation of stem cells into functional organs.
6. The graduates understand the scope of tissue engineering in producing organs for therapeutic applications.

UNIT – I INTRODUCTION TO TISSUE ENGINEERING

Basic definition and overview; General scientific issues; History of Tissue engineering, Basic steps in tissue engineering; Ethical issues.

UNIT - II CELLS AND TISSUE ORGANIZATION

Cells- cell growth and death; cell differentiation; Cells in tissues and organs.
Cell to cell interactions; cell adhesion molecules (CAM)
Organization of cells into higher ordered structures- Mesenchymal cells; EMT, MET; Molecular mechanisms and control of EMT process. Tissues- Epithelial, connective; Vascularity; angiogenesis; wound healing. ECM (extra cellular matrix) –components; dynamics of cell-ECM interaction.

UNIT – III FUNCTIONAL TISSUE ENGINEERING

Cell and tissue culture- media; culture initiation; transformation and immortalization; validation; differentiation; maintenance of cells in vitro; cryopreservation.Stem cells in tissue engineering Bioreactors for tissue engineering- Bioreactor design requirements; Spinner flask bioreactors . Rotating-wallbioreactors , Compression bioreactors, Strain bioreactors, Hydrostatic pressure bioreactors, Flow perfusion ioreactors, Combined bioreactors

UNIT- IV BIOMATERIALS OF TISSUE ENGINEERING

Scaffolds- fabrication; 3D scaffolds
Biodegradable polymers; synthetic polymers; hybrid of synthetic and biological polymers; prosthetic devices.
Engineering biomaterials for tissue engineering.

UNIT-V APPLICATIONS OF TISSUE ENGINEERING

Tissue replacement –crucial factors
Skin grafting
Bone tissue engineering; Cardiac tissue engineering; Neural tissue engineering; Vascular tissue engineering; as models in cancer and drug discovery.

Text Books:

1. Principles of tissue engineering. Robert.P.Lanza, Robert Langer & Vacanti. Academic Press. 2nd edition 2000.
2. Tissue engineering. B. Palsson, J.A. Hubbell, R. Plonsey & J.D. Bronzino. CRC Taylor & Francis.

Suggested Reading:

1. Tissue engineering- Design, practice & reporting, Bernard prish. Woodhead Publishing Ltd. Cambridge. UK 2009.
2. Methods of tissue engineering. Atala O.P & Lanza.L. Woodhead Publishing Ltd. Cambridge. UK 2009.

Elective-IV

BIOPROCESS VALIDATIONS & CURRENT GOOD MANUFACTURING PRACTICES

BT481

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Student is taught with the concepts of prospective process validations and analytical methods validations.
2. Students are explained the development of validation protocol and methods of evaluation.
3. Students are explained with good laboratory practices with suitable examples.
4. Students are enlightened thoroughly the (SOP) of biotech process.
5. Students are taught with proper illustrations with the concept of waste minimization and zero contamination.
6. Students are taught and explained about health hygiene of persons involved.

Course Outcomes:

1. Apply prospective process validation and analytical methods in biotechnology industries.
2. Students will be capable of developing validation protocols and methods of evaluation in Quality control department of biotechnology industry.
3. Students will apply good laboratory practices in real life situations in bio process industriesand laboratories of R&D and quality control units.
4. Students will apply SOP in process operations of biotech industries.
5. Students will apply the concepts of waste minimization and zero contamination in process units of biotechnology industries.
6. Students will apply the concepts of personal hygiene of employees of biotech industries and implementation of good health practices.

UNIT- I: BIOPROCESS VALIDATIONS

Validations- Prerequisites, Process Design & testing process characterization, Process Optimization, Validation Options, Prospective process validation, Retrospective validations, Concurrent validations, Revalidation, Organizing validation studies, Analytical methods validation, cleaning validation, pre-validation verification, Documentation, Control of cleaning materials & ancillary tools, frequency of cleaning, Development of validation protocol, Method of Evaluation.

UNIT- II: GOOD LABORATORY PRATICES (GLP)

Introduction to Good Laboratory Practices, Responsibilities in GLP, Quality assurance and facilities for GLP, Computational processes in GLP.

UNIT III: STANDARD OPERATING PROCEDURES (SOP)

Standard Operating Procedures (SOP) and Guidelines and regulations of PDA and ICH for GLP and GMP.

UNIT- IV: GOOD MANUFACTURING PRACTICES (GMP)

Introduction to GMP; Manufacturing & Quality control facilities; Sanitation & Hygiene; Control of raw materials, Packaging Materials, manufacturing processes, Minimization or Zero Contamination, and finished products; Documentation and compliance of GMP.

UNIT- V:GMP FOR BIOLOGICAL PRODUCTS

Products based on immunological principles, Layouts and Designs of Manufacturing Areas, Equipment designs and operations, Standard operating procedures for Production, Quality control, Labeling, Records and Waste Disposal; Health & hygiene of Persons involved.

Text Books:

1. How to Practice GMPs-PP Sharma.
2. Good Laboratory Practice: The Why and the How by Jurg P. Seiler, Springer-Verlag Berlin.

Suggested Reading:

1. Bioprocess Validation: The Present and Future by PhD Trevor Deeks, pub: PDA/DHI (2007).
2. Process Validation in Manufacturing of Biopharmaceuticals: Guidelines, Current Practices, and Industrial Case Studies (Biotechnology and Bioprocessing Series),Informa HealthCare; 2 edition (2005).
3. The L&K Process Guide, The tool for biopharmaceutical drug development, Pub: L&K Biosciences.
4. Bioprocess Engineering: Basic Concepts, 2/E Michael L. Shuler, Fikret Kargi, Dokuz ISBN-13: 9780130819086, Publisher: Prentice Hall (2002).

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Elective-IV

BT482 **FOOD BIOTECHNOLOGY**

Instruction	4L Periods per week
Duration of University Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives:

1. Student is made to understand the importance of food biotechnology and its nutritive value.
2. Students are taught the types of food available in the nature and its consumption value.
3. Students made to understand the food spoilage.
4. Students are enlightened about the importance of food processing.
5. Students are made aware of chemical and physical methods of food processing.
6. Student is made to understand the methods of food preservation and its control in food spoilage.

Course Outcomes:

1. Apply the fundamentals of food biotechnology to their real life situation.
2. Be able to differentiate types of food and explain their consumption value.
3. Be able to describe the types of pathogens and their effect on food.
4. Be able to describe the physical and chemical methods of food processing.
5. Be in a position to preserve the food material to avoid food spoilage.
6. By understanding the principles of biotechnology able to work in a suitable food industry.

UNIT-I SCOPE AND IMPORTANCE OF FOOD BIOTECHNOLOGY

Introduction to Scope and importance of food biotechnology, Nutritive value of the food ; consumption and structure of foods and the importance of industrial processing of foods, various technologies and methods in food preservation, processing and packaging, food grade polymers.

UNIT- II FOOD PRODUCTS

Introduction to Probiotics, Nutraceuticals and GM foods ; Development of Industrial Food products: High Fructose Corn syrup, Single Cell Protein and Fermented foods, Bakery Products, Beverages, Milk Products and Mushroom Development; Food labeling, Food standards.

UNIT- III FOOD SPOILAGE AND FOOD MICROBIOLOGY

Food spoilage, Bacterial agents of food borne illness; Clostridium, Salmonella, Vibrio and Shigella, non bacterial agents; helminthes, Protozoa, Algae, Fungi and Viruses.

UNIT- IV FOOD PROCESSING

Bio-processing : Enzymes and chemicals used in food processing for flavor development; Processing of meat, fisheries, vegetables, dairy products; Thermal processing of foods; Microwave heating; Thermal inactivation of microorganisms; Freezing and thawing methods of food processing.

UNIT- V FOOD PRESERVATION

Food preservation using Irradiation: Characteristics of Radiations of Interest in food preservation, Principles underlying the destruction of microorganisms by irradiation, Processing of foods for Irradiation, Legal status of food irradiation, Effect of Irradiation of Food constituents and Storage Stability; Food Preservation with low and High Temperatures and Preservation of foods by Drying, equipment for Drying.

Text Books:

1. Roger Angold, Gordon Beech & Taggart, "Food Biotechnology" 1st edition, Cambridge University Press, 1989.
2. Frazier, William, C.Westhoff, Dennisc , "Food Microbiology" 2nd Edition TATA Mcgraw Hill Publishers, 1989.
3. Norman Potter, Hotch Kiss, "food science" 2nd edition, chapman Publishers, 1996.
4. Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto, Robert E. Levin, "Food biotechnology" 2nd Edition, CRC Press, 1999.

Suggested Reading:

1. Ashok Pandey, "Biotechnology:Food Fermentation" Asia Tech Publishers Inc,New Delhi,1999.

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Elective-IV

2. J.M.Jay, M.J.Loessner and D.A.Golden, "Modern food microbiology", 7^{th} edition,Springer,2006.
3.Romeo T. Toledo, "Fundamentals of Food Process Engineering", 3rd edition, Springer, February, 2007.

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Elective-IV

BT483 **NANOBIOTECHNOLOGY**

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Course Objectives

1. To introduce the concept of nanotechnology and nanobiotechnology
2. To educate students about significance of nano-size
3. To gain knowledge on the synthesis of nanomaterials
4. To gain knowledge on the characterization of nanomaterials
5. To have awareness about different types of Nanostructures
6. To get familiarize with applications of nanobiotechnology in different fields

Course Outcomes

1. Students will acquire the knowledge of multidisciplinary nature of nanotechnology
2. Students will be able to explain the nanoscale paradigm in terms of properties at the nanoscale dimension.
3. Students will be able to describe different methods used for the synthesis of nanomaterials
4. Students will have the knowledge of characterization of nanomaterials
5. Students will have awareness of nanostructures
6. Students will learn various applications of nanobiotechnology

UNIT-1 INTRODUCTION AND SIGNIFICANCE OF NANO DOMIAN

Nanotechnology - A Historical Perspective, definition of nanoscale with special reference to biosystems, scope and future prospects of Nanotechnology, Nanobiotechnology and Bionanotechnology, Opportunities and Challenges of Bionanotechnology; Limitations of micron size, need for nano-size—surface volume ratio significance, significance and key features of nano-Size, derivation of Bohr's atomic radius of a hydrogen atom, comparison of particle behavior at nano-size to Macro Size: Gold and Titania, advantages of scaling down—nano-size.

UNIT- II SYNTHESIS AND CHARACTERIZATION OF NANOMATERIALS

Synthesis of Nanomaterials – Top-down and bottom up approaches with examples, physical, chemical and biological methods, characterization of nanomaterials- Optical (UV-Visible/fluorescence), X-ray diffraction, Imaging and size-(Electron Microscopy- SEM, TEM), Atomic force microscopy, Scanning tunneling microscopy, Spectroscopy- NMR, Raman FT-IR and Plasma Resonance.

UNIT- III NANOSTRUCTURES

Smart materials, nanoscale biostructures, carbon nanotubes, nanowires, nanoshells, quantum dots, dendrimers, nanosomes, liposomes, virosomes, polymersomes.

UNIT- IV. GENERAL APPLICATIONS OF NANOBIOTECHOLOGY

Application of nanotechnology in medical diagnosis, drug discovery, drug development, drug delivery, Photodynamic Therapy.

UNIT- V. CURRENTAPPLICATIONS OF NANOBIOTECHOLOGY

Application of nanotechnology in Protein Engineering, Tissue engineering, Agriculture, Environment, food processing, Nanotechnology and Nanoparticles: Clinical, Ethical, and Regulatory Issues.

Text books:

1. Christof M. Niemeyer and Chad A. Mirkin, "Nanobiotechnology: Concepts, Applications and Perspectives" Wiley Publishers, April 2004.
2. Mark Ratner and Daniel Ratner, " Nanotechnology: A Gentle Introduction to Next Big Idea", Low Price edition, Third Impression, Pearson Education

Suggested Reading:

1. David S Goodsell, "Bionanotechnology", John Wiley & Sons, 2004.
2. Debasis Bagchi, Manashi Bagchi, Hiroyoshi Moriyama, Fereidoon S hahidi, "Bio-Nanotechnology: A Revolution in Food, Biomedical and Health Sciences" Wiley -Blackwell, 2013.
3. Elisabeth S P, Aravind P, "Bionanotechnology", Morgan & Claypool publishers, 2007

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ME 464 **Entrepreneurship (for Mech, Prod, Civil, EEE & CSE)**

Instruction	4L Periods per week
Duration of university Examination	3 Hours
University Examination	75 Marks
Sessionals	25 Marks
Credits	3

Objectives:

1. To understand the essence of Entrepreneurship
2. To know the environment of industry and related opportunities and challenges
3. To know the concept a procedure of idea generation
4. To understand the elements of business plan and its procedure
5. To understand project management and its techniques
6. To know behavioral issues and Time management

Outcomes: After completing this course, students will be able to:

1. Apply the entrepreneurial process
2. Analyze the feasibility of a new business plan and preparation of Business plan
3. Evaluate entrepreneurial tendency and attitude
4. Brainstorm ideas for new and innovative products or services
5. Use project management techniques like PERT and CPM
6. Analyze behavioural aspects and use time management matrix

UNIT-I

Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries, Types of enterprises, Corporate Social Responsibility.

UNIT-II

Identification and characteristics of entrepreneurs: First generation entrepreneurs, environmental influence and women entrepreneurs, Conception and evaluation of ideas and their sources, Selection of Technology, Collaborative interaction for Technology development.

UNIT-III

Business plan: Introduction, Elements of Business Plan and its salient features, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary.

UNIT-IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden

UNIT-V

Behavioral aspects of entrepreneurs: Personality, determinants, attributes and models, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, “Dynamics of Entrepreneurial Development and Management”, Himalaya Publishing House, 1997.
2. Prasanna Chandra, “Project-Planning, Analysis, Selection, Implementation and Review”, Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, “Entrepreneurial Development”, S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, “Entrepreneurship”, Tata Me Graw Hill Publishing Company Ltd., 5lh Ed., 2005
2. Stephen R. Covey and A. Roger Merrill, “First Things First”, Simon and Schuster Publication, 1994.
3. Sudha G.S., “Organizational Behavior”, National Publishing House, 1996.

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BT423 **SEMINAR**

Instruction	3L Periods per week
Sessionals	25 Marks
Credits	1

Oral presentation is an important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of state of the art topics in a broad area of his /her specialization.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to following aspects of seminar presentations.

- Literature survey
- Consolidation of available information
- Power point Preparation
- Technical writing

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Give twenty(20) minutes presentation through OHP/ PPT/ Slide Projector followed by Ten (10) minutes discussion
3. Submit a report on the seminar topic with list of references and hard copy of the slides.

Seminars are to be scheduled from 3^{rd} week to the last week of the semester and any change in schedule should be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar should be from any peer reviewed recent journal publications.

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BT 901 **PROJECT**

Instruction	6L Periods per week
University Examination	Viva-voce
University Examination	100 Marks
Sessionals	50 Marks
Credits	9

Dealing with a real time problem should be the focus of under graduate project.
All projects will be monitored at least four times in the II-semester through individual presentations (Project batch wise).

Every student should maintain a project dairy, wherein he/she needs to record the progress of his/her work and get it signed at least once in a week by the guide(s). If working outside and college campus, both the external and internal guides should sign the same.

Sessional marks should be based on the marks, awarded by a project monitoring committee of faculty members as well as the marks given by the guide.

Common norms are established for final documentation of the project report, the students are directed to download from the website regarding the guidelines for preparing the project report and the project report format.

The project report shall be evaluated for 100 Marks by the External Examiner.

If the project work found inadequate in the end examination, the candidate should repeat the project work with a new problem or improve the quality of work and report it again.

Break up for 100 Marks in the end examination:

1. Power point presentation 20 Marks
2. Thesis/Report preparation 40 Marks
3. Viva-voce 40 Marks

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16MCC101 **DISCRETE MATHEMATICS**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Gain Logical and Mathematical ability to introduce most of the basic terminologies used in computer science with particular reference to the relationships among the discrete structures.
2. Learn about Boolean algebra.
3. Apply the concepts of Relations, Functions, properties of Integers and Set Theory.
4. Learn about principle of Inclusion, Exclusion and Generating Functions.
5. Understand the concept of Recurrence Relations, Groups and Algebraic Structures
6. Model and analyze the computational processing using combinatorial methods.

Course Outcomes:
After completion of the course the students would be able to:
1. Apply knowledge of the concepts needed to test the logic of a program.
2. Apply knowledge of Boolean algebra and Set Theory.
3. Apply knowledge of Properties of Integers, Relations and Functions.
4. Expose principles of Inclusion and Exclusion, Generating Functions, Recurrence Relations, Groups and Algebraic Structures.
5. Synthesize the indirection of hypothesis and simple indirection methods.
6. Prove elementary properties of modular arithmetic and explain their applications in Computer Science.

UNIT – I
Fundamentals of Logic: Basic Connectives and Truth Tables, Logical Equivalence, Logical Implication, Use of Quantifiers, Definitions and the Proof of Theorems. **Boolean algebra**: Switching Functions, Logic gates, Don't Care Condition **Set Theory**: Sets and Subsets, Set operations and the Laws of Set theory Counting and Venn Diagrams.

UNIT – II
Properties of Integers: The well-ordering principle, Recursive definitions, The Division Algorithm, Euclidean Algorithm, Fundamental theorem of arithmetic. **Functions:** Cartesian product, Functions, Onto Functions, Special Functions, Pigeonhole Principle, Composition and Inverse Functions, Computational Complexity. **Relations**: Partial Order Relations, Lattices, Equivalence Relations and Partitions.

UNIT – III
Principle of Inclusion and Exclusion: Principles of Inclusion and Exclusion, Generalization of principle, Derangements, Rooks Polynomial, Arrangements with Forbidden Positions.
Generating Functions: Introductory examples, Definitions and examples, Partition of Integers, Exponential generating function, Summation operator.

UNIT – IV
Recurrence Relations: First-order linear recurrence relation, Second-order linear homogeneous recurrence relations with constant coefficients, Non- homogeneous recurrence relations, Divide-and-conquer algorithms. **Algebraic Structures**: Definition, Examples and properties. **Groups**: Definition, Examples and elementary properties, Homomorphism, Isomorphism and Cyclic groups.

UNIT – V
Graph Theory: Definitions and examples, Sub graphs, Complements and graph isomorphism, Vertex degree, Planar graphs: Hamiltonian paths and Cycles, Graph coloring.
Trees: Definitions, Properties and examples, Rooted Trees, Spanning Trees and Minimum Spanning Trees.

Text Books:
1. Ralph P. Grimaldi, "Discrete and Combinatorial Mathematics", Pearson Education, 4th Edition, 2003.

Suggested Reading:

1. Kenneth H Rosen, “Discrete Mathematics and its Applications” Tata McGraw Hill, 6^{th} Edition, 2007.
2. J.P Tremblay & R. Manohar, “Discrete mathematical Structures with Applications to computer science” McGraw Hill. 1987.
3. Joe L. Mott, A.kandal & T.P. Baker, “Discrete mathematics for compute scientists, & mathematicians", Prentice Hall N.J., 1986
4. Kevin Ferland, “Discrete Mathematics”, Houghton Mifflin Company, 2009.

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16MCC102 COMPUTER PROGRAMMING AND PROBLEM SOLVING

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Understand algorithms, flow charts and pseudo codes.
2. Learn programming environment.
3. Gain the basic terminology used in computer programming.
4. Understand different data types in C programming.
5. Understand the decision structure, loops, functions, arrays, pointers, strings, structures and files.

Course Outcomes:
After completion of the course, the students would be able to:
1. Design Algorithms and Flowcharts to solve the various problems.
2. Execute the programs.
3. Apply different data types in various programs.
4. Apply the built-in functions, customized functions and preprocessor directives in various programs.
5. Apply the Arrays and Pointers for solving the problems.
6. Apply the Strings and Structures, dynamic memory allocation techniques and files for solving the various problems.

UNIT – I
Algorithm, flowchart, pseudo code, Structured Programming, program development steps, creating and running programs, structure of a C program, character set, keywords, identifiers, constants, basic data types and sizes, variables, operators, operator precedence and associativity, expressions, evaluating expressions, type conversions, basic formatted Input/output statements, decision control structures: if and switch statements, loop control structures: while, do-while and for, continue, break.

UNIT – II
Functions: Basic concepts, user defined functions, parameter passing, local variables, global variables, recursive functions, comparison of iteration and recursion, standard library functions, header files, storage classes, preprocessor.

UNIT – III
Arrays: Basic concepts, one-dimensional array, passing arrays to functions, searching and sorting: linear search, binary search and bubble sort, two-dimensional array, multi-dimensional array.
Pointers: Basic concepts, pointers as function arguments, pointer arithmetic, pointers to pointers, pointers and one-dimensional arrays, pointers and two-dimensional arrays, array of pointers.

UNIT – IV
Strings: Basic concepts, string I/O operations, pointers and strings, string manipulation functions. **Structures**: Declaration, definition and initialization of structures, accessing structures, nested structures, array of structures, structures and functions, pointers to structures, unions, enumerated types, typedef.

UNIT – V
Dynamic memory management functions, command line arguments. **Files**: Basic concepts, text files, binary files, basic file I/O operations, sequential-access files, random-access files.

Text Books:
1. Pradip D &Manas G, “Programming in C”, 2nd edition, Oxford University Press, 2007.
2. B.A. Forouzan and R.F.Gilberg,”Computer science, A structured programming approach using C”, 3rd edition, Cengage learning, 2007.

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Suggested Reading:

1. BW Kernighan DM Ritchie, “The C programming Language”, 2nd edition, Prentice Hall India, 1998.
2. P.J Deitel and H.M Deitel , “C How to program” , 6th edition, PHI, 2010.
3. Yashwant Kanetkar, “Let us C”, 13th edition, BPB Publications, 2013.
4. E Balaguruswamy, “Programming in ANSI C”, 5th edition, Tata McGraw-Hill, 2007.
5. K R Venugopal& S R Prasad, “Mastering C”, McGraw-Hill, 2007.

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16MCC103 **ELEMENTS OF INFORMATION TECHNOLOGY**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:

1. Understand concepts of Information Technology and its applications.
2. Understand the physical and logical structure of the computer.
3. Have knowledge of the concepts of Networks and Communication Technology.
4. Obtain Knowledge of Files and Databases.
5. Understand the flow of information and the various levels of management within an organization.
6. Identifying security issues of computers and communication systems.

Course Outcomes:
After completion of the course, the students would be able to:

1. Get concepts of Information Technology and its Applications.
2. Identify the physical and logical structure of the computer.
3. Gain the knowledge of Network and Communication Technology.
4. Become familiar with the use of Files and Databases.
5. Gain the knowledge of flow of information in an organization and the various levels of management with in an organization.
6. Handle security issues of computers and communication systems.

UNIT -I

Introduction to Information Technology: Data, Information, Basic operations of Computers, Hardware: Input, Output, Memory, Communication, **Software**: **System software**: Operating System, Device drivers, Utility programs, GUI, **Application software**: Ways to obtain application software, Types of application software, Five sizes of computers, **Common operating systems**: DOS, MAC OS, Windows: XP, VISTA, Windows 7.0, Network OS, Hand held devices OS.

UNIT -II

Hardware: Generations of Computers, Measuring Capacity, Binary Coding Schemes, Number System, Block diagram of Computer, **Micro Computer System Unit**: Computer case, Power supply, Mother Board, Chips, CPU, Memory, Ports and Cables, **Input Devices**: Keyboard, Pointing devices, Source data entry devices, Audio and Video devices, Digital cameras, Speech recognition systems, RFID, Sensors, human biology input device, **Output Devices**: Soft copy output, Hard copy output, Mixed output devices, **Secondary Storage Device**: Floppy disks, hard disks, optical disks, flash memory, magnetic tape, online secondary storage, smart cards.

UNIT -III

Network communications: Digital basics of computers, **Networks**: Benefits of networks, Client – Server and Peer to Peer Networks, Types of Networks, Components of Networks, Intranet, Extranet and VPNS, Network Topologies. **Communications**: Wired and Wireless Communication Media, Cyber threats, Hackers and Safe Guards, **Internet and World Wide Web**.

UNIT- IV

Files & Databases: Data Storage Hierarchy, Types of Files, Key Field, Compression and Decompression, File Management Systems, **Database Management Systems**: Benefits of DBMS, DBA, Database Models, Data Mining, E-Commerce, Ethics of Using Databases.

UNIT -V

Information Systems: Qualities of good information, Information flows within an Organization, Computer Based Information Systems: OIS, TPS, MIS, DSS, ESS and ES. **System Development**: Six phases of system analysis and design. **Software Development**: Programming as a five step procedures. Five Generations of Programming Languages, **Security Issues**: Threats to Computers & Communication Systems. Safe guarding computers and communications.

Text Book:

1. Williams B.K. Sawyer et.al. "Using information Technology", 9th Edition, Tata McGraw Hill, 2011.

Suggested Reading:

1. Aksoy & DeNardis" Introduction to Information technology", Cengage Learning, 2006.
2. Dennis P. Curtin, Kim Folley, et.al. "Information Technology, The breaking Wave", Tata McGraw Hill, 1998.
3. ITL Edn Solutions Ltd. "Introduction to Information Technology", Education, 2005.

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16MBC128 MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:
1. Introduce managerial economics and demonstrate its importance in managerial decision making.
2. Develop an understanding of demand and relevance of it's forecasting in the business.
3. Examine the economic analysis of production process in relationship with inputs.
4. Explain different costs and their relationship with the output.
5. Explain the concept of Accountancy and provide knowledge on preparation and analysis of Final accounts.
6. Understand the importance of project evaluation in achieving a firm's objective.

Course Outcomes:
After completion of the course, students will be able to:
1. Apply fundamental knowledge of Managerial economics' concepts and tools.
2. Understand various aspects of demand analysis and forecasting.
3. Analyze production function in terms of best combination of inputs.
4. Decision the best cost and benefits to achieve the objectives.
5. Analyze different opportunities and come out with best feasible capital investment decisions.
6. Understand accountancy concepts and conventions, final accounts and financial analysis.

UNIT - I:
Introduction to Managerial Economics : Definition, Nature and Scope of Managerial Economics, Micro Economics vs Macro Economics. Relationship of Managerial economics with other disciplines- Mathematics, Statistics, Accounting, and Operations Research. Role and responsibilities of Managerial economist in Business decisions. Fundamental concepts of Managerial economics - Opportunity cost concept, Principle of Time perspective, Incremental principle, discounting principle, and Equi-marginalism.

UNIT- II:
Demand Analysis : Meaning of Demand, Determinants of demand, types of demand, Individual vs Market Demand, Demand schedule, Demand curve and Demand function. Law of Demand and its exceptions. Elasticity of Demand- Definition, Types, and Measurement of Elasticity of Demand. Demand Forecasting- Factors governing demand forecasting, Methods of demand forecasting (Survey method, Statistical method, Expert opinion method, Test marketing, and judgmental approach).

UNIT - III:
Production and Cost Analysis : Production Analysis: Concept and Meaning of production-Factors of production, Production Function, law of variable proportions (with one variable and two variable inputs), Iso-quants and Iso-costs, Laws of returns, Economies and dis Economies of scale - internal and external economies. Cost analysis: Cost concepts - Actual vs opportunity cost, Incremental and sunk cost, Short run and long run cost, Fixed and variable cost. Cost output relationship in short -run and long-run.
Break Even analysis (BEA) – Break even chart, Determination of Break Even Point (simple numerical problems) Margin of safety. Managerial applications, and limitations of BEA.

UNIT - IV:
Introduction to Financial Accounting : Definition, Concepts and conventions of Accounting, Principles of double entry book keeping, Preparation of journal, ledger and Trial balance. Preparation of Financial statements- Trading and profit and loss account, and Balance sheet with simple adjustments.

UNIT –V:
Capital Management and Capital Budgeting: Significance of capital, Types of capital and sources of capital. Meaning of capital budgeting, Importance of capital budgeting. Methods of capital budgeting- Payback period

method, Average rate of Return (ARR), Net present value method (NPV) Internal rate of return method (IRR) Profitability Index. (Simple Numerical Problems).

Text Books:
1. P.L. Mehta,"Managerial Economics – Analysis, Problems and Cases" , Sultan Chand &Sons Educational, 2011.
2. Grawal T.S, Introduction to Accountancy", S.Chand Publishers, 2009.
3. Pandey, I.M, Financial management, 10th Ed.Vikas Publishing House, 2010.

Suggested Reading:
1. Varshney R.L. K.L. Maheswari Managerial economic, Sultan Chand.
2. J.C.Pappas and E.F.Brigham, Managerial Economics.
3. Maheswari, S.N, Introduction to Accountancy, Vikas Publishing House, 2005.
4. M. Kasi Reddy & S.Saraswathi, Managerial economics & Financial Accounting, PHI 2007.

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16EGC101 PROFESSIONAL COMMUNICATION IN ENGLISH

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:

1. Understand the role and importance of communication and to develop their basic communication skills in English.
2. Improve the students' listening skills and introduce them to different reading strategies.
3. Train students to use language appropriately for interviews, presentations and public speaking
4. Encourage the all-round development of students by focusing on soft skills.
5. Develop the students writing skills, career skills and make them industry ready.

Course Outcomes:
After completion of the course, students would be able to:

1. Apply critical and creative thinking abilities necessary for effective communication in today's business world.
2. Demonstrate competency in writing effective paragraphs, letters and reports.
3. Become effective, confident speakers and deliver persuasive presentations.
4. Understand the nuances of listening comprehend texts and draw inferences and conclusions.
5. Understand the significance of soft skills in the working environment.

UNIT – I:
Understanding Communication in English: Meaning, definition, Nature and Scope of Communication, Importance of Communication, Process of Communication, Intrapersonal and interpersonal communication, One way vs. Two way communication. Barriers to Effective Communication, Overcoming the Barriers. Communication in a business organization: Internal (Upward, Downward, Horizontal, Grapevine, Problems, Solutions) and External Communication. Strategies for conducting successful business meetings.

UNIT-II
Developing Listening & Reading Skills: Process and Types of listening. Problems in comprehension and retention. Barriers to listening, effective listening strategies. Note – taking. Process and purpose of reading. Reading Techniques-Skimming, Scanning, inferences and conclusion. Reading comprehension-known and unknown passages.

UNIT – III
Soft Skills: Introduction to Soft skills, Hard skills vs Soft skills, Public Speaking, Presentation Skills and techniques, Body Language, Leadership skills, Team Building, Decision Making, Business Etiquette - Email & Telephone Etiquette.

UNIT – IV
Written Communication: Sentence Structures & Paragraph Writing. Letter Writing-form, structure, layout. Sales Letters. Basics of Official Correspondence: Handling Correspondence, Receipt and Dispatch of Mails, Filing system, Classification of Mails; Quotations, Orders, Tenders. Information Transfer.

UNIT-V
Career Skills: Resume Writing, Elements of an Effective Resume, Application Letters, Job Interview –Purpose, Types, Interview Skills & Techniques. Grammar & Vocabulary.

Text Books:

1. **Vibrant English**, Orient Blackswan Ltd.

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Suggested Reading:

1. M .Ashraf Rizvi, **Effective Technical Communication**, Tata Mc Graw- Hill, New Delhi
2. Meenakshi Raman and Sangeetha Sharma, **Technical Communication - Principles and Practice**, Oxford Univ. Press, New Delhi.
3. Alok Jain, P.S. Bhatia and A.M. Shiekh, **Professional Communication Skills** S. Chand & Company Ltd., 2005
4. R.C.Sharma & Krishna Mohan, **Developing Communication Skills, Business correspondence and report writing** Tata McGraw Hill
5. Evans, D, **Decision maker**, Cambridge University Press, 1997.
6. Shiv Khera, **You Can Win,** Macmillan Books – Revised Edition, 2003
7. Stephen Covey **7 Habits of Highly effective people,** Free Press

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16MCC104 COMPUTER PROGRAMMING LAB USING 'C'

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:
1. Learn programming environment.
2. Gain the basic terminology used in computer programming.
3. Understand different data types in C programming.
4. Understand the decision structure, loops, functions, arrays, pointers, strings, structures and files.

Course Outcomes:
After completion of the course, the students would be able to:
1. Write, compile, debug and execute the programs.
2. Apply various data types in various programs.
3. Apply the built-in functions and customized functions for solving the programs.
4. Use the decision structures, loop structures, functions, and arrays in various programs.
5. Apply pointers, strings and structures in various programs.
6. Write programs using files.

C-Programs:
1. Write a program to calculate the area of a circle, rectangle, square and triangle.
2. Write a program to find the Roots of a Quadratic Equation $ax^2+bx+c=0$, where $a>0$.
3. Write a program to find the biggest of three different numbers by using nested if – else statement.
4. Write a program to find the division of the student using percentage of marks.
5. Write a program, which takes two integer operands and one operator form the user, performs the operation and then prints the result. (Consider the operators +,-,*, /, % and use Switch Statement).
6. Write a program to find max, min and sum of given set of numbers.
7. Write a program to find the sum of individual digits of a positive integer.
8. Write a program to find the factorial of a given positive number.
9. A Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 and 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence.
10. Write a program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.
11. Write a program to find the reverse of the given positive integer and check reverse number is palindrome or not.
12. Write a program to find the sin(x) value using series expansion. (Hint: $\sin(x) = x - x^3/3! + x^5/5! - \ldots..$)
13. Write a program to find the cos(x) value using series expansion. (Hint: $\cos(x) = 1 - x^2/2! + x^4/4! - \ldots..$)
14. Write program for the following using non-recursive functions.
    i) To find the factorial of a given integer.
    ii) To find the GCD (greatest common divisor) of two given integers.
15. Write program for the following using recursive functions.
    iii) To find the factorial of a given integer.
    iv) To find the GCD (greatest common divisor) of two given integers.
16. Write programs using functions to perform the following search techniques
    i) Linear search ii) Binary search
17. Write a program to implement bubble sort technique.
18. Write program using function to perform the Additions of Two Matrices
19. Write program using function to perform the Multiplication of Two Matrices
20. Write program using function to perform the Transpose of a given Matrix
21. Write a program to display the array elements from last index to first index and display the even and odd elements sum.
22. Write a program to demonstrate call by reference mechanism by swapping two integers.
23. Write a program to find the number of characters, words and sentences in the given string.

24. Write a program to copy the contents of one string into another string using pointers.
25. Write a program to concatenate two strings without using strcat library function.

26. Write a program that uses functions to perform the following operations using Structure complex.
    i) Reading a complex number
    ii) Displaying a complex number
    iii) Addition of two complex numbers
27. Write a program that uses functions to perform the following operations using Structure complex.
    i) Reading a complex number
    ii) Displaying a complex number
    iii) Multiplication of two complex numbers
28. Write a program which counts number of characters, words and sentences in the file.
29. Write a program which copies contents of one file into another file.
30. Write programs to demonstrate sequential access files.
31. Write programs to demonstrate random access files.

Suggested Reading:

1. E Balaguruswamy, “Programming in ANSI C”, 5th edition, Tata McGraw-Hill, 2007.
2. K R Venugopal & S R Prasad, “Mastering C”, McGraw-Hill, 2007.
3. Yashwant Kanetkar, “Let us C”, 13th edition, BPB Publications, 2013..

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16MC C105 ELEMENTS OF INFORMATION TECHNOLOGY LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:
1. Have knowledge of physical and logical structure of compute system.
2. Have hands on learning of MS-Word features such as section breaks, formatting, Mail Merge, Macros.
3. Gain knowledge of MS-Excel features such as Formulas and Functions and Different type of charts.
4. Acquire knowledge of MS-PowerPoint features.
5. In-depth learning of MS-Access features such as Creation of databases, Queries, Forms and Reports.
6. Learn basic dollar prompt commands in Linux.

Course Outcomes:
After completion of the course, students would be able to:
1. Assemble System and Load Software in the system
2. Create professional MS-Word documents
3. Efficiently generate Excel documents.
4. Give efficient presentations.
5. Handle various database applications.
6. Use basic dollar prompt commands in Linux.

Lab Experiments:
1. Identify and describe the relationships and role of the components of the "Logical' Diagram of the computer. (e.g. processor, RAM, ROM, BIOS, input, output, storage.)
2. Relate the "logical" diagram of a computer system to the "physical" system by Identifying physical components of a computer and describing their purpose. (e.g. the Processor, memory chips, motherboard, disk drives, and controller cards such as AGP Board, network cards, sound card, as well as parallel and serial ports etc.)
3. Assemble the computer which they will use and load the OS with partitions for Windows and Linux, configure for network connection
4. Troubleshoot his/her PC
5. Install/Uninstall SW/HW on his/her PC from time to time
6. Identify and distinguish between various types of application software. by describing and using them. (e.g. word processor, spreadsheet, database, browser, mailers etc.)
7. Distinguish between various commercially available systems by relating the cost to Features available on each system
8. **MS Word:** Create documents with standard formatting commands, single/multi Column, breaks, insert pictures/objects, drawings, hyperlinks, header/footer, and tables, Mail Merge, Macros.
9. **MS Power Point:** Create presentations with preset animations, using different layouts, Backgrounds, slide master, insert pictures/objects, drawings, hyperlinks, header/footer, Tables
10. **MS Excel:** Creating worksheets with various kinds of data, making charts, conditional Formatting, awareness of the various functions- statistical, date/time, math/trig etc, ability to explore (help) and use these functions if need be, demonstration through some Common functions like sum, average, standard deviation, logical and information.
11. **MS-Access:** Creation of database, queries, forms, Reports using student information system.
12. Learning of basic Dollar prompt commands in Linux.

Suggested Reading:

1. Williams B.K. Sawyer et.al. "Using information Technology", 9th Edn. Tata Mc-Graw Hill, 2011.
2. Srivastava S.S. "MS OFFICE", Laxmi Publications, New Delhi.
3. Behrous A Fourzan, Richard F Gilberg "Unix and Shell Programming: A Text Book", Thompson Learning 2003.

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16EGC102 PROFESSIONAL COMMUNICATION LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:

Students will:

1. Introduce to phonetics and the different sounds in English.
2. Familiarize with the software and give them sufficient practice in correct pronunciation.
3. Speak English correctly with focus on stress and intonation.
4. Participate in group discussions with confidence and to make effective presentations.
5. Plan and prepare for an interview, process of interview and interview techniques.

Course Outcomes:

After completion of the course, students would be able to:

1. Understand the speech sounds in English and the nuances of pronunciation.
2. Understand tone, intonation and rhythm and apply stress correctly.
3. Participate in group discussions with clarity and confidence.
4. Speak confidently on stage with appropriate body language.
5. Plan, prepare and face interviews with confidence.

Syllabus:

1. Introduction to English Phonetics: Introduction to auditory, acoustic and articulatory phonetics, organs of speech: the respiratory, articulatory and phonatory systems.
2. Sound system of English: Phonetic sounds and phonemic sounds, introduction to International Phonetic Alphabet, classification and description of English phonemic sounds, minimal pairs. The syllable: types of syllables, consonant clusters
3. Word stress: Primary stress, secondary stress, functional stress, rules of word stress.
4. Listening skills – practice with IELTS and TOEFL material
5. Situational dialogues and role play.
6. Group Discussions – dynamics of group, intervention, summarizing, modulation of voice and body language.
7. Presentation Skills – Elements of effective presentation – Structure of presentation – Presentation tools – Body language. Creating an effective PPT
8. Interview Skills – concept and process, pre-interview planning, opening strategies, answering strategies, mock interviews.

Suggested Reading:

1. E. Suresh Kumar et al, **English for Success** (with CD), Cambridge University Press India Pvt, Ltd. 2010.
2. T Balasubramanian, **A Textbook of English Phonetics for Indian Students**, Macmillan, 2008.
3. J Sethi et al. **A Practical Course in English Pronunciation** (with CD), Prentice Hall India, 2005.
4. Edgar Thorpe. **Winning at Interviews**, Pearson Education, 2006
5. Priyadarshi Patnaik**. Group Discussions and Interviews,** Cambridge University Press Pvt Ltd 2011

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16MCC106 **OBJECT ORIENTED PROGRAMMING**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:

1. Learn java basics & object oriented programming principles.
2. Know the concepts of interfaces, packages.
3. Get the concepts of exception handling in java.
4. Acquire the concept of multithreading
5. Interpret the concepts on I/O package.
6. Understand the basic concepts of Applets and AWT.

Course Outcomes:
After completion of the course, the students would be able to:

1. Gain the knowledge on object oriented programming concepts.
2. Create classes and objects.
3. Acquire knowledge on multithreading and exception handling.
4. Understand the role of Strings and I/O Streams.
5. Design and Develop the GUI Components.
6. Perform event driven programming.

UNIT -I
Object Oriented Programming: History of java, and evolution of java, java Buzzwords, Object Oriented Programming, Data types, Variables and Arrays, Operators, Control Statements,

UNIT -II
Introduction To Classes: Classes, Methods, Constructors, This keyword, finalize method, Garbage Collection, Overloading, Overriding, Recursion, nested classes,

Inheritance: Inheritance and its types, super, overriding, Abstract Classes, Using final.
Packages And Interfaces: packages, Access protection, Importing packages, Implementing Interfaces

UNIT -III
Exceptional Handling: Exception–handling fundamentals, Exception types, Using try and Catch, throw, throws and finally clauses.

Multithreaded Programming: java Thread Model, Differences between multiple processes and multiple threads, thread states, creating threads, interrupting threads, thread priorities, synchronizing threads, inter thread communication.

UNIT - IV
String Handling: String class, String buffer class, String length, Special String operations, string comparison, Primitive type wrappers

Java I/0 classes and Interfaces, Files, Stream and Byte Classes, Character Streams, Serialization. Deserialization.

UNIT –V
GUI and Event Driven Programming: Applet Class, Event Handling, Delegation event model, event classes, event listener Interfaces.

Using AWT Controls, Layout Managers and Menus: AWT classes, Window fundamentals**,** labels, Buttons, Checkboxes, lists etc, layout managers, Handling Events by extending AWT components.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

Text Books:

1. Patrick Naughton "JAVA, The Complete Reference" Tata McGraw Hill, 4th Edition 2005. (For Unit : I,II,III and IV)
2. Richard A.Johnson, "Java Programming and Object-Oriented Application Development" Cengage Learning, India edition 2009. (For Unit : V)

Suggested Reading:

1. John Dean and Raymond "Introduction Programming with Java A problem solving approach", McGraw Hill 2008.
2. Joe Wigglesworth and Paula McMillan, "Java Programming: Advanced Topics" Cengage Learning. 3rd Edition 2009.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

16MCC107 COMPUTER ORGANIZATION

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:

1. Understand the basics of Boolean algebra.
2. Learn the concepts of digital circuits.
3. Understand the various computer micro operations.
4. Acquire the knowledge of computer organization and design.
5. Learn various topics pertaining to the operations of Central Processing Unit.
6. Understand the basic principles of concurrent and parallel processing.

Course Outcomes:
After completion of the course, the students would be able to:

1. Acquainted with the representations of number systems.
2. Understand the concepts of Boolean algebra and KMaps.
3. Learn the basic computer organization and its design.
4. Understand the components of CPU and their functionality.
5. Learn the input–output and memory organization.
6. Understands Parallel processing and its applicability.

UNIT -I
Data Representation: Data types, Complements, Fixed and Floating Point Representation, Other binary codes and error Detection codes.

Digital Logic Circuits: Digital Computers, Logic Gates, Boolean algebra, Map Simplification, Combinational Circuits, Flip Flops, Sequential Circuits.

Digital Components: Integrated Circuits, Decoder, Multiplexers, 'Registers, Shift Registers, Binary counter, Memory unit.

UNIT -II
Register Transfer And Micro Operations: Register Transfer language, Register transfer, Bus and Memory Transfer, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations and Arithmetic logic shift unit.

Basic Computer Organization And Design: Instruction codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycles, Memory Reference Instructions, Input, Output and Interrupts, Design of Accumulator logic.

UNIT -III
Central Processing Unit: Micro programmed Control, Control Memory, Address Sequencing, Micro program Example, Design of Control Unit. General Register Organization, Stack Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control.

UNIT -IV
Input–Output And Memory Organization: Peripheral Devices, I/O output interface, Asynchronous data transfer, Modes of transfer, Priority Interrupt, DMA, Input output Processor, Serial Communication. : Memory Hierarchy, Main Memory, Cache Memory.

UNIT -V
Parallel Processing: Trends of Parallel Processing, UniProcessor Architecture, Parallel Processing Mechanism, Multi Programming and Time Sharing, Pipeline Computers, Array Computers, Multi-Processor Systems, Serial Vs Parallel Processing, Parallelism Vs Pipelining.

Text Books:

1. M. Morris Mano, "Computer System Architecture", Pearson Asia/Prentice Hall, 3rd edn.2007. (For Units I,II,III and IV)
2. Kai Hwang and Faye A.Briggs, “Computer Architecture and Parallel Processing” International edn., 1984 (For Unit : V),

Suggested Reading:

1. William Stallings "Computer Organization & Architecture", Pearson Education, Sixth Edition, 2003.

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Master of Computer Applicatio
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16MCC108 **SOFTWARE ENGINEERING**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Provide the basic definition and understanding of software engineering.
2. Acquaint the software engineering paradigms.
3. Familiarize with the concepts of software requirement specifications.
4. Understand the software design concepts.
5. Learn the concepts of software testing.

Course Outcomes:
After completion of the course, the students will be able to:
1. Understand the basics of software engineering principles
2. Acquire the knowledge on software development models.
3. Translate the problems into software design models.
4. Acquaint with the basics of software design principles.
5. Understand the basics software testing approaches and strategies.
6. Learn the concepts of software reengineering, reverse engineering and software maintenance activities.

UNIT-I
Introduction to Software Engineering: Software Engineering Challenges, Software Engineering approach, Software Process, Waterfall, Iterative, Prototype, Incremental, Spiral, Models.

UNIT- II
Software Requirement Analysis and specification: Software Requirements, Need for SRS, Problem analysis, Requirements specification, IEEE format of SRS, Function Oriented Design: Design Principles, Module-level concepts, Design notations and specifications

UNIT-III
Structured design methodology, Software Architecture: Role of Software Architecture, Architecture views, Component and Connector view. Risk Engineering - Risk Analysis and Management. RMMI Techniques.

UNIT-IV
Effort & Schedule Estimation, Software Project Estimation, COCOMO, Function Point Analysis. Testing Techniques & Strategies: white box, black box, basis path testing, Unit testing, Integration testing, Validation testing & System Testing

UNIT-V
Software Maintenance, Maintenance activities, Software Reengineering, Reverse Engineering, Forward Engineering, Software configuration management.

Text Books:
1. Roger S, Pressman, "**Software Engineering: A Practitioner's Approach**", 6thddition, Tata Mc Graw Hill, 2010.

Suggested Reading:
1. Pankaj Jalote "**An Integrated Approach to Software Engineering**", 3rd edition, Narosa Publishing House, 2010.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

16MCC109 **DATA STRUCTURES USING C ++**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Know the basic concepts of C++.
2. Acquire the knowledge on classes and Inheritance concepts.
3. Aware of different linear data structures concepts.
4. Get the knowledge on different sorting techniques.
5. Understand the concept of hashing and collision resolution techniques.
6. Aware of different non-linear data structures.

Course Outcomes:
After completion of the course, students would be able to:
1. Gain knowledge on basic concepts of C++.
2. Get the knowledge on classes and inheritance concepts.
3. Learn various linear data structures concepts.
4. Distinguish between different sorting techniques.
5. Implements different collision resolution techniques on hashing.
6. Acquire knowledge on various non-linear data structures.

UNIT- I
C++ Introduction: Overview, Program Structure, namespace, identifiers, variables, constants, data types, enum, operators, Overloading of functions, default arguments, this pointer, inline functions, dynamic memory allocation and De allocation (new and delete), operator overloading.

UNIT- II
C++ Class Overview: Class Definition, Objects, Class Members, Access Control, Class Scope, Constructors and destructors, friend functions. Function and class templates, Inheritance basics, base and derived classes, inheritance types, base class access control, overriding, runtime Polymorphism using virtual functions.

UNIT- III
Sparse Matrix: Representation and its efficiency in storage.
Stacks: Definition and Operations and Applications, Array and Linked Representation of Stacks.
Queues: Definition and Operations. Array and Linked Representation of Queues and their Applications.
Linked Lists: Definition and Operations, Double linked list representation, Circular linked lists.

UNIT- IV
Sorting: Bubble sort, Merge Sort, Selection Sort, heap sort, Quick sort, Insertion sort , Posterior Analysis, Sequential Search, binary search.
Hashing : Hash table, its implementation, Hash table representation, types of hashing,collision resolution techniques.

UNIT- V
Trees: Definitions and Properties, Representation of Binary Trees, Operations. Binary Tree Traversal, Binary search trees, operations- insertion, deletion and searching, heap trees. AVL Tress and Operations on AVL Trees.B-Trees and its operations.
Graphs: Definition and representation of graphs, data structures for representing graphs- edge list structures, adjacency list structures, adjacency matrix,Graph traversals – BFS and DFS. Spanning trees, minimum spanning trees, prim's and kruskal's algorithms.

Text Books:
1. Object Oriented Programming with C++, E. Balaguru Swamy, Tata McGraw Hill,4th Edition, 2008.
2. Data structures, Algorithms and Applications in C++, S. Sahani, Universities Press. 2nd Edition, 2006.

Suggested Reading:

1. Data structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI. 2nd Edition, 2002.
2. Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and D.Mount, Wiley student edition, seventh edition, John Wiley and Sons, 2011.
3. Data structures and Algorithm Analysis in C++, Mark Allen Weiss, 3rdEdition, Pearson Education. Ltd., 2007.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

16MCC110 **OPERATIONS RESEARCH**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
The students will:
1. Understand and analyze managerial problems in industry to utilize resources effectively.
2. Formulating the mathematical models for real world managerial problems in industry.
3. Minimizing loss and maximizing profit of an organization.
4. Find the shortest paths to the transportation problems.
5. Provide networks and queuing models which are applicable to manage organizational functionalities.
6. Learn techniques to solve linear programming problems using different methods.
7. Solve problems using dynamic programming.

Course Outcomes:
After completion of the course, the students would be able to:
1. Apply the methods to utilize organizational resources effectively.
2. Formulate mathematical models for real world problems.
3. Apply the methods of maximization and minimization to get more profits and reduced losses.
4. Solve linear programming problems.
5. Model and solve the managerial problems using dynamic programming.
6. Apply networks and queuing models to solve organizational problems.

UNIT - I
Linear Programming: Introduction, Concepts of Linear Programming Model, Development of LP models, Graphical Method, Linear Programming Methods, Special cases of Linear Programming, Duality.

UNIT - II
Transportation Problem: Introduction, Mathematical Model for Transportation Problem, Types of Transportation problem, Methods to solve Transportation Problem, Transshipment Model.

UNIT - III
Assignment Problem: Introduction, Zero-One Programming Model for Assignment Problem, Types of Assignment Problem, Hungerian Method, Branch-and-Bound Technique for Assignment Problem.
Network Techniques: Introduction, Shortest path models – Systematic Algorithm, Dijkastras Algorithm, Floyd Algorithm, Minimum Spanning Tree Problems – PRISM, Kruskal's Algorithms.

UNIT - IV
Dynamic Programming: Introduction, Applications of Dynamic Programming, Solution of Linear Programming Problem through Dynamic Programming.

UNIT - V
Game Theory: Introduction, Game with Pure Strategies, Game with Mixed Strategies, Dominance Property, Graphical Method for 2 X n or m x 2 Games, Linear Programming Approach for Game Theory.

Text Books:
1. Panneerselvam "Operations Research", Second Edition, PHI, 2006.

Suggested Reading:
1. Prem Kumar Gupta and DS Hira, "Operations Research", S. Chand, 2011.
2. JK Sharma, "Operations Research Theory and Applications", Fourth Edition, MacMillan, 2010.
3. Rathindra P sen, "Operations Research- Algorithm and Application", PHI, 2010.
4. K.Swarup, P.K. Gupta and Man Mohan "Operations Research" Sultan Chand & Sons, 2012.

16MTC102 **PROBABILITY AND STATISTICS**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
The students will:
1. Extend and formalize knowledge of the theory of probability and random variables.
2. Introduce new techniques for carrying out probability calculations and identifying probability distributions.
3. Motivate the use of statistical inference in practical data analysis.
4. Study the elementary concepts and techniques in statistical methodology.
5. Provide the introduction to subsequent statistics courses.

Course Outcomes:
After completion of the course, the students would be able to:
1. Describe discrete data graphically and compute measures of centrality and dispersion.
2. Compute probabilities by modeling sample spaces and applying rules of permutations and combinations, additive and multiplicative laws and conditional probability
3. Construct the probability distribution of a random variable, based on a real-world situation, and use it to compute expectation and variance.
4. Compute probabilities based on practical situations using the binomial and normal distributions.
5. Use of statistical inference in practical data analysis.

UNIT –I:
Introduction to Statistics: Over view, origin and development of Statistics, Managerial applications of statistics. Methods for collection of data, constructing a graphical methods (Histogram, Ogive curve, Pie-Chart, Stem and Leaf diagram) Measures of Central Tendency, Measures of Dispersion: Skewnes and Kurtosis.

UNIT-II:
Probability and Random Variables - Introduction to Probability: Concepts and Definitions of probability-classical and axiomatic approach. Sampling theorems- Addition theorem, multiplication theorem and conditional probability and Bayes Theorem.
Random variables: Expectation and variance of a random variable, Probability distribution function, properties of discrete and continuous probability distribution functions.

UNIT-III:
Probability distributions- Discrete probability distributions: Binomial distribution, Properties and applications - Poisson distribution, Properties and applications.
Continuous probability distributions: Normal distribution, Standard normal random variable, Properties and applications, Exponential distribution Properties and applications.

UNIT-IV:
Sampling Estimation-Statistical estimation: Point and interval estimation, confidence interval.
Testing of Hypothesis: Steps for statistical testing, Type I and Type II errors. Large sample tests-Test for one and two proportions, Test for one and two means, Test for equality of variances.

UNIT-V:
Hypothesis testing for Small samples and Curve Fitting-Small sample tests: t- distribution- Properties and applications, Testing for one and two means.
Chi-square distribution: Test for goodness of fit, Test for independence of attributes

Curve fitting: Correlation-Properties, Regression-Lines of Regression-Properties. Fitting of Straight Line and Growth Curves.

Text Books:

1. S.C.Guptha & V.K.Kapoor "Fundamentals of Mathematical Statistics" , Sultan Chand Pub.,2014.
2. S.C.Guptha "Fundamentals of Statistics", Himalaya Publishing, 7th Edition , 2014.

Suggested Reading:

1. A.K. Md. Ehsanes Saleh Vijay K. Rohatgi, "An Introduction to Probability and Statistics", Wiley, 2008.
2. Anthony J. Hayter "Probability and Statistics for Engineers and Scientists", Brooks/Cole; International edition, 4th Revised edition, 2012

HEAD OF DEPARTME
Master of Computer Applicatio
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16MCC111 OBJECT ORIENTED PROGRAMMING LAB UISNG JAVA

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will be able to:
1. Memorize the object oriented programming concepts.
2. Create classes, objects and constructors.
3. Know the difference of overloading and overriding.
4. Learn the concepts of exception handling and multithreading.
5. Acquire the knowledge on I/O package.
6. Learn the Applets and AWT components.

Course Outcomes:
After completion of the course, students would be able to:
1. Write programs using object oriented programming.
2. Develop classes, objects and constructors.
3. Implement multithreading and exception handling concepts.
4. Create programs on strings and I/O streams.
5. Develop Applets and AWT Components
6. Apply event handling and arrange layout managers.

List of Sample Problems/Experiments:

1. Write programs to perform basic operations (Operators, Control Structures, Arrays etc..)
2. Write a program to create classes, objects
3. Write Programs using constructor
4. Write programs using method overloading
5. Write programs using method overriding, dynamic method dispatch
6. Write Programs using inheritance
7. Write programs on interfaces
8. Write programs on packages
9. Write programs on Exception handling
10. Write programs on Multithreading
11. Write programs using wrapper classes
12. Write Programs using I/O streams and files
13. Write programs on applets
14. Write Programs using AWT
15. Write programs using Event handling, Layout managers

Suggested Reading:

1. Patrick Naughton "Java, the Complete Reference" Tata McGraw Hill 2005.
2. Richard A.Johnson, "Java Programming and Object-Oriented Application Development" Cengage Learning, India edition 2009.

16MCC112 **DATA STRUCTURES LAB USING C++**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:

Students will:

1. Know the concepts of classes, constructors and destructors.
2. Acquire the knowledge on inheritance concepts.
3. Aware of different linear data structures concepts.
4. Get the knowledge on different sorting techniques.
5. Understand the concept of hashing and collision resolution techniques.
6. Aware of different non-linear data structures.

Course Outcomes:

After completion of the course, students would be able to:

1. Design classes, constructors and destructors.
2. Implement programs on various inheritance types.
3. Develop programs on various linear data structures.
4. Implement the programs on different sorting techniques.
5. Implements different collision resolution techniques on hashing.
6. Develop programs on various non-linear data structures.

List of Sample Problems/Experiments:

1. Write a C++ program to illustrate the concept of Class with Constructors, Methods.
2. Write a C ++ program to illustrate the concept of Inheritance.
3. Write a C++ programs for implementing Stack using following:
   a) Arrays
   b) Linked Lists
4. Write a C++ programs for implementing Queues using following:
   a) Arrays
   b) Linked Lists
5. Write a C++ programs for implementing Linked Lists:
   a) Single Linked Lists
   b) Double Linked Lists
   c) Circular Linked Lists
6. Write a program for infix to postfix conversion.
7. Write a C++ program for implementing Binary Search Trees.
8. Write a C++ program for implementing Hashing.
9. Write a C++ program for implementing Quick Sort.
10. Write a C++ program for implementing Insertion Sort.
11. Write a C++ program for implementing Selection Sort.
12. Write a C++ program for implementing Merge Sort.
13. Write a C++ program for implementing Graph Traversals DFS and BFS.

Suggested Reading:

1. Complete reference to C++, 4th Edition, Herbert Schildt., 2003.
2. Object Oriented Programming with C++, E. BalaguruSwamy, Tata McGraw Hill, 4th Edition, 2008.
3. Advanced Data structures & Algorithms in C++,V.V.Muniswamy,Jaico Publishing House.
4. Data structures via C++, A.M. Berman, Oxford University Press.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

16MCC113 **DATABASE MANAGEMENT SYSTEM**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:

1. Learn the basic fundamentals of database.
2. Understand the data models.
3. Make a study of SQL and relational database design.
4. Know about data storage techniques and query processing.
5. Impart knowledge in transaction processing, concurrency control techniques.
6. Study the concepts of system crash and recovery management.

Course Outcomes:
After completion of the course the students would be able to:

1. Acquire the knowledge of the basic concepts of the database.
2. Create the data models.
3. Map ER models into Relations and normalize the relations
4. Acquire the knowledge of query evaluation.
5. Gain the knowledge of concurrent execution and transaction management.
6. Understand the issues in system crash and recovery measures.

UNIT-I
Introduction to DBMS and DB Models: File system Vs. DBMS, Advantages of DBMS, Data Abstraction, Database Design, and ER diagrams, Entities, Attributes and Entity Sets, Relationship Sets, Additional features of ER model, Conceptual Design with the ER model. The Relational Model: Introduction to the Relational Model, Integrity Constraints over relations, Logical Database design(ER to Relational), creating tables, views, Destroying / Altering Tables and Views.

UNIT-II
Schema Refinement and Normal Forms: Introduction to Schema Refinement, Functional Dependencies, Normal Forms, Decompositions, Normalizations. **Structured Query Language**: Overviews, Basic Structure of SQL, Queries, Set Operations, Null Values, Additional Basic Operations, Aggregate Functions, Nested Sub queries, Join Expression. **Advanced SQL**: SQL Data Types, Integrity Constraints, Authorization, Functions and Procedural Constructs, Cursors, Triggers.

UNIT-III
Indexing and Hashing: Basic Concepts, File Organization Indexing, Index Data Structures, Tree-Structured indexing: Indexed sequential Access Method (ISAM) B+ Trees: A dynamic index structure, format of a node, search, Insert, Delete, Duplicates+ Trees in Practice.
Hash-Based Indexing: Static Hashing, Extendable Hashing, Linear Hashing, Extendable Hashing versus Linear Hashing. Comparison of Ordered Indexing and Hashing.

UNIT-IV
Transaction Management: ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control. **Concurrency Control**: 2PL, Serializability, and Recoverability, Introduction to Lock Management, Dealing with Deadlock, Specialized Locking Techniques, Concurrency Control without Locking.

UNIT-V
Crash Recovery: Introduction to ARIES, The Log, Other Recovery Related Structures, The WAL, Check pointing, recovering from a system Crash, Media recovery. Security and Authorization: Introduction to database security, Access Control Discretionary Access control, Mandatory access control. Additional Issues related to Security.

Text Books:

1. Silberschataz, Korth, Sudarshan "Database System Concepts", 5th Edition McGraw Hill 2011.

Suggested Reading:

1. Raghu Ramakrishna, Johannes, Gehrke "Database Management Systems", 3rd Edition, Mc-Graw Hill 2003
2. Ramez Elmasri, Shamkant B. Navathe, Somayajulu, Gupta "Fundamentals of Database systems", Pearson Education 2006.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

16MCC114 **WEB TECHNOLOGIES**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Acquire knowledge on XHTML and CSS.
2. Learn basics of JavaScript.
3. Know how to create interactive web pages.
4. Acquire knowledge on XML.
5. Learn basics of PHP and MYSQL databases.
6. Acquire knowledge on client side and server side programming.

Course Outcomes:
After completion of the course, the students would be able to:
1. Develop the web pages using XHTML and CSS.
2. Perform client side validations.
3. Create interactive web pages.
4. Store and transport data using XML.
5. Access MYSQL database using PHP.
6. Design and Develop simple websites.

UNIT – I
Introduction to XHTML: origins and evolution of HTML and XHTML, basic syntax, standard XHTML document structure, basic text markup, images, hypertext links, lists, tables, forms, frames, syntactic differences between HTML and XHTML.
Cascading Style Sheets (CSS): Introduction, levels of style sheets, style specification formats, selector forms, property value forms, font properties, list properties, color, alignment of text, box model, background images, positioning.

UNIT – II
Basics of JavaScript: overview of JavaScript, object orientation and JavaScript, general syntactic characteristics, primitives, operations, expressions, screen output and keyboard input, control statements, object creation and modification, arrays, functions, constructors, pattern matching using regular expressions, errors in scripts.

UNIT- III
JavaScript and XHTML Documents: JavaScript execution environment, document object model, element access in JavaScript, events and event handling, handling events from body elements, handling events from button elements, Handling events from text box and password elements.
Dynamic Documents with JavaScript: Introduction, positioning elements, moving elements, element visibility, changing colors and fonts, dynamic content, stacking elements, locating the mouse cursor, reacting to a mouse click, slow movement of elements, dragging and dropping elements.

UNIT – IV
Introduction to XML: Introduction, syntax of XML, XML document structure, document type definitions, namespaces, XML schemas, displaying raw XML documents, displaying XML documents with CSS, XSLT style sheets, XML processors.

UNIT – V
Introduction to PHP: origins and uses of PHP, overview of PHP, general syntactic characteristics, primitives, operations, expressions, output, control statements, arrays, functions, pattern matching, form handling, cookies, session tracking.
Database Access through the web: MYSQL database system, database access with PHP and MYSQL.

Text Book:

1. Robert W.Sebesta, "**Programming the World Wide Web**", 4^{th} Edition, Pearson Education, 2008.

Suggested Reading:

1. Thomas Powell "HTML & XHTML: The Complete Reference", 4^{th} Edition, Tata McGraw-Hill, 2003.
2. Thomas A Powell, Fritz Schneider "JavaScript: The Complete Reference", 3^{rd} edition, Tata McGraw Hill, 2013.
3. Steven Holzner "PHP: The Complete Reference", McGraw Hill Education, 2008.

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Master of Computer Applicatio
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16MCC115 DESIGN AND ANALYSIS OF ALGORITMS

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:

Students will:

1. Learn the various asymptotic notations and amortized analysis.
2. Acquire knowledge on divide and conquer and Greedy designing techniques.
3. Learn the concepts of dynamic programming techniques.
4. Acquire knowledge on backtracking and branch and bound designing techniques.
5. Learn the concepts of NP-Hard and NP-completeness.
6. Learn important algorithmic design paradigms and methods of analysis.

Course Outcomes:

After completion of the course, the students would be able to:

1. Analyze the time and space complexities of algorithms.
2. Solve various problems using divide and conquer and greedy method.
3. Solve various problems using dynamic programming, backtracking and branch and bound techniques.
4. Identify the complexity classes such as P, NP, NP-Complete and NP-Hard to which an algorithm belongs and design a feasible solution.
5. Determine the amortized running time of the problem.

UNIT-I

Introduction: Algorithm Definition, Algorithm Specification, Performance Analysis.
Review of Elementary Data Structures: Stacks, Queues, Trees, Dictionaries, Priority Queues, Sets and Disjoint Set Union.

UNIT-II

Divide and Conquer: General Method, Finding the Maximum and Minimum, Merge Sort, Quick Sort, Stassen's Matrix Multiplication.
Greedy Method: General method**,** Knapsack problem, Job Sequencing with Deadlines, Minimum Cost Spanning Trees, Optimal Storage on Tapes, Optimal Merge Patterns.

UNIT-III

Dynamic Programming: General Method, Multistage Graphs, All-Pairs Shortest Paths, Optimal Binary Search Trees, 0/1 Knapsack, Reliability Design, Traveling Salesmen Problem.
Basic Traversal and Search Techniques: Breadth First Search (DFS) and Traversal, Depth First Search (DFS) and Traversal, Connected Components and Spanning Trees, Bi-connected Components and DFS.

UNIT-IV

Backtracking: General Method, 8-Queen's Problem, Sum of Subsets, Graph Coloring, Hamiltonian Cycles, Knapsack Problem.
Branch and Bound: The Method, 0/1 Knapsack Problem, Traveling Salesperson Problem.

UNIT -V

NP-Hard and NP-Complete Problems: Basic Concepts, Cook's Theorem, NP-Hard Graph Problems and NP-Hard Scheduling Problems.

Text Book:

1. Ellis Horowitz, Sartaj Shani, Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, University Press, 2007.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

Suggested Reading:

1. R. Pannerselvam “Design and Analysis of Algorithms”, PHI, 2007.
2. Hari Mohan Pandey "Design and Analysis of Algorithms", University Science Press, 2009.
3. Aho, Hopcroft, Ullman “The Design and Analysis of Computer Algorithms”, Pearson Education, 2000.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein “Introduction to Algorithms”, 2nd Edition, Prentice Hall of India Private Limited, 2006.
5. Anany Levitin “Introduction to the Design & Analysis of Algorithms”, Pearson Education, 2003.
6. Parag H.Dave, Himanshu B. Dave “Design and Analysis of Algorithms”, Pearson Education, 2nd Edition, 2014.

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16MCC116 **OPERATING SYSTEMS**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:

Students will:

1. Aware of the evolution and fundamental principles of operating system, processes and their communication.
2. Aware of the process execution in terms of threads and they came to know about different thread libraries.
3. Aware of the various process synchronization tools and they came to know about dead lock and its issues.
4. Aware of the various operating system components like process management, memory management.
5. Know about file management and I/O subsystems concepts in operating systems.
6. Aware of components of operating system in LINUX with relevant case study.

Course Outcomes:

After completion of the course the students would be able to:

1. Get the knowledge of operating system components and its services.
2. Understand the basic process execution in terms of threads and they came to know about different thread libraries.
3. Learn the various process synchronization tools and they came to know about dead lock and its issues.
4. Distinguish the mapping between the physical memory and virtual memory.
5. Apply file handling concepts in OS perspective.
6. Acquire the knowledge of components and services of LINUX Operating System.

UNIT-I

Operating System Introduction: Operating Systems Objectives and functions, Computer System Architecture, OS Structure, OS Operations, Evolution of Operating Systems - Simple Batch, Multi programmed, time shared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, Special - Purpose Systems**.**

System structures: Operating System Services, System Calls, Types of System Calls, System Programs, Operating System Design and Implementation, Operating System Structure, Virtual Machines, Operating System debugging.

Process Concept: Process Concept, Process Scheduling, Operations on process, Inter process Communication.

Multithreaded Programming: Multithreading Models, Thread Libraries, Threading Issues.

UNIT–II

Process Scheduling: Scheduling Criteria, Scheduling Algorithms, Thread Scheduling, Multiple Processor Scheduling.

Process Synchronization: Critical Section Problem, Peterson's Solution, Semaphores, Classic Problems of Synchronization, Monitors.

Deadlocks: System Model, Deadlock Characterization, Methods in Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock.

UNIT- III

Memory Management Strategies: Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation.

Virtual Memory Management: Demand Paging, Copy on Write, Page Replacement Algorithms, Allocation of Frames, Thrashing.

System Protection: Goals of Protection, Principles of Protection, Domain of Protection, Access Matrix.

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Master of Computer Applications
C.B.I.T., Hyderabad-500 075

UNIT- IV

File System: File Concept, Access Methods, Directory and Disk Structure, File System Mounting, File Sharing, Protection.

Implementing File System: File System Structure, File System Implementation, Directory Implementation, Allocation Methods, Free Space Management, Efficiency and Performance, Recovery.

Secondary Storage Structure: Overview of Mass Storage Structure, Disk Structure, Disk Attachment, Disk Scheduling, Disk Management, Swap Space Management, RAID Structure.

UNIT- V

I/O Systems: I/O Hardware, Application I/O Interface, Kernel I/O Subsystem, Transforming I/O Request to Hardware Operations, STREAMS.

Case Study: **The Linux System**: Linux History, Design Principles, Kernel Modules, Process Management, Scheduling, Memory Management, File Systems, Input and Output, Inter process Communication.

Text Book:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", 7th Edition, John Wiley and Sons, 2011.
2.

Suggested Reading:

1. Gary Nutt, "Operating Systems", 3rd Edition, Pearson Education, 2004.
2. Harvey M. Deital, "Operating Systems", 3rd Edition, Pearson Education, 2004.

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16MCC117 DATABASE MANAGEMENT SYSTEMS LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:
1. Present SQL and procedural interfaces to SQL comprehensively.
2. Give an introduction integrity constraints on a database using a state-of-the-art RDBMS
3. Understand the concepts of Views and their usability.
4. Impart the knowledge PL/ SQL including stored procedures, stored functions, cursors, packages
5. Understand the Data Control Language (DCL) privileges and roles.
6. Present the concepts of Forms and Reports

Course Outcomes:
After completion of the course, the students would be able to:
1. Populate and query a database using SQL DML/DDL commands.
2. Declare and enforce integrity constraints on a database using a state-of-the-art RDBMS
3. Implement the views with multiple options.
4. Programming PL/SQL including stored procedures, stored functions, cursors, packages.
5. Access and control authorization.
6. Design and build a Forms and Reports

List of Programs:

I. SQL
1. Creating tables using commands in DDL
2. Manipulating the data using DML
3. Using Aggregate functions Set operators
4. Simple condition query creation using SQL Plus
5. Complex condition query creation using SQL Plus
6. Exercising all types of Joins, views
7. Exercising Data Control Language and Transaction Control Language

II. PL/SQL

8. Demonstration of Blocks, Cursors,
9. Procedures, Functions and Packages.
10. Creation of Triggers

III. FORMS

11. Designing forms for various databases.(Creating, Inserting, Updating, Deleting)

IV. REPORTS

12. Generation using SQL Reports
13. Creation of Reports based on different queries.

Note:-The creation of sample database for the purpose of the experiments is expected to be pre-decided by the instructor.

Suggested Reading:

1. Nilesh Shah "**Database Systems Using Oracle**", PHI, 2007.
2. Rick F Van der Lans "**Introduction to SQL**", 4th Edition, Pearson Education, 2007.
3. Benjamin Rosenzweig, Elena Silvestrova "**Oracle PL/SQL by Example**", 3rd Edition, Pearson Education, 2004.
4. Albert Lulushi "**Oracle Forms Developer's Handbook**", Pearson Education, 2006.

16MCC118 **WEB TECHNOLOGIES LAB**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:

1. Practice various tags in XHTML and CSS.
2. Practice programs using JavaScript control statements, arrays, functions etc.
3. Practice programs using events on the XHTML elements.
4. Practice programs using XML.
5. Practice programs using PHP control statements, arrays, functions etc.
6. Practice programs using MYSQL database.

Course Outcomes:
After completion of the course, the students would be able to:

1. Create static web pages using XHTML and CSS.
2. Create dynamic web pages and perform client side validations using JavaScript.
3. Store and Transport data using XML.
4. Write programs using PHP.
5. Access MYSQL database through PHP.
6. Design and Develop websites.

List of programs:

XHTML: Create programs using the following concepts

1. Text Markup Tags.
2. Images.
3. Hyperlinks.
4. Ordered and Unordered Lists.
5. Tables and Nested Tables.
6. Forms.
7. Frames.

CSS: Create programs using the following concepts

8. Inline Styles.
9. Internal Stylesheet.
10. External Stylesheet.
11. Pseudo Classes.
12. Font properties. Borders, Margins, Paddings and Background Images.

JAVASCRIPT: Create programs using the following concepts

13. Pre-defined objects (Date, String, Math etc.,).
14. Selection statements switch statements and loop statements.
15. Demonstrate user defined objects.
16. Array object.
17. Functions.
18. Illustrate pattern matching using regular expressions.
19. Handle various events occurred in the HTML document.
20. Validate the form data.
21. Illustrate positioning of the HTML elements in the web page.
22. Demonstrate moving elements, elements visibility, stacking elements and dragging and dropping elements.

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XML: Create programs using the following concepts

24. XML Documents.
25. XML Schema for the XML documents.
26. CSS style sheets for the XML documents.
27. XSLT style sheet for the XML documents.
28. Design an XML document to store information about patients in a hospital.

PHP: Create programs using the following concepts

29. Selection statements and loop statements.
30. Arrays.
31. Functions.
32. Pattern matching.
33. Handling forms.
34. Access MYSQL database through PHP.

Suggested Reading:

1. Robert W.Sebesta “**Programming the World Wide Web**”, 4th Edition, Pearson Education, 2008.
2. Thomas Powell “**HTML & XHTML: The Complete Reference**”, 4th Edition, Tata McGraw-Hill, 2003.
3. Thomas A Powell, Fritz Schneider “**JavaScript: The Complete Reference**”, 3rd Edition, Tata McGraw Hill, 2013.
4. Steven Holzner “**PHP: The Complete Reference**”, McGraw Hill Education, 2008.

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Master of Computer Applications
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16MCC119 OPERATING SYSTEMS LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:
1. Learn programs on system calls, threads and signals
2. Learn programs on process scheduling algorithms
3. Learn programs on Inter process Communication.
4. Learn programs on synchronization problems
5. Learn programs on files
6. Learn about the basic Linux commands.
7. Learn basic shell programs.

Course Outcomes:
After completion of the course, the students would be able to:
1. Write programs on system calls, threads and signals.
2. Write programs on process scheduling algorithms
3. Write programs on Inter process Communication.
4. Write programs on synchronization problems
5. Write programs on files
6. Use basic Linux commands
7. Write basic shell programs

List of Programs:

1. Programs using process related systems calls.
2. Print type of file for each command line arguments.
3. Programs to create threads.
4. Program using Signals.
5. Programs on process scheduling algorithms
6. Echo server-using pipes.
7. Echo server-using message Queues.
8. Producer & Consumer Problem using Semaphores and Shared memory
9. Producer & Consumer Problem using message passing.
10. Readers & Writers Problem using Semaphores and Shared memory
11. Dining philosopher's problem using semaphores.
12. Programs related to files
13. Program using File Locking.
14. Basic Linux Commands
15. Basic shell scripts

Suggested Reading:

1. W. Richard Stevens, "**Unix Network Programming**", Pearson Education Inc, PHI Learning 1990.
2. Behrouz A. Forouzan, Richard F. Gilberg, "**UNIX and Shell Programming: A Textbook**", Books/Cole-Thomson Learning, 2003.

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C.B.I.T., Hyderabad-500 075

16MBC04 ORGANIZATIONAL BEHAVIOUR (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:
1. Familiarize the students with the basic understanding of individual behavior and explore issues of motivation, communication, leadership, power, politics and organizational change.
2. Provide a comprehensive, up-to-date, practical knowledge base that provides an engaging introduction and concepts of organizational behavior.
3. Orient the students with real life examples that correlate the theory to actual practice from the industry.
4. Enable the students to practically implement the Organizational Behavior principles and practice in real time situations in their careers and life.

Course Outcomes:
After completion of this course students would be able to:
1. Analyze the behavior, perception and personality of individuals and groups in organizations in terms of the key factors that influence organizational behavior.
2. Assess the potential effects of organizational-level factors on organizational behavior.
3. Critically evaluate the potential effects of motivating and leading the individuals in the Organization.
4. Analyze organizational behavioral issues in the context of groups, power, politics and conflict issues.

UNIT – I
Organizational behavior – Nature and levels of organizational behavior – Individuals in organization – Individual differences – Personality and Ability – The Big 5 Model of personality – Organizationally relevant personality traits. The nature of perception – characteristics of the perceiver, target and situation – perceptual problems.

UNIT – II
Organizational Designs and Structures – Traditional and Contemporary organizational designs. Organizational culture and ethical behavior – factors shaping organizational culture– creating an ethical culture.

UNIT – III
Motivation–early and contemporary theories of motivation. Leadership – early and contemporary approaches to leadership.

UNIT – IV
Groups and group development – turning groups into effective teams. Managing change – process, types and challenges. Communicating effectively in organizations – communication process–barriers to communication–overcoming barriers to communication–persuasive communication–communication in crisis situations.

UNIT – V
Power, Politics, Conflict and Negotiations–Sources of individual, functional and divisional Power. Organizational politics. Conflict – causes and consequences – Pondy's model of organizational conflict–conflict resolution strategies.

Text Books:

1. Jennifer George and Gareth Jones “Understanding and Managing Organizational Behavior”, Pearson Education Inc., 2012
2. Jon L Pierce and Donald G. Gardner, “Management and Organizational behavior”, Cengage Learning India (P) Ltd., 2001.
3. Richard Pettinger “Organizational Behaviour”, Routledge, 2010

Suggested Reading:

1. Stephen P. Robbins, Jennifer George and Gareth Jones “Management and Organizational Behavior”, Pearson Education. Inc., 2009.
2. K. Aswathappa “Organizational Behavior”, Himalaya Publishing House., 2013.
3. John Schermerhorn, Jr. James G. Hunt and Richard N. Osborn “Organizational Behavior”, 10^{th} Edition, Wiley India, Edition. 2009.

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Master of Computer Applications
C.B.I.T., Hyderabad-500 075

16CEC03 HUMAN VALUES AND PROFESSIONAL ETHICS (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:

Students will:

1. Develop the critical ability among students to distinguish between what is of value and what is superficial in life
2. Enable the students understand the values, the need for value adoption and prepare them meet the challenges
3. Enable the students develop the potential to adopt values, develop a good character and personality and lead a happy life
4. Motivate the students practice the values in life and contribute for the society around them and for the development of the institutions /organization around they are in.
5. Make the students understand the professional ethics and their applications to engineering profession

Course Outcomes:

After completion of the course, students would be able to:

1. Develop the capability of shaping themselves into outstanding personalities, through a value based life.
2. Turn themselves into champions of their lives.
3. Take things positively, convert everything into happiness and contribute for the happiness of others.
4. Become potential sources for contributing to the development of the society around them and institutions / organizations they work in.
5. Shape themselves into valuable professionals, follow professional ethics and are able to solve their ethical dilemmas.

UNIT-I

Concepts and Classification of Values –Need and challenges for value Adoption

Definition of Values – Concept of Values – Classification of Values – Hierarchy of Values – Types of Values –Espoused and Applied Values – Value judgement based on Culture – Value judgement based on Tradition – Interdependence of Values Need for value education – Findings of Commissions and Committees - Corruption and illegal practices – Science and Technology without values- Exploitation of nature – Increasing use of violence and intoxicants – Lack of education in values – Implications of education in values – Vision for a better India Challenges for Value adoption – Cultural, Social, Religious, Intellectual and Personal challenges.

UNIT – II

Personal Development and Values in Life

Personal Development: Enlightened self-interest – Accountability and responsibility – Desires and weaknesses – Character development – Good relationships, self-restraint, Spirituality and Purity – The quest for Character – Tests of Character – The key to good character.

Values in Life: Building an ethical policy – Integrating values in everyday life – Archaic Social Values – Parenting practices – Critical Thinking - Analyzing and Prioritizing values – Practicing Yoga and Meditation.

UNIT – III

Practicing Values for the development of Society

Resentment Management and Self-analysis – Positive Thinking and Emotional Maturity – The importance of Women , Children and Taking care of them – Helping the poor and needy – Fighting against addictions and atrocities – Environmental awareness – Working for the Sustainable development of the society. Values in

Education system: Present Scenario- Engineering education –Current trends-Need for quality improvement- Adoption of value education – Principles of Integrity-Institutional Development.

UNIT – IV

Basic Concepts of Professional Ethics

Ethics, Morals and Human life , Types of Ethics, Personal Ethics, Professional ethics, Ethical dilemmas, Indian and Global thoughts on ethics, Profession, Professional and Professionalism, Ethical role of a professional Basic ethical principles, Some basic ethical theories, use of ethical theories. Science, Religion Ethics, Genders and ethics, Media and ethics, Computer Ethics, Case Studies on Professional Ethics, Exemplary life sketches of prominent Indian personalities.

UNIT-V

Ethics in engineering profession

Engineering profession-Technology and Society-Engineering as Social Experimentation-Engineering ethics-Ethical obligations of Engineering Professionals-Role of Engineers-Engineers as Managers-Professional responsibilities of Engineers- Engineers Responsibility for Safety- A few Case Studies on Risk management. Conflicts of Interest- Occupational Crimes- Plagiarism-Self plagiarism-Ethics Audit-Consideration for ethics audit-Ethics Standards and Bench Marking.

Text Books:

1. Subramanian. R. “Professional Ethics” , Oxford University Press , 2013
2. Nagarajan R.S. “A Text Book on Human Values and Professional Ethics” New Age, Pub. 2007.
3. Dinesh Babu S., “Professional Ethics and Human Values” , Laxmi Publications , 2007

Suggested Reading:

1. SantoshAjmera and Nanda Kishore Reddy “Ethics, Integrity and Aptitude”,Mc Grawhill Education Private Limited, 2014.
2. GovindaRajan M., Natarajan S., Senthil Kumar V.S. “Professional Ethics and Human Values” Prentice Hall India Private Limited, 2012.
3. Course Material for Post Graduate Diploma In “Value Education & Spirituality” Prepared by Annamalai University in Collaboration with Brahma Kumaris, 2010

16CEE21 DISASTER MITIGATION AND MANAGEMENT (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:
1. Equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts.
2. Impart knowledge in students about the nature, mechanism causes, consequences and mitigation measures of the various natural disasters including hydro metrological and geological based disasters.
3. Enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters including chemical, biological and nuclear warfare agents.
4. Equip the students with the knowledge of various chronological phases in the disaster management cycle.
5. Create awareness about the disaster management framework and legislations in the context of national and global conventions.
6. Enable students to understand the applications of geospatial technologies like remote sensing and geographical information systems in disaster management.

Course Outcomes:
After completion of the course, students would be able to:
1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at local level
2. Choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan.
3. Understand various mechanisms and consequences of natural and human induced disasters for the participatory role of engineers in disaster management.
4. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans
5. Understand various participatory approaches/strategies and their application in disaster management
6. Understand the concepts of remote sensing and geographical information systems for their effective application in disaster management.

UNIT-I

Introduction to Natural, human induced and human made disasters – Meaning, nature, types and effects; International decade of natural disaster reduction (IDNDR); International strategy of natural disaster reduction (ISDR)

UNIT-II

Natural Disasters– Hydro meteorological disasters: Causes, impacts, Early warning systems, structural and non-structural measures for floods, drought and cyclones; Tropical cyclones: Overview, cyclogenesis, drought monitoring and management.; Geographical based disasters: Earthquakes and Tsunami- Overview, causes, impacts, zoning, structural and non-structural mitigation measures; Tsunami generation; Landslides and avalanches: Overview, causes, impacts, zoning and mitigation measures. Case studies related to various hydro meteorological and geographical based disasters.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

UNIT - III

Human induced hazards: Risks and control measures in a chemical industry, Causes, impacts and mitigation measures for chemical accidents, chemical disaster management, current status and perspectives; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents and traffic accidents.

UNIT – IV

Use of remote sensing and GIS in disaster mitigation and management; Scope of application of ICST (Information, communication and space technologies in disaster management, Critical applications& Infrastructure; Potential application of Remote sensing and GIS in disaster management and in various disastrous conditions like earthquakes, drought, Floods, landslides etc.

UNIT - V

Concept of disaster management: Introduction to disaster management, Relationship between Risk, vulnerability and a disaster, Disaster management cycle, Principles of disaster mitigation: Hazard identification and vulnerability analysis, Early warning systems and forecasting; Infrastructure and development in disaster management; Disaster management in India: National disaster management framework at central, state, district and local levels. Community based disaster management.

Text Books:

1. Rajib, S and Krishna Murthy "Disaster Management Global Challenges and Local Solutions", Universities Press Hyderabad, R.R ,2012.
2. Notes / Reading material published by National Disaster Management Institute, Ministry of Home Affairs, Govt. of India.

Suggested Reading:

1. Navele, P & Raja, C.K. "Earth and Atmospheric Disasters Management, Natural and Manmade", B.S. Publications, Hyderabad.
2. Fearn-Banks "Crises computations approach: A case book approach", Route ledge Publishers, Special Indian Education, New York & London, 2011.
3. Battacharya. T "Disaster Science and Management", Tata McGraw Hill Company, New Delhi.

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Master of Computer Applicatio
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16MEE20 **ENTREPRENUERSHIP (Open Elective)**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:
1. Understand the essence of Entrepreneurship
2. Know the environment of industry and related opportunities and challenges
3. Know the concept a procedure of idea generation
4. Understand the elements of business plan and its procedure
5. Understand project management and its techniques
6. Know behavioral issues and Time management

Course Outcomes:
After completion of the course, students would be able to:
1. Apply the entrepreneurial process
2. Analyze the feasibility of a new business venture and preparation of Business plan
3. Ability to evaluate entrepreneurial tendency and attitude
4. Brainstorm ideas for new and innovative products or services
5. Use a variety of feasibility studies, assess and select prospective new venture concepts
6. Describe how to investigate financing alternatives for specific new venture concepts

UNIT-I
Indian Industrial Environment-competence, Opportunities and Challenges. Entrepreneurship and Economic growth. Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries. Types of enterprises, Corporate Social Responsibility.

UNIT-II
Identification and characteristics of entrepreneurs: Emergence of First generation entrepreneurs, environmental influence and women entrepreneurs. Conception and evaluation of ideas and their sources. Choice of Technology - Collaborative interaction for Technology development.

UNIT-III
Business plan: Introduction, Elements of Business Plan and its salient features. Technical Analysis, Profitability and Financial Analysis, Marketing Analysis. Feasibility studies, Executive Summary.

UNIT-IV
Project Management during construction phase: project organization, project planning and control using CPM, PERT techniques. Human aspects of project management. Assessment of tax burden.

UNIT-V
Behavioral aspects of entrepreneurs: Personality - determinants, attributes andmodels. Leadership concepts and models. Values and attitudes. Motivation aspects. Change behaviour. Time Management: Various approaches of time management, their strengths and weaknesses. The urgency addiction and time management matrix

Text Books:
1. Vasant Desai "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.

2. Prasanna Chandra “Project-Planning, Analysis, Selection, Implementation and Review”, Tata Mc Graw-Hill Publishing Company Ltd. 1995.

Suggested Reading:

1. Stephen R. Covey and A. Roger Merrill “First Things First”, Simon and Schuster Publication, 1994.
2. G.S. Sudha “Organizational Behaviuor”, 1996.
3. Robert D. Hisrich, Michael P. Peters “Entrepreneurship”, Tata Me Graw Hill Publishing Company Ltd., 5^{th} Edition, 2005
4. Robert D. Hisrich, Michael P. Peters “Entrepreneurship”, Tata Me Graw Hill Publishing Company Ltd., 5^{th} Edition, 2005

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16MCC120 **COMPUTER NETWORKS**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:

Students will:

1. Learn the basics of data communication and networks.
2. Get the idea of different layers of OSI model.
3. Learn the concepts of Data Link layer such as Flow and Error control.
4. Study various Routing Algorithms and concepts of Network layers.
5. Learn Transport layer protocols and concepts of Application layer.
6. Obtain the concepts of Socket programming.

Course Outcomes:

After completion of the course, the students would be able to:

1. Gain good knowledge of the basics of data communication and networks.
2. Get an overview of the different layers of OSI model.
3. Gain knowledge of Flow and Error control mechanisms of Data Link layer.
4. Design various Routing Algorithms of Network layer.
5. Formulate Transport layer protocols and concepts of Application layer.
6. Acquire the knowledge of Socket programming.

UNIT - I

Data Communications: Components – Data Representation - Data Flow, Networks- Network Criteria – Physical Structure- Network Models – Categories of Networks – Internetwork, Internet, Protocols and Standards, Network models - ISO/OSI model and its layers, TCP/IP model, Addressing, Physical layer and Media – Digital to Digital conversion, Line coding, Transmission modes, Transmission Media- Guided media – Unguided media, Modem, RS232 Interfacing.

UNIT-II

Data link Layer: Error detection and Correction – Block coding, Hamming code, CRC, Flow and Error control, Noiseless channels - Simple and Stop and Wait protocols, Noisy channels-Stop and Wait ARQ – Go back-N ARQ – Selective repeat ARQ – Piggybacking, HDLC.

Multiple Access: LAN-Pure and Slotted ALOHA, Ethernet IEE 802.3, IEEE 802.4,IEEE 802.5, Bridges.

UNIT-III

Network Layer- Internetworks - Switching– Virtual Circuit and Datagram Network concepts, Logical Addressing, Internet Protocol. Routing – Unicast Routing Protocols - Distance Vector Routing, RIP, Link State Routing, OSPF, Path Vector Routing, BGP.

UNIT-IV

Transport Layer: Services of Transport Layer, Multiplexing.

Transmission Control Protocol (TCP) – Congestion control and Quality of Services - User Datagram Protocol (UDP).

Application Layer: Domain Name Space (DNS), SMTP and FTP, WWW and HTTP, Fire Walls.

UNIT-V

Socket Programming: Socket address, elementary socket system calls, advanced socket system calls, reserved ports, socket option, asynchronous I/O input/output Multiplexing out-of-band data, sockets and signals, Internet super server.

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Master of Computer Applications
C.B.I.T., Hyderabad-500 075

Text Books:

1. Behroz A Forouzan, “Data Communications and Networking”, 4th Edition, Tata McGraw – Hill, 2009.
2. W. Richard Stevens, “Unix Network Programming”, Pearson Education Inc, PHI Learning 1990.

Suggested Reading:

1. Andrew S. Tanenbaum, “Computer Networks”, 5th Edition, Pearson Education, 2011.

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Master of Computer Applications
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16MCC121 **DATA WAREHOUSING AND DATA MINING**

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Identify the scope and necessity of Data Mining & Warehousing for the society.
2. Describe and designing of Data Warehousing to integrate the Data Mining system
3. Understand Data Mining functionalities to solve the real world problems.
4. Develop ability to design various algorithms based on data mining techniques.
5. Understand various interesting patterns and presentation techniques for decision making
6. Gain the interest in research and design of new Data Mining Techniques.

Course Outcomes:
After completion of the course, the students would be able to:
1. Identify the scope of Data Mining & Warehousing for the society.
2. Design of Data Warehouses and integrate the Data Mining system for various organizations.
3. Apply Data Mining functionalities to solve the real world problems
4. Design and implement the various data mining algorithms based on various requirements
5. Identify interesting patterns and presentation techniques in making decisions
6. Make base for further research on advanced Data Mining Techniques

UNIT-I:
Introduction: What Motivated Data Mining? Why Is It Important, What Is Data Mining, Data Mining—On What Kind of Data, Data Mining Functionalities—What Kinds of Patterns Can Be Mined?, Are All of the Patterns Interesting? Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Database or Data Warehouse System, Major Issues in Data Mining,. Data Preprocessing: Why Preprocess the Data, Descriptive Data Summarization, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization and Concept Hierarchy Generation.

UNIT-II:
DataWarehouse and OLAP Technology: What Is a DataWarehouse, A Multidimensional Data Model, DataWarehouse Architecture, DataWarehouse Implementation, From DataWarehousing to Data Mining, Data Cube Computation and Data Generalization: Efficient Methods for Data Cube Computation, Further Development of Data Cube and OLAP Technology, Attribute-Oriented Induction—An Alternative Method for Data Generalization and Concept Description.

UNIT-III:
Mining Frequent Patterns, Associations, and Correlations: Basic Concepts, Efficient and Scalable Frequent Item set Mining Methods, Mining Various Kinds of Association Rules, From Association Mining to Correlation Analysis, Constraint-Based Association Mining,

UNIT-IV:
Classification and Prediction: What Is Classification? What Is Prediction, Issues Regarding Classification and Prediction, Classification by Decision Tree Induction, Bayesian Classification, Rule-Based Classification, Classification by Back propagation, Support Vector Machines, Classification by Association Rule Analysis, Lazy Learners, Other Classification Methods, Prediction Accuracy and Error Measures, Evaluating the Accuracy of a Classifier or Predictor, Ensemble Methods—Increasing the Accuracy, Model Selection.

UNIT-V
Cluster Analysis: What Is Cluster Analysis, Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Hierarchical Methods, Density-Based Methods, Grid-Based

Methods, Model-Based Clustering Methods, Clustering High-Dimensional Data, Constraint-Based Cluster Analysis, Outlier Analysis.

Text Books:

1. Jaiwei Han and Micheline Kamber “Data Mining- Concepts and Techniques”, Morgan and Kaufmann, 2nd Edition, 2006.

Suggested Reading:

1. Pang-Ning Tan,Micheal Steinbach, Vipin Kumar, “Introduction to data Mining”, Pearson Education, 2008.
2. Ian. H. Witten, Eibe Frank and Mark.A.Hall “Data Mining:Practical Machine Learning Tools and Techniques”, 3rd Edition(Then Morgan Kufmann series in Data Management systems), 2011
3. “Statistical and Machine learning –Learning Data Mining, Techniques for Better Predictive Modeling and Analysis to Big Data”.
4. Arun K Pujari “Data Mining Techniques”, University Press, 2nd Edition, 2009
5. MH Dunham “Data Mining” Pearson Education, 2009.

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16MCC122 ADVANCED JAVA PROGRAMMING

Instruction	3L+1T Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	4

Course Objectives:
Students will:
1. Servlets, session management and usage of JDBC in servlets.
2. Java beans, Application builder tool and java beans API.
3. EJB Architecture, EJB requirements and EJB entity beans.
4. EJB clients, deployment tips and perl control structures and operators.
5. JSP scripting elements & directives and java messaging services.
6. JDBC driver connection to database, Row set object and Result set.

Course Outcomes:
After completion of the course, the students would be able to:
1. Get the knowledge of servlets, session management and usage of JDBC in servlets.
2. Employ the java beans, Application builder tool and java beans API.
3. Demonstrate the EJB Architecture, EJB requirements and EJB entity beans.
4. Demonstrate the EJB clients, deployment tips and perl control structures and operators.
5. Identify the JSP scripting elements & directives and java messaging services.
6. Examine the JDBC driver connection to database, Row set object and Result set

UNIT - I
J2EE Platform: Enterprise Architecture Styles, Containers and Technologies.
Servlet overview: The Java web server – your first servlet – servlet chaining – server side includes- Session management – security – HTML forms – using JDBC in servlets – applet to servlet communication.

UNIT - II
Java Beans: The software component assembly model- The java beans development kit- developing beans – notable beans – using infobus - Glasgow developments - Application Builder tool- JAR files-Introspection-Bound Properties-Persistence-customizers - java beans API.

UNIT - III
EJB: EJB architecture- EJB requirements – design and implementation – EJB session beans- EJB entity beans-EJB Clients – deployment tips, tricks and traps for building distributed and other systems – implementation and future directions of EJB-Variable in perl- perl control structures and operators – functions and scope.

UNIT - IV
JSP: Introduction JSP-Examining MVC and JSP -JSP scripting elements & directives-Working with variables scopes-Error Pages - using Java Beans in JSP Working with Java Mail-Understanding Protocols in Javamail-Components-Javamail API-Integrating into J2EE-Understanding Java Messaging Services-Transactions.

UNIT – V
JDBC : Introduction to JDBC, JDBC Drivers, Packages related to JDBC, JDBC Data Sources, Retrieving Meta Information from database and Result set, Distributed Transactions and Row Set objects, Accessing a Database through Servlets and JDBC.

Text Books:
1. H. Schildt, 2002 “Java 2 Complete Reference”, 5th Edition, Tata McGraw Hill, New Delhi.
2. Subramanyan AllamRaju “Professional Java Server Programming”, J2EE 1.3 Edition, A Press Publications.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

Suggested Reading:

1. K. Moss "Java Servlets", 2nd Edition, Tata McGraw Hill, New Delhi, 1999.
2. Joseph O'Neil "Java Beans from the Ground Up", Tata McGraw Hill, New Delhi, 1998.
3. J. McGovern,R. Adatia,Y. Fain, "J2EE 1.4 Bible", Wiley-Dreamtech India Pvt. Ltd, New Delhi, 2003.

HEAD OF DEPARTME
Master of Computer Applicatio
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16MCC123 **COMPUTER NETWORKS LAB**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:
1. Learn Networking commands.
2. Understand connection oriented and connection less iterative programs
3. Learn connection oriented and connection less concurrent programs.
4. Acquire the knowledge of Pre fork Server program.
5. Obtain the concept of Remote command execution.
6. Gain the knowledge of Advanced Socket System Calls.

Course Outcomes:
After completion of the course, the students would be able to:
1. Use Networking commands.
2. Implement connection oriented and connection less iterative programs.
3. Execute connection oriented and connection less concurrent programs.
4. Implement the Pre fork Server program.
5. Run the program on Remote command execution.
6. Execute programs on Advanced Socket System Calls.

List of Programs:

1. Using and understanding following Commands. Ifconfig, net stat, ping, arp, telnet, ftp, finger.
2. a) Connection oriented Iterative Echo Server
   b) Connectionless Iterative Echo server
3. a) Connection oriented Concurrent Echo Server
   b) Connectionless Concurrent Echo server
4. a) Connection oriented Iterative Time Server
   b) Connectionless Iterative Time Server
5. a) Connection oriented Concurrent Time Server
   b) Connectionless Concurrent Time Server
6. Remote command execution.
7. Program to pass file descriptors.
8. To demonstrate the usage of Advanced Socket System Calls like
   Getsockopt(), Setsockopt(), Select(), Readv(), getpeernamet(), Getsockname().
9. To demonstrate the Non-Blocking (Asynchronous) Input-Output.
10. To demonstrate the implementation of Pre forked Server.

Suggested Reading:

1. W. Richard Stevens, “Unix Network Programming”, Pearson Education Inc, PHI Learning 1990.
2. Behroz A Forouzan, “Data Communications and Networking”, 4th Edition, Tata McGraw – Hill, 2009.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

16MCC124 DATA WAREHOUSING AND DATA MINING LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:

1. Understand the need of Data Warehouses over Databases, and the difference between usage of operational and historical data repositories.
2. Understand loading the data from different sources and preprocessing of different types of the data.
3. Build different types of data models from various datasets which are useful to model the data
4. Experience row and column operations of different datasets.
5. Get a clear idea of various classes of Data Mining techniques, their need, scenarios (situations) and scope of their applicability.
6. Learn the algorithms used for various types of Data Mining Problems.

Course Outcomes:
After completion of the course, the students would be able to:

1. Understand the need of Data Warehouses over Databases.
2. Load the data from different sources and preprocess of different types of the data.
3. Build variety of data models useful in modeling data.
4. Use data mining functionalities in different Scenarios.
5. Prepare graphs using data mining tools for patterns presentation.
6. Execute variety of algorithms.

List of Programs:

1. Connect and load data from Databases, User input, Excel files
2. Select the records from data sets using “Select” operation.
3. Extract samples from different data sets using “Selection” operation.
4. Demonstrate of record operation “balance” on different datasets.
5. Aggregate the records using Aggregate operation on different datasets
6. Manage the records of different datasets using “Sort” operation.
7. Merge the records from different datasets.
8. Separate the top most records using “Distinct” operation.
9. Demonstration of record operation “Distinct” on different datasets
10. Filter the fields from different datasets.
11. Derive a new field using existing fields from different datasets using “Derive” operation.
12. Demonstration of field operation “Derive” on different data sets
13. Group the data into different bins using binning.
14. Partition the data using field operation portioning.
15. Interchange the rows and columns of dataset using transpose operation.
16. Draw the graph of “Plot” Graph building on variety of data
17. Draw the graph of “Distribution” Graph building on variety of data
18. Construct histogram on variety of data.
19. Construct collection graph on variety of data.
20. Draw the graph of “Multi plot” Graph building on variety of data
21. Create “Web” Graph on variety of dat.
22. Build Apiori association model on transactional data.
23. Build C4.5 classifier.
24. Train and Test CRT classifier on categorical data.
25. Train and Test CHAID classifier.
26. Construct and Test QUEST classifier.
27. Design, Model and test Neural Network classifier.
28. Construct Binary classifier for binary class data.
29. Construct and Test K-Means clustering model.
30. Model COHENON unsupervised data.

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Master of Computer Applications
C.B.I.T., Hyderabad-500 075

31. Construct GRI classifier.
32. Construct different REGRESSION equations.
33. Design and Test Logistic modeling.
34. Demonstration of output operations
    a) Stats b) Analysis, c) Matrix, d) Table, e) Transform

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16MCC125 **MINI PROJECTS**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	50 Marks
Continuous Internal Evaluation	25 Marks
Credits	2

Course Objectives:
Students will:

1. Handle small scale projects in the lab.
2. Learn the basic concepts of Front End, Middleware and Back End technologies.
3. Learn the implementation of Mini Project which shall lead into the implementation of Major Project.

Course Outcomes:
After completion of the Mini Project, the students would be able to:

1. Implement the basic level technologies pertaining to Front End, Middleware and Back End.
2. Implement the Major Project successfully.

Fourth Semester of the MCA course contains the Mini Project has to be carried out by each student individually in a period of 15 weeks of duration. Students should submit a synopsis at the end of 2nd week in consultation with the Project Guide. The synopsis should consist of definition of the problem, scope of the problem and plan of action. Before completion of the fourth semester the students are required to present their work before the internal committee of the MCA department, in which each student will be awarded with marks.

At the end of the semester the students are required to present their project work before the External Committee for Vive-Voce examination, in which each student will be awarded with marks.

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16MCE102 **SOFTWARE TESTING (Elective-I)**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:
1. Learn the basic concepts of Testing.
2. Follow the methodology of White Box Testing.
3. Learn the concepts of Functional Testing.
4. Obtain knowledge of Integration and System Tastings.
5. Understand the concepts of Object Oriented Testing.
6. Obtain the concepts Millennium Testing.

Course Outcomes:
After completion of the course, the students would be able to:
1. Gain the basic knowledge of Testing.
2. Acquire the knowledge of White Box Testing methods.
3. Test an application using Functional Testing.
4. Gain knowledge about Integration and System Testing.
5. Use Object Oriented Testing and Millennium Testing methods.
6. Explore on testing types which are to be applied for various applications.

UNIT-I
Introduction to Software Testing Concepts, White Box Approach, Basis Path Testing, Cyclomatic Complexity, Independent paths, D-D Graphs, Dataflow Testing,

UNIT-II
Functional Testing: Boundary Value Testing, Equivalence Class Testing, Decision Table-Based Testing, Retrospective on Functional Testing.

UNIT-III
Integration and System Testing: Levels of Testing, Unit testing, Integration Testing, System Testing, Interaction Testing.

UNIT-IV
Object-Oriented Testing: Issues in Object-Oriented Testing, Class Testing, GUI Testing, Object-Oriented System Testing.

UNIT-V
Millennium Testing: Exploratory Testing, Model-Based Testing, Test-Driven Development, All Pairs Testing, Software Testing Excellence.

Text Books:
1. Paul C. Jorgensen, "Software Testing: A Craftsman's Approach", 3rd Edition, CRC Press, 2007.
2. Roger S. Pressman "Software Engineering", 7th Edition, Pearson Education.

Suggested Reading:
1. Boris Beizer "Software Testing Techniques", 2nd Edition, Dreamtech, 2013.
2. M.G. Limaye "Software Testing: Principles – Techniques and Tools", 1st Edition, Tata Mc. Hill, 2009
3. Mauro Pezze, Michal Young "Software Testing and Analysis: Process, Principles and Techniques", Wiley India Pvt. Ltd.

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Master of Computer Applications
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16MCE103 **ARTIFICIAL NEURAL NETWORKS (Elective-I)**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:

Students will:

1. Basics of Biological Neural Networks.
2. Basics of Artificial Neural Networks.
3. Applications of Artificial Neural Networks.
4. Different pattern recognition tasks using Artificial Neural Networks.
5. Competitive learning neural networks.
6. ART networks.

Course Outcomes: After completion of the course, the students would be able to:

1. Gain the knowledge of ANN techniques and their applications.
2. Understand the various algorithms for ANN.
3. Apply various algorithms for ANN.
4. Understand the clustering concepts and algorithms
5. Bring out structural ART networks and feature extraction techniques.
6. Identify, Analyze, Formulate and solve different application oriented problems.

UNIT – I

Introduction to ANN - Features, structure and working of Biological Neural Network Trends in Computing Comparison of BNN and ANN.

Basics of Artificial Neural Networks - History of neural network research, characteristics of neural networks terminology, models of neuron Mc Culloch – Pitts model, Perceptron, Adaline model, Basic learning laws, Topology of neural network architecture

UNIT – II

Backpropagation networks (BPN) - Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, backpropagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning.

Activation & Synaptic Dynamics - Introduction, Activation Dynamics models, synaptic Dynamics models, stability and convergence, recall in neural networks.

UNIT – III

Basic functional units of ANN for pattern recognition tasks - Basic feedforward, Basic feed back and basic competitive learning neural network. Pattern association, pattern classification and pattern mapping tasks.

Feedforward neural networks – Linear responsibility X-OR problem and solution.

- Analysis of pattern mapping networks summary of basic gradient search methods.

Feedback neural networks Pattern storage networks, stochastic networks and simulated annealing, Boltzmann machine and Boltzmann learning.

UNIT – IV

Competitive learning neural networks - Components of CL network pattern clustering and feature mapping network, ART networks, Features of ART models, character recognition using ART network.

UNIT – V

Applications of ANN - Pattern classification – Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron – Recognition of handwritten characters.

NET Talk - to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation.

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Master of Computer Applications
C.B.I.T., Hyderabad-500 075

Text Books:

1. B. Yegnanarayana “Artificial Neural Networks”, PHI, 2010.
2. S. Raj Sekaran , Vijayalakshmi Pari “Neural networks, Fuzzy logic and Genetic Algorithms”, 2015.

Suggested Reading:

1. Simon Hhaykin “Neural Networks A comprehensive Foundations”, Pearson Education, 2^{nd} Edition 2004.
2. Li Min Fu “Neural Networks in Computer Intelligence”, TMH 2003.
3. James A Feeman David M S Kapura “Neural Networks”, Pearson Education 2004.

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16MCE106 **CLOUD COMPUTING (ELECTIVE-II)**

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:
1. Analyze the components of cloud computing and its business perspective.
2. Evaluate the various cloud development tools.
3. Collaborate with real time cloud services.
4. Analyze the case studies to derive the best practice model to apply when developing and deploying cloud based applications.
5. Understand large data processing in the cloud.
6. Utilize the resource management in the cloud.

Course Outcomes:
After completion of the course, the student would be able to:
1. Identify the components of cloud computing for service perspective.
2. Apply the Cloud Computing developing tools.
3. Imply the Cloud Computing models for developing best applications.
4. Give services in Real time requirements.
5. Apply large data processing methods in Clouds.
6. Use the maximum Cloud Computing resources properly.

UNIT-I
Fundamental Cloud Computing-Understanding Cloud Computing, Origins influences, Basic Concepts and Terminology, Goals, Benefits, risks, Challenges, Rolls and boundaries, Cloud characteristics, Cloud Delivery models, Cloud deployment models.

UNIT-II
Cloud enabling technology-Broadband Networks and Internet architecture, Data center technology, Visualization technology, Cloud Security-basic terms and concepts, Threat agents, Cloud security threats,

UNIT-III
Cloud Infrastructure Mechanisms-Logical network perimeter, Virtual server, Cloud Storage device, cloud usage monitor, Resource replication, special cloud mechanisms, cloud management mechanisms, cloud security mechanisms,

UNIT-IV
Cloud Computing Architecture-Fundamental Architecture, Work load distribution architecture, Resource pooling architecture, Dynamic scalability architecture, service load balancing architecture, Cloud bursting architecture, redundant storage architecture, Hyper clustering architecture, load balanced virtual server instances architecture, non-disruptive service architecture, zero down time architecture, cloud balancing architecture, Resource reservation architecture, rapid provision architecture.

UNIT-V
Working with clouds-(Cloud Provider Perspective) Building IaaS Environments, Equipping PaaS Environment, optimizing SaaS Environments. (Cloud consumer perspective)- Working with IaaS Environments, working with PaaS Environment, working with SaaS Environments.

Text Book:

1. Thomas Erl, Ricardo Puttini "Cloud Computing: Concepts, Technology & Architecture", Prentice, Hall, 1st Edn. 2015

Suggested Reading:

1. Rajkumar Buyya, James Broberge and Anddrzej, M Gosciniski “Cloud Computing Principles and Paradims”. Wiley publishing 2011.
2. John W Rittinghouse,james F.Ransome. “Cloud Computing Implementation, Management and Security” CRC Press 2009.
3. Kai Hwang. Geoffrey C.Fox,Jack J. Dongarra, “Distributed and Cloud Computing from parallel Processing to the Internet of things”.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

16MCE107 SOFTWARE PROJECT MANAGEMENT (ELECTIVE-II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
Semester End Examination	70 Marks
Continuous Internal Evaluation	30 Marks
Credits	3

Course Objectives:
Students will:

1. Introduce software project management and to describe its distinctive characteristics.
2. Discuss project planning and the planning process.
3. Show how graphical schedule representations are used by project management.
4. Discuss the notion of risks and the risk management process.
5. Managing the people in software industry.
6. Understand the quality of a project.

Course Outcomes: After completion of the course, the students would be able to:

1. Gain basic knowledge of software project management principles
2. Come up with a project schedule and assign resources
3. Choose an appropriate project development model.
4. Identify project risks, monitor and track project deadlines.
5. Work in a team environment and be aware of different modes of communications.
6. Understand the various levels of quality metrics and measurements.

UNIT-I

Software Project Management: Introduction, Importance, Software Projects Vs Other types of Projects, Contract Management, Technical Project Management, Activities covered by SPM, Plans, Methods and Methodologies. Setting Objectives, Project Success and Failures, Management and Control.
Project Evaluation and Programme Management: Project port polio management, Evaluation of Individual projects, Cost Benefit Evaluation Techniques, Risk Evaluation, Program Management, Managing the Resource with in the Program, Strategic Program Management, Aids to Program Management, **Overview of Project Planning.**

UNIT-II

Selection of an Appropriate Project Approach: Choosing the methodologies and technologies, Software process and process models.
Software Effort Estimation: Problems with Over and Underestimates, Software Effort Estimation Techniques. Function Point Analysis. A Parametric Productive Model – COCOMO-2
Activity Planning: Objectives of Activity Planning, Schedules, Activities, Sequencing, Network Planning Models.

UNIT-III

Risk Management : Categories of Risk, A Frame work with Dealing with Risk, Evaluating Risk with the Schedule.
Resource Allocation: Nature of Resource, Identify Resource Requirements, Scheduling, Creating Critical path, Cost Schedules, Scheduling Sequence.
Monitoring & Control: Creating Framework, Collecting Data, Project Termination Review, Visualizing Progress, Cost Monitoring, Prioritizing Monitoring, Change Control, Software Configuration Management.

UNIT-IV

Managing Contracts: Types of Contracts, Stages in Contract Placement, Typical Terms of Contracts, Contract Management Acceptance.
Managing People in Software Environments: Organizational behavior, selecting the Right person for the Job, Instruction in the best methods, Motivations, the Oldham-hackman Job characteristics model, Stress, Health and Safety, Some Ethical and Professional concerns.
Working in Teams: Becoming a Team, Decision making, Organization and Team Structures, Coordination of dependencies, Communication genres, Communication plans, Leadership.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

UNIT –V

Software Quality : The Place of Software Quality in Project planning, Quality Management Systems, Process Capability models, Software Reliability Quality plans,

ISO : ISO – 9126, Product and Process Metrics

An Overview of PRINCE 2 : Components of Prince 2.

Text Book:

1. Bob Hughes and Mike Cotterell "Software Project Management", 5th Edition, Tata McGraw Hill, 2010.

Suggested Reading:

1. Walker Rayce "Software Project Management: A Unified Framework", Addison Wesley, 1998.
2. Watts S. Humphrey "Managing Software Process", Addison – Wesley Pearson Education, 1998.

HEAD OF DEPARTMENT
Master of Computer Applications
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INFORMATION SECURITY

Instruction	4L periods per week
Duration of Main Examination	3 Hours
Main Examination	75 Marks
Internal Examination	20 Marks
Assignment	5 Marks
Credits	3

Course Objectives:

1. To gain the knowledge of SDLC and the need for Security.
2. To gain the knowledge of Legal, Ethical professional issues.
3. To gain the knowledge of Firewalls and VPNS & Cryptographic Algorithms.

Course Outcomes:

1. Students would have gained knowledge of SDLC and requirement of Information Security.
2. Students would have gained knowledge of Legal, Ethical Professional Issues.
3. Students would have gained knowledge of Firewalls and VPNS, knowledge of Cryptographic Algorithms.

Pre Requisites:

1. Students should have knowledge of Computer Networks and Data Communications.

Unit-I

Introduction: History, Critical characteristics of information, Components of an information system, securing the components, The SDLC, The security SDLC. Security Professionals and the organization. Need for Security: Business needs, Threats, Attacks- secure software development.

Unit-II

Legal, Ethical and Professional Issues: Law and ethics in information security, Ethics and information Security.

Security Analysis: Risk Management, Identifying and assessing risk, Controlling Risk.

Planning for Security: Security policy, Standards and practices, Design of Security Architecture.

Unit-III

Security Technology: Firewalls and VPNs: Physical design Firewalls, Protecting remote connections.

Intrusion detection and other security tools: Intrusion detection and prevention systems, Scanning and analysis tools.

Unit-IV

Cryptography: Foundations of cryptology, Cipher methods, Cryptographic Algorithms (Symmetric Key-DES,IDEA, and AES) and public key cryptography (Public key Encryptions-RSA), Cryptographic tools, Protocols for secure communications, Attacks on cryptosystems.

Unit- V

Message Digest: Message Digest (MD-5, SHA), Digital signatures.
SSL and SET: SSL and SET protocols, Internet transactions using both SSL and SET.

Text Books:

1. Michel E Withman and Herbert J Mattord, "Principles and Practices of Information Security", Cengage Learning, 2009 (Unit-I to III).

2. William Stallings, "Cryptography and Network Security", Pearson Education, 2000. (Unit-III, IV and V)

Suggested Reading:

1. Thomas R Peltier, Justin Peltier, John Blackley, "Information Security Fundamentals", Auerbach Publications, 2010

2. Behrouz A. Forouzan, "Cryptography and Network Security", Tata McGraw Hill, 2007.

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Master of Computer Applications
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MIDDLEWARE TECHNOLOGIES

Instruction	4L periods per week
Duration of Main Examination	3 Hours.
Main Examination	75 Marks
Internal Examination	20 Marks
Assignment	5 Marks
Credits	3

Course Objectives:

1. To understand the fundamentals of Web Services.
2. To make a study of basics EJB types of EJB and applications.
3. To impart knowledge in CORBA and COM.
4. To learn a latest framework .NET.

Course Outcomes:

1. Understand the basic concepts of the various Web services
2. Acquire the knowledge of EJB and its types.
3. Understanding the differences between CORBA and COM
4. Acquire the knowledge about different .NET framework and its programming

Pre Requisites:

1. A knowledge on Distributed Systems is required.
2. A knowledge on Java Programming language is required.
3. A knowledge on Java Script and VB Script is required.
4. A knowledge on Web programming is required.

Unit – I

Client/Server Concepts: Client/Server, File Server, Database server, Group server, Object Server, Web server, Middleware – General middleware –Service specific middleware. Client/Server Building blocks – RPC – Messaging – Peer- to- Peer. Web Services – SOA, SOAP, WSDL, REST Services.

Unit – II

EJB Architecture: EJB – EJB Architecture – Overview of EJB software architecture –View of EJB – Conversion – Building and Deploying EJBs – Role in EJB.

Unit – III

EJB Applications: EJB Session Beans – EJB entity beans – EJB Clients – EJB Deployment Building an application with EJB.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

Unit – IV

Introduction to .NET, Overview of .NET applications, .NET Framework – CTS – CLS – CLR – Managed execution, Runtime environment. Understanding assemblers, .NET security.

Introduction Microsoft Visual C# and Visual Studio.NET : Welcome to C# , Working with variables, operators, and expressions; writing methods and applying scope, using decision statements, using iteration statements, managing errors and exceptions.

Unit -V

Understanding the C# Language : Creating and managing classes and objects, understanding values and references, creating value types with enumerations and structures, using arrays and collections, understanding parameter arrays, working with inheritance, using garbage collection and resource management.

Working with Windows Applications: Introducing windows forms, working with menus, performing validation, using complex controls, using the MDI, Windows and dialog boxes, creating GUI Components.

Text Books:

1. Robert Orfali, Dan Harkey and Jeri Edwards, "The Essential Client / Server Survival Guide", Galgotia Publications Pvt.Ltd, 2002 (Unit 1).

2. Tom Valesky, "Enterprise Java Beans", Pearson Education, 2002 (Unit 2 & 3).

3. John Sharp, Job Jagger, "Microsoft Visual C#.NET step by step", Prentice hall of India Private Ltd, 2003. (Unit 4 & 5)

Essential Reading

1. Jeffrey R. Shapiro, "The Complete Reference Visual Basic.NET", TMH, 2002.

2. Burton Harvey, Simon Robinson, Julian Templemanm, Karli Watson, " C# Programming ", 3rd Indian Reprint, Shroff Publishers & Distributors Pvt. Ltd, 2001.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

OBJECT ORIENTED SYSTEM DEVELOPMENT

Instruction	4L periods per week
Duration of Main Examination	3 Hours.
Main Examination	75 Marks
Internal Examination	20 Marks
Assignment	5 Marks
Credits	3

Course Objectives:

1. To understand the basic building blocks of UML.
2. To learn about the structural and Dynamic modeling.
3. Understanding the concepts of Architectural modeling.
4. To understand the concept and structure of USDP.

Course Outcomes:

1. Students would have gained the knowledge of how to model the object oriented applications through UML.
2. Students would have gained the knowledge of Structural and Behavioral modeling
3. Student would have gained the theoretical knowledge of Forward and Reverse Engineering.

Pre Requisites:

1. Students should have the knowledge of Software Engineering Principles and the stages of Software Development Life Cycle and the Traditional models.

Unit – I

UML Introduction: Why we model, introducing the UML, Building blocks of UML.
Basic Behavioral Modeling: Use Cases, Use Case Diagrams,
Structural Modeling: Classes, Class Diagrams, Relationships, Common Mechanism, Advanced Structural Modeling, Object Diagrams

Unit – II

Dynamic modeling: Interactions, Interaction Diagrams, Events and signals, State Machines, Processes and Threads, Time and Space, State Chart Diagrams, Activity Diagrams.

Unit – III

Architectural Modeling: Interfaces, Packages, Instances, Components, Component Diagrams, Design Patterns and Frame works, Deployment diagrams, Systems and models,

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

Unit – IV

Unified Software Development Process: The Unified Process, The Four Ps, Use-Case- Driven Process, Architecture – Centric Process, Iterative and Incremental Process.

Unit – V

Core Workflows: Requirements Capture, Capturing Requirements as Use Cases, Analysis Model, Design Model, Implementation Model and Test Model.

Text Books:

1. Grady Booch, James Rumbaugh, Ivor Jacbson, "The Unified Modeling Language – User Guide", 2^{nd} Edition, Pearson Education, India, 2007.

2. Ivor Jacbson, Grady Booch, James Rumbaugh, "The Unified Software Development Process", Pearson Education, India, 2008.

Suggested Reading:

1. Grady Booch, Rabert A. Maksimehuc and Three more, " Object Oriented Analysis and Design with Applications", 3^{rd} Edition, Pearson Education, 1991.

2. Craig Larman, "Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development", 3^{rd} Edition, Pearson Education, 2008.

3. Ali Bahrami, "Object Oriented System Development", Irwin/Mc Graw Hill, 1999.

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SOFTWARE TESTING

Instruction	4L periods per week
Duration of Main Examination	3 Hours.
Main Examination	75 Marks
Internal Examination	20 Marks
Assignment	5 Marks
Credits	3

Course Objectives:

1. To understand the basic concepts of Testing.
2. To learn about the Functional and Integration Testing.
3. Understanding the concepts Object Oriented and Millennium Testing.

Course Outcomes:

1. Students would have gained the knowledge of Functional and Integration Testing.
2. Students would have gained the knowledge of Object Oriented Testing, Millennium Testing.
3. Students should have gained the knowledge testing tools which are to be applied for various applications.

Pre Requisites:

1. Students should have the knowledge of Software Engineering Principles and the basic knowledge of Testing Approaches and Strategies.

Unit-I

Introduction to Software Testing Concepts, White Box Approach, Basis Path Testing, Cyclomatic Complexity, Independent paths, D-D Graphs, Dataflow Testing,

Unit-II

Functional Testing: Boundary Value Testing, Equivalence Class Testing, Decision Table-Based Testing, Retrospective on Functional Testing.

Unit-III

Integration and System Testing: Levels of Testing, Unit testing, Integration Testing, System Testing, Interaction Testing.

Unit-IV

Object-Oriented Testing: Issues in Object-Oriented Testing, Class Testing, GUI Testing, Object-Oriented System Testing.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

Unit-V

Millennium Testing: Exploratory Testing, Model-Based Testing, Test-Driven Development, All Pairs Testing, Software Testing Excellence.

Text Books:

1. Paul C. Jorgensen, “Software Testing: A Craftsman’s Approach”, 3^{rd} Edition, CRC Press, 2007.

2. Roger S. Pressman “Software Engineering”, 7^{th} Edition, Pearson Education.

Suggested Reading:

1. Boris Beizer, “Software Testing Techniques”, 2^{nd} Edition, Dreamtech, 2013.

2. M.G. Limaye, “Software Testing: Principles – Techniques and Tools”, 1^{st} Edition, Tata Mc. Hill, 2009

3. Mauro Pezze, Michal Young, “Software Testing and Analysis: Process, Principles and Techniques”, Wiley India Pvt. Ltd.

HEAD OF DEPARTME
Master of Computer Applicatio
C.B.I.T., Hyderabad-500 075

MOBILE COMPUTING

Instruction	4L periods per week
Duration of Main Examination	3 Hours.
Main Examination	75 Marks
Internal Examination	20 Marks
Assignment	5 Marks
Credits	3

Course Objectives:

1. To understand the basic concepts of Data Communications.
2. To learn about the telecommunications and broadcasting systems.
3. Understanding the concepts of Wireless LANs.
4. Learn the features of different mobile OS and Mobile Applications.

Course Outcomes:

1. Good Knowledge on Data Communications.
2. Understanding the Implementation of telecommunications and broadcasting systems.
3. Awareness of Wireless Transmissions and Protocols.
4. Capable to develop mobile applications.

Pre Requisites:

1. Students should have knowledge of Computer Networks and Data Communications.

Unit- I

Introduction and applications of mobile computing, Wireless transmission: Frequencies, Signals, Antennas, Signal Propagation, Multiplexing, Modulation, Spread spectrum, Cellular systems. Medium Access Control, SDMA, FDMA, TDMA, CDMA, Comparisons.

Unit- II

Telecommunication system: GSM, DECT, TDMA, TETRA, UMTS & IMT-2000.
Satellite systems: Applications, Basics, routing, localization, Handover.
Broadcast systems: Cyclic representation of data, Digital audio Broad casting, Digital video Broadcasting, Convergence of Broadcasting and mobile communication.

Unit- III

Wireless LAN: Infrared Vs Radio Transmission, Infrastructure and Ad hoc Networks, IEEE 802.11, HIPERLAN, Bluetooth.

Unit- IV

Mobile IP, Dynamic Host Configuration Protocol, Mobile Adhoc Networks, Mobile Transport Layer, Traditional TCP, Classical TCP improvements, TCP over 2.5/3G Wireless Networks, Performance Enhancing Proxies.

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Master of Computer Applications
C.B.I.T., Hyderabad-500 075

Unit- V

File systems, WWW, Wireless Application Protocol.

Introduction to Android and IOS, Mobile Applications: PhoneGap, Monotouch, Mono and Derby

Text Books:

1. Jochen M.Schiller, “Mobile Communications”, 2^{nd} Edition, Pearson Education, India 2003. (Unit I – V)(Unit-V: Chapter 10: File systems, WWW, WAP).

2. Jeff McWheter, Scott Gowell, “Professional Mobile Application Development”, Wiley India Pvt. Ltd. – 2013 (Unit – V: Chapter 6, 7, 11 and 12).

Suggested Reading:

1. Dharma P. Agarwal, Qing An Zeng, “Introduction to wireless and Mobile systems”, 2^{nd} Edition, Thomas India, 2007.

2. Frank Adelstien, Sandeep K.S.Gupta, “Fundamentals of Mobile and Pervasive Computing”, Tata McGraw Hill, 2005.

3. Ivan Stojmenovic, “Handbook of Wireless and Mobile Computing”, Wiley India, 2006

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Master of Computer Applicatio
C.B.I.T., Hyderabad-500 075

SOFTWARE PROJECT MANAGEMENT

Instruction	4L periods per week
Duration of Main Examination	3 Hours.
Main Examination	75 Marks
Internal Examination	20 Marks
Assignment	5 Marks
Credits	3

Course Objectives:

1. To introduce software project management and to describe its distinctive characteristics.
2. To discuss project planning and the planning process.
3. To show how graphical schedule representations are used by project management.
4. To discuss the notion of risks and the risk management process.

Course outcomes:

1. A basic knowledge of software project management principles
2. The ability to come up with a project schedule and assign resources
3. Choose an appropriate project development methodology (e.g. Waterfall, Spiral..) and identify project risks, monitor and track project deadlines.
4. The capability to work in a team environment and be aware of different modes of communications

Pre Requisites:

1. Students should have concepts of Software Engineering.

Unit I

Introduction to Software Project Management, Project Evaluation and Programme Management, An Overview of Project Planning.

Unit II

Selection of an Appropriate Project Approach, Software Effort Estimation, Activity Planning.

Unit III

Risk Management, Resource Allocation, Monitoring & Control.

Unit-IV

Managing Contracts, Managing People in Software Environments, Working in Teams.

Unit –V

Software Quality, ISO, An Overview of PRINCE 2.

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Master of Computer Applications
C.B.I.T., Hyderabad-500 075

Text Books:

1. Bob Hughes and Mike Cotterell, "Software Project Management", 5th Edition, Tata McGraw Hill, 2010.

Suggested Reading:

1. Walker Rayce, "Software Project Management: A Unified Framework", Addison Wesley, 1998.

2. Watts S. Humphrey, "Managing Software Process", Addison – Wesley Pearson Education, 1998.

HEAD OF DEPARTME
Master of Computer Applicatio
C.B.I.T., Hyderabad-500 075

CLOUD COMPUTING

Instruction	4L periods per week
Duration of Main Examination	3 Hours.
Main Examination	75 Marks
Internal Examination	20 Marks
Assignment	5 Marks
Credits	3

Course Objectives:

1. To understand the fundamentals of Cloud Computing
2. To make a study of basics Virtual Machines and virtualization
3. To understand the architecture of cloud computing and impart knowledge in Cloud Security
4. To learn a Cloud Programming and Software Environments

Course Outcomes:

1. Understand the basic concepts of the cloud computing.
2. Understand the virtual machines and virtualization.
3. Understanding the Cloud computing through Case studies.
4. Gaining the importance of security in Cloud.
5. Learning Cloud supporting languages.

Pre Requisites:

1. This course assumes a sound background in operating systems and computer architecture. All students should be proficient in a programming language such as C# or Java or python as used on an operating system like Windows or Linux.

UNIT - I

The Evolution of Cloud Computing: Hardware Evolution, Internet Software Evolution, Server Virtualization. Web Services Delivered from the Cloud : Communication-as-a-Service (CaaS),Infrastructure-as-a-Service (IaaS), Monitoring-as-a-Service (MaaS),Platform-as-a-Service (PaaS),Software-as-a-Service (SaaS).

UNIT - II

Building Cloud Networks : The Evolution from the MSP Model to Cloud Computing and Software-as-a-Service, The Cloud Data Center, Collaboration, Service-Oriented Architectures as a Step Toward Cloud Computing, Basic Approach to a Data Center-Based SOA,The Role of Open Source Software in Data Centers, Where Open Source Software Is Used.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

UNIT - III

Virtualization Practicum, Federation, Presence, Identity, and Privacy inthe Cloud : Federation in the Cloud, Presence in the Cloud,Privacy and Its Relation to Cloud-Based Information Systems.

UNIT - IV

Security in the Cloud: Cloud Security Challenges, Software-as-a-Service Security,Is Security-as-a-Service the New MSSP.

UNIT - V

Common Standards in Cloud Computing : The Open Cloud Consortium, The Distributed Management Task Force, Standards for Application Developers, Standards for Messaging, Standards for Security. End-User Access to Cloud Computing : YouTube API Overview ,Zimbr, Facebook,Zoho, DimDim Collaboration

Text Book:

1. John W. Rittinghouse, James F. Ransome, "Cloud Computing: Implementation, Management and Security", CRC Press 2009.

Suggested Reading:

1. Kai Hwang. Geoffrey C.Fox, Jack J. Dongarra, “Distributed and Cloud Computing From Parallel Processing to the Internet of Things”, Elsevier, 2012.

2. Rajkumar Buyya, James Broberg and Andrzej M. Goscinski, “Cloud Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing)”, Wiley Publishing, 2011

3. Raluca Ada Popa, Catherine M.S. Redfield, Nickolai Zeldovich, and Hari Balakrishnan, “CryptDB: Protecting Confidentiality with encrypted Query Processing” 23rd ACM Symposium on Operating Systems Principles (SOSP 2011), Cascais, Portugal October 2011.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

PROGRAMMING LAB - OOSD

Instruction	3 Periods per week
Duration of Main Examination	3 Hours
Main Examination	50 Marks
Sessional	25 Marks
Credits	2

Course Objectives:

1. To understand the basic operations of case tool (Rational Rose)
2. To know about the representation of Structural and Dynamic modeling
3. Understanding the concepts of Architectural modeling and its representation.

Course Outcomes:

1. Students would have gained the practical knowledge of structural modeling of Object Oriented Applications through UML.
2. Students would have gained the practical knowledge of dynamic modeling of Object Oriented Applications through UML.
3. Students would have gained the practical knowledge of Forward and Reverse Engineering.

Pre Requisites:

1. Students should have the knowledge of Software Diagrams like DFD's and ER Diagrams.

The students have to implement the following UML modellings on a selected case study by forming themselves into teams in the LAB.

They should use an appropriate case tool like Rational Rose.

- Use case modeling
- Structural modeling
- Behavioral modeling
- Architectural modeling

The outcome of each case study should consists of

1. Use case Diagram
2. Class Diagram
3. Object Diagram
4. Sequence Diagram
5. Collaboration Diagram
6. State chart Diagram
7. Activity Diagram
8. Component Diagram
9. Deployment Diagram

The students should finally submit a technical report on their case study in IEEE format.

Text Books:

1. Ivor Jacbson, Grady Booch, James Rumbaugh, "The Unified Software Development Process", Pearson Education, India, 2008.

2. Curtis HK T Sang, Clarence SW Lau, Ying K. Leung, "Object-Oriented Technology: from Diagram to Code with Visual Paradigm for UML" 1st Edition, McGraw-Hill Science/Engineering/Math, *2005.*

Suggested Reading*:*

1. Grady Booch, James Rumbaugh, Ivor Jacbson, "The Unified Modeling Language – User Guide", 2nd Edition, Pearson Education, India, 2007.

2. Grady Booch, Rabert A. Maksimehuc and Three more, " Object Oriented Analysis and Design with Applications", 3rd Edition, Pearson Education, 1991.

3. Craig Larman, "Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development", 3rd Edition, Pearson Education, 2008.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

MC 317 **With effect from the academic year 2015-16**

PROGRAMMING LAB - MWT

Instruction	3 Periods per week
Duration of Main Examination	3 Hours
Main Examination	50 Marks
Sessional	25 Marks
Credits	2

Course Objectives:

1. To understand the remote method invocation.
2. To gain knowledge in Java Beans and Enterprise java beans
3. To gain knowledge in .NET programming using C# programming language.

Course Outcomes:

1. To practice web service programs through ejbs
2. To practice computer applications through C# programming language.

Pre Requisites:

1. A strong knowledge on Computer programming is required.
2. A knowledge on Java Script and VB Script is required
3. Knowledge on Web programming is required.

1. Create a Distributed name Server (like DNS) RMI.
2. Create a Java Bean to draw various graphical shapes and display it using or without using BDK.
3. Develop an enterprise Java Bean for student Information System.
4. Develop an enterprise Java Bean for Library operations.
5. Create and invoke Web Services.
6. Develop an application for converting the currency values using .NET.
7. Develop an application for browsing CD catalogue using .NET.
8. Develop a Student Information System Forms using .NET and store data into database.
9. Develop a Library Information System Forms using .NET and store data into database.
10. Implement a Sample Inventory Management System using .NET and store data into database.

Text Book:

1. Robert Orfali, Dan Harkey and Jeri Edwards, “The Essential Client / Server Survival Guide”, Galgotia Publications Pvt. Ltd, 2002.

Suggested Reading:

1. Tom Valesky, “Enterprise Java Beans”, Pearson Education, 2002.

2. John Sharp, Job Jagger, “Microsoft Visual C#.NET step by step”, Prentice hall of India Private Ltd, 2003.

MC 318 With effect from Academic Year 2015-16

SEMINAR

Instruction	3 Periods per week
Sessional	25 Marks

Oral presentation is an important is an important aspect of technical and objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in a broad area of thread specifications

Seminar topics may be chosen by the students with advice from the faculty members . Students are to be exposed to the following aspects of the seminar presentation.

- Literature Survey
- Organization of the material
- Presentation of PPTs
- Technical writing

Each student is required to:

1. Submit one page synopsis before the seminar talk for display on the notice board
2. Give a 15 minutes presentation through OHP, PC, Slide projector followed by a 5 minutes discussions
3. Submit a report on the seminar topic with a list of reference and slided used

Seminars are to be scheduled from the 3rd week to the last week of semester and any change in schedule should be discouraged.

For award of Sessional marks students are to be judged by at least two faculty members on the basis of an oral and written presentation as sell as their involvement in the discussion.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

MC 901 **With effect from Academic Year 2015-16**

PROJECT WORK

Instruction	6 Periods per week
University Examination	Viva-Voce
University Examination	Grade
Sessional	50 Marks

Sixth Semester of the MCA course is exclusively meant for project work. Project has to be carried out by each student individually in a period of 15 weeks of duration. Students should submit a synopsis at the end of 2nd week in consultation with the Project Guide. The synopsis should consist of definition of the problem, scope of the problem and plan of action. After completion of eight weeks students are required to present a Project Seminar on the topic covering the aspects of analysis, design and implementation of the project work.

At the end of the semester the students are required to present themselves for a University Vive-voce examination in which each student will be awarded with a grade.

A committee consisting of two faculty members of the respective college along with a guide will evaluate the project and award internal marks.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075

PROJECT SEMINAR

Instruction	3 Periods per week
Sessional	25 Marks

Each student will be required to:

1. Submit one page of synopsis on the project work for display on notice board.
2. Give a 20 minutes presentation followed by 10 minutes discussion.
3. Submit a technical write-up on the project.

At least two teachers will be associated with the Project Seminar to evaluate students for the award of sessional marks which will be on the basis of performance in all the 3 items stated above.

The project seminar presentation should include the following components of the project:

- Problem definition and specification.
- Literature survey, familiarity with research journals.
- Broad knowledge of available techniques to solve a particular problem.
- Planning of the work, preparation of bar(activity) charts
- Presentation-oral and written.

HEAD OF DEPARTMENT
Master of Computer Applications
C.B.I.T., Hyderabad-500 075