Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEE 501		ELECTRICAL MACHINES-II	60	20	20	30	20	3	1	2	5

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):
To prepare the students to have a basic and practical knowledge of DC machine. To prepare the students to have a basic knowledge of 3 phase Synchronous machine.

Course Outcomes (COs): Upon completion of this course students will be able to:

1. Demonstrate various parts of an electrical machine.
2. Conduct Different test on DC machine.
3. Understand and analyze synchronous generator.
4. Demonstrate constructional details, principle of operation of Special Machines.

Syllabus:

UNIT I **[8 Hrs]**

DC Generators: Introduction, construction, types, emf equation, lap and wave windings, armature reaction, commutation, methods of improving commutation, equalizer rings, demagnetizing and cross magnetizing ampere turns, various characteristics of shunt, series and compound generators, voltage build up, losses and efficiency, condition for maximum efficiency.

UNIT II **[8 Hrs]**

DC Motors: Introduction, principals, back-emf, torque of motor, types, characteristics of shunt, series and compound motors, speed control (field and armature control methods), basic idea of solid state devices in controlling of DC motors, Starting of DC motors, three point and four point starters, losses and efficiency, testing (brake test, swimburnes, hopkinson test), Applications.

UNIT III **[9 Hrs]**

Synchronous Generators (Alternators): Introduction, Construction, advantages of rotating field, types of rotors, emf equation, excitation systems, equivalent circuit and their phasor diagrams, voltage regulation, synchronous impedance method, mmf method. Zero power factor method, two reaction theory of salient pole rotor, phasor diagram, power developed and power angle characteristics of salient pole machine, determination of Xd and Xq, synchronization, synchronizing power and torque, parallel operation application.

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Indore

Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

UNIT IV **[7 Hrs]**

Synchronous Motors: Introduction, construction, principal of operation, starting of synchronous motor, equivalent circuit and phasor diagrams, power and torque, performance calculation, speed torque characteristics, power factor control-effect of change of excitation.

UNIT V **[7 Hrs]**

Synchronous Motors: V curve and inverted V curve, synchronous condenser and reactors, synchronous phase modifiers, hunting-causes and remedies, applications, synchronous induction motor application.

Text Books:

1. A. E. Fitzgerald, C. KingsleyJr and Umans, Electric Machinery, 6th Edition McGraw Hill, International Student Edition.
2. I.J. Nagrath & D.P. Kothari, Electric Machines, 3/e, Tata McGraw Hill, New Delhi.

Reference Books:

1. M.G. Say, Performance & design of AC machines, CBS publishers & distributors, Delhi, 3rd edition
2. A.E. Clayton & N.N. Nancock, The Performance & design of DC machines CBS publications & distributors, Delhi, 3rd edition
3. P.S. Bhimbra, Generalized theory of Electrical Machines, Khanna publishers, Delhi,
4. Ashfaq Husain, Electric Machines, DhanpatRai, New Delhi.
5. Syed A. Nasar, Electric Machines & Power Systems, Volume I , Tata McGraw Hill, New Delhi
6. E. Fitzerald, C. Kingsley & S.D. Umans , Electric Machinery Tata McGraw Hill ,New Delhi ,5 edition.
7. Stephen J Chapman, Electric Machinery Fundamentals, McGraw-Hill

List of Experiments: Experiments can cover any of the above topics, following is a suggestive list:

1. To obtain open circuit characteristics of self excited DC shunt generator and to find its critical resistance.
2. Speed control of D.C. shunt motor by Field current control method & plot the curve for speed verses field current.
3. Speed control of D.C. shunt motor by Armature voltage control method & plot the curve for speed verses armature voltage.
4. To perform Swinburne's test on a DC shunt machine and to calculate efficiency at full load.
5. To perform Hopkinson's test on a DC shunt machine and to calculate full load efficiency (a) when running as motor and (b) when running as generator.
6. Draw & verify open circuit characteristics of 3-Ø synchronous generator.
7. Draw & verify short circuit characteristics of 3-Ø synchronous generator.
8. Draw & verify external load characteristics of 3-Ø synchronous generator.
9. Calculate X_d & X_q parameter of synchronous machine by slip test.
10. Synchronization of a three-phase alternator with the infinite bus and control load sharing.
11. Draw & verify 'V' curve of 3-Ø synchronous motor.

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Shri Vaishnav Vidyapeeth Vishwavidyalaya
Indore

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Indore

Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEE 502		POWER ELECTRONICS	60	20	20	30	20	3	1	2	5

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):
This course aims to equip the students with a basic understanding of modern power semiconductor devices, various important topologies of power converter circuits for specific types of applications. The course also equips students with an ability to understand and analyze non-linear circuits involving power electronic converters.

Course Outcomes (COs): Upon completion of the course, the student will be able to
1. Understand the principle of operation of commonly employed power electronic converters.
2. Analyze non-linear circuits with several power electronic switches.
3. Equipped to take up advanced courses in Power Electronics and its application areas.

Syllabus:

UNIT-I **[10 Hrs]**
Power Semiconductor diodes and Transistors: Types of power diodes-General purpose diodes-Fast recovery diodes- Their characteristics and applications, Bipolar junction transistors, Power MOSFETS P-Channel, N-Channel, IGBTs- Basic Structure and working, Steady state and switching characteristics-Comparison of BJT, MOSFET and IGBT-Their applications. SCRs, Static and dynamic characteristics-Two transistor analogy. GTO, DIAC, TRIAC, UJT, IGCT Characteristics.

UNIT-II **[8 Hrs]**
Turn on and turn off mechanism of BJT. Power MOSFET, IGBTs SCR trigger circuits-R, RC and UJT triggering circuits. Triggering circuits for single phase bridge rectifier and Choppers. Driver Circuits of MOSFET IGBT & BJT- Various commutation methods of SCRs- Protection of SCRs.

UNIT-III **[7 Hrs]**
AC-DC Converter: Principles of controlled rectification—Study of single phase and three phase half controlled and full controlled bridge rectifiers with R, RL, RLE loads Effect of source inductances. Dual Converters—circulating current mode and Non-circulating current mode, Control Strategies

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Indore

Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

UNIT-IV **[8 Hrs]**

DC-DC Converter: Classification of Choppers: A, B, C, D & E- Switching mode regulators - Study of Buck, Boost and Buck-Boost regulators.

AC-AC Converter: Principle of operation of Single Phase Bridge type cyclo-converters and their applications. Single phase and Three phase AC Voltage controllers with R & RL load.

UNIT-V **[8 Hrs]**

DC-AC Converter: Principle of operation of Single Phase Inverters-Three phase bridge inverters (180 and 120 Degree modes)-voltage control of invertors—Single Pulse Width Modulation-Multiple pulse width Modulation-Sinusoidal Pulse Width Modulation .Comparison of Voltage Source Inverter and Current Source Inverters- Introduction to Multilevel inverters.

Text Books:

1. Rashid, M.H, 'Power Electronics - Circuits, Devices and Applications', Prentice Hall Publications, 3 rd Edition, 2003.
2. M.D.Singh and K.B.Kanchandhani, 'Power Electronics', Tata McGraw-Hill Publishing Company Limited, 2nd Edition, 2006.

Reference Books:

1. Ned Mohan, Tore M. Undeland, William P. Robbins, 'Power Electronics', John Wiley & Sons Publications, 3rd Edition, 2006.
2. Vedam Subramaniam, 'Power Electronics', New Age International (P) Ltd Publishers, 2001.
3. Philip T. Krein, 'Elements of Power Electronics', Oxford University Press, 1st Edition, 2012.
4. V. R. Moorthi, 'Power Electronics- Devices, Circuits and Industrial Applications', Oxford University Press, 1st Edition, 2005. 4. P.S. Bimbhra, 'Power Electronics', Khanna Publishers, 3rd Edition, 13th Reprint, 2004

List of Experiments:

1. Show Static and dynamic characteristics of an SCR.
2. Examine Static and dynamic characteristics of TRAIC.
3. Examine Static and dynamic characteristics of DAIC.
4. Determine Characteristics of MOSFET and IGBT.
5. Analyze Single phase SCR Half controlled converter with R and RL load.
6. Analyze Single phase fully controlled (bridge) converter with R and RL load.
7. Design 3-phase SCR Half Controlled Converter (using simulation platform like MATLAB/Simulink)
8. Design of 3-phase SCR Fully Controlled Converter (using simulation platform like MATLAB /Simulink)
9. Recall of classes of commutation A, B, C, D, E, F.
10. Simulation of Chopper circuit using SCR.

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Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEE 503		CONTROL SYSTEM ENGINEERING	60	20	20	30	20	3	1	2	5

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

The course will provide understanding of control system and mathematical modeling of the system

Course Outcomes (COs):

After the successful completion of this course students will be able to

1. Demonstrate the understanding of basic element and modeling of the control system.
2. Analyze the stability in time domain and frequency domain
3. Design the controller and compensators for the system

Syllabus:

Unit 1 **8 Hrs**

Introduction: Basic Elements of Control System, Open loop and Closed loop systems, Differential equation, Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems, Block diagram reduction Techniques, Signal flow graph, Constructional and working concept of ac servomotor.

Unit 2 **8 Hrs**

Time Domain Analysis: Standard test signals ,Time response of first order systems ,Characteristic Equation of Feedback control systems, Transient response of second order systems ,Time domain specifications , Steady state response , Steady state errors and error constants , P, PI, PD and PID Compensation

Unit 3 **8 Hrs**

Stability Analysis and Root locus: The concept of stability – Routh's stability criterion – qualitative stability and conditional stability – limitations of Routh's stability.The root locus concept - construction of root loci-effects of adding poles and zeros to G(s) H(s) on the root loci.

Unit 4 **8 Hrs**

Frequency domain Analysis: Frequency domain specifications-Bode diagrams-Determination of Frequency domain specifications and Phase margin and Gain margin-Stability Analysis from Bode Plots. Polar Plots, Nyquist Plots,Stability analysis. Compensation techniques – Lag, Lead, Lead-Lag Controllers design in frequency Domain

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Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

Unit 5 **8 Hrs**

State Space Analysis of Continuous Systems: Concepts of state, state variables and state model, derivation of state models from block diagrams, Diagonalization- Solving the Time invariant state Equations- State Transition Matrix and it's Properties – Concepts of Controllability and Observability.

Text Books:

1. I.J.Nagrath and M.Gopal," Control System Engineering", New Age International Pu blishers, 5th Edition, 2008.
2. Richard C Dorf; Robert H Bishop, "Modern control system", Pearson Education, 13th Edition, 2017.

References Books:

1. M F Golnaraghi and Benjamin C Kuo, "Automatic control systems", New York McGraw-Hill Education, 9th Edition, 2017.
2. M.Gopal, Digital Control and State Variable Methods, Tata McGraw- Hill 4th Edition, 2014.
3. Joseph J DiStefano, Allen R Stubberud and Ivan J Williams , Schaum's Outline Series, "Feedback and Control Systems", Tata McGraw- Hill, 2nd Edition 2014.
4. John J.D'azzo & Constantine H.Houpis, 'Linear control system analysis and design', Tata McGraw-Hill., 4th Edition 2000 .

List of Experiments:

1. Perform step response of a transfer function
2. Perform impulse response of a transfer function
3. Perform ramp response of a transfer function
4. Analyze torque speed characteristics and determine the transfer function of a DC servomotor.
5. Analyze characteristics of a small AC servomotor and determine its transfer function.
6. Perform the transient and frequency response of a second order network.
7. Perform the performance of various types of controllers used to control the temperature of an oven.
8. Draw nyquist plot from a transfer function
9. Draw root locus from a transfer function
10. Draw bode plot from a transfer function

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Indore

Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEE 504		SWITCHGEAR AND PROTECTION	60	20	20	30	20	3	1	2	5

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):
To introduce the students the different types of faults, circuit breakers and protective relays for protecting power system equipments.

Course Outcomes (COs):
After the successful completion of this course students will be able to

1. Gain knowledge on protective relays and circuit breakers.
2. Understand the concept of protection of generators, transformers and bus bars.
3. Gain knowledge in different types of microprocessor based relays.
4. Understand the concept of lightning and its protection.

Syllabus:

UNIT I **[7 Hrs]**

Fault Analysis

Faults in power systems (Symmetrical & Unsymmetrical), Fault analysis in per unit System, representation of power system as Single line and equivalent impendence diagram. Symmetrical components and its application to power systems, Sequence networks and their interconnection for different types of faults, Effect of fault impedance, Current limiting reactors, its location and application, Short circuit calculation.

UNIT II **[9 Hrs]**

Protective Relays

Requirement of relays, Primary & backup protection, Desirable qualities of relays, Concept of Pickup, reset & drop-off, Drop off/ Pickup ratio, inverse time & definite time charterstics. Types of Relay: Attracted armature, Balanced Beam, Induction disc, Induction cup, Moving coil & moving Iron, Rectifier , Thermal, Bimetal directional relay, Frequency, DC, all or nothing relays, Pilot & negative sequence, Over current, Over Voltage, Directional, Differential and Distance relays, R-X diagram, Impedance mho & reactance relay. Introduction of static analog & digital relays.

UNIT III **[9 Hrs]**

Circuit Breakers

Elementary principle of arc quenching, recovery & re-striking voltage, arc quenching devices, description and operation of Bulk oil, Minimum oil, Air break, Air blast, SF6, Vacuum circuit

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Registrar
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breakers and DC circuit breakers, their comparative merits, LT Switch gear, HRC fuses, current limiting reactor & influence of reactors in CB ratings, Testing of circuit breaker.

UNIT IV **[9 Hrs]**

System Protection

Protection of Generators -Earth Fault, percentage, differential, Loss of excitation, Prime mover failure, Over current, Turn to turn fault, Negative phase sequence, heating, Reverse power protection schemes Protection of Transformers Internal & external fault protection, Differential, Earth fault, Over Current, Overheating, Protection schemes, Protection of transmission lines, Over current, Distance and carrier current protection schemes.

UNIT V **[9 Hrs]**

Surge Protection & insulation co-ordination

Switching surges, Phenomena of Lightning, over voltage due to lightning, Protection against lightning, Lightning arrestors, selection of lightning arrestors, Surge absorbers and diverters, Rod gap, Horn gap expulsion type & valve type lightning arrestors, solid resistance and reactance earthing, Arc suppression coil, Earthing transformers, Earth wires, Earthing of appliances, insulation co-ordination,

Text Books:

1. Switchgear & protection, by Sunil S. Rao. Khanna Publication, 2008.
2. Electrical Power systems, by CL Wadhwa, New age International, 2009.

Reference Books:

1. B. Ravindran and M Chander, Power System protection and Switchgear, New Age International reprint 2006.

List of Experiments:

1. Determination of drop out factor of an instantaneous over current relay.
2. Determination of operating characteristic of IDMT relay.
3. Determination of operating characteristic of differential relay.
4. Study and operation of gas actuated protective relay.
5. Study and operation of static over current relay.
6. Determination of transmission line parameters using MATLAB.
7. Analysis of power system faults (Symmetrical & Asymmetrical) using MATLAB.
8. Study of SF6 circuit breaker
9. Simulation of protection of generator and Transformer.
10. Simulation of protection of Feeder & Motor protection.

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Board of Studies
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Indore

Registrar
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Indore

Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEE 512	ELECTIVE	RELIABILITY ENGINEERING	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Educational Objectives (CEOs):

The overall aim of this course is to provide knowledge of basic reliability evaluation theories with applications for electric power systems. The course gives a thoroughly introduction to reliability theory and generally used models. It aims to arm the students with the concepts of evaluation of generation, transmission and distribution system reliability and their impacts on system planning.

Course Outcomes (COs):

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

1. **Understand** the concept of probability theory, distribution, network modelling and reliability analysis.
2. **Analyze** the reliability functions with their relationships and Markov modeling.
3. **Evaluate** reliability models using frequency and duration techniques and generate various reliability models.
4. **Explicate** the reliability of composite systems and distribution systems.

Syllabus:

UNIT I **[8 hours]**

Probability Theory: Introduction to Probability, Probability distributions: Random variables, density and distribution functions. Mathematical expectation. Binominal distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution. Normal Gaussian, Gamma and Beta distribution. Correlation and regression.

UNIT II **[8 hours]**

Basic Tools and Techniques- Random processes methods & Markov process, Computation of power system reliability measures by using Markov reward models, Evaluation of reliability indices, Universal Generating Function (UGF) Method, Monte Carlo simulation.

UNIT III **[8 hours]**

Generation System Reliability Analysis: Capacity Outage Calculations, Reliability indices using the loss of load probability method, unit commitment and operating constraints, optimal reserve management, single and multi-stage expansion. Interconnected System, Factors affecting interconnection under emergency assistance.

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Registrar
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Indore

Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

UNIT IV **[6 hours]**

Transmission System Reliability Analysis: Introduction, Objectives of Transmission Planning, Network Reconfiguration, System and Load Point Indices, Data required for Composite System Reliability.

UNIT V **[10 hours]**

Distribution System Reliability Analysis: Radial Networks– Introduction, Network Reconfiguration, Evaluation Techniques, Effects of Lateral Distribution Protection, Bus Bar Failure, Scheduled Maintenance, Temporary and Transient Failure, Weather Effects, Breaker Failure.

Text Books:

1. R. Billinton, R.N.Allan, Reliability Evaluation of Power systems, 1996 Plenum Press, New York.
2. Marko Cepin, "Assessment of Power System Reliability- Methods and Applications", Springer-Verlag London Limited 2011.

Reference Books:

1. Sharles E.Ebeling. "An Introduction to Reliability and Maintainability Engineering", TMH.
2. J.Endrenyi , "Reliability Modelling in Electric Power Systems", John Wiley & sons, NY.
3. Athanasios Papoulis and S.Unnikrishna Pillai ,"Probability, Random variables and Stochastic Processes, 4th edition, Tata McGraw Hill, 2002.

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Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEE 513		ANTENNA THEORY	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives:

The student will learn and understand:

1. To give insight of the radiation phenomena.
2. To give a thorough understanding of the radiation characteristics of different types of antennas.
3. To create awareness about the different types of propagation of radio waves at different frequencies.
4. Fundamental antenna parameters and numerical methods to analyze and differentiate the antennas.
5. Concept of radiation mechanism of various antennas.
6. Mechanism and models for radio-wave propagation.

Course Outcomes:

Upon completion of this course the students will be able to:

1. Identify basic antenna parameters.
2. Design and analyze antenna arrays.
3. Design and analyze wire and aperture antennas.
4. Identify the characteristics of radio-wave propagation.

Syllabus:

UNIT I **[9Hours]**

Antenna Fundamentals

Retarded potential – Radiation mechanism, directivity and gain, bandwidth, polarization, co polarization and cross polarization level, beam width, input impedance, bandwidth, efficiency, input impedance, antenna effective length and area, antenna temperature- radiation pattern- Gain- Directivity and Impedance measurements.

UNIT II **[6Hours]**

Design of Arrays

Linear Array – Two element array, N-element linear array- broadside array, End fire array- Directivity, radiation pattern. Planar array – array factor, beam width, directivity. Circular array -array factor.

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Indore

Registrar
Shri Vaishnav Vidyapeeth Vishwavidyalaya
Indore

Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

UNIT III **[9Hours]**

Design of Antennas

Long wire, V-Antenna, Rhombic antenna, Monopole Antenna – dipole antenna, helical antenna, Spiral antenna, Log periodic antenna, Yagi-Uda antenna. Aperture antenna – Horn antenna, parabolic reflector antenna. Microstrip antenna.

UNIT IV **[7Hours]**

Antennas for modern wireless communications

Antennas for Terrestrial mobile communication – mobile handsets and base stations. Antennas for Satellite Communication- MSAT briefcase terminal and vehicle mounted Antennas.

UNIT **[8Hours]**

Wave Propagation

Propagation Mechanism- Reflection, refraction and Transmission, Scattering and diffraction. Propagation Model- Path Loss, Free space loss, Plane earth Loss. Noise Modeling. Modes of propagation- Ground wave Propagation, Sky wave Propagation, Space wave, Tropospheric Refraction, Obstruction Loss, Diffraction, Influence of Clutter. – Tropospheric effects, Ionospheric Effects.

Text Books:

1. J.D.Krauss, "Antenna for all Applications", TMH, 3rd Edition, 2010, *ISBN* 0-89006-513-6.
2. C.A.Balanis, "Antenna Theory – Analysis and Design", Third Edition, John Wiley & Sons, 2010. *ISBN* 0-471-66782-X

Reference Books:

1. R.S.Elliot, "Antenna Theory and Design", IEEE Press, John Wiley, 2005, *ISBN*-13 978-0-470-01741-8, 3rd edition.
2. K.D.Prasad, "Antennas and Radiating Systems", Satyaprakasan
3. Edward C.Jordan And Keith G.Balmain" Electromagnetic Waves And Radiating Systems" Prentice Hall Of India, 2006
4. R.E.Collin,"Antennas And Radiowave Propagation", Mc Graw Hill 1985.
5. Constantine.A.Balanis "Antenna Theory Analysis and Design", Wiley Student Edition, 2006.
6. Rajeswari Chatterjee, "Antenna Theory And Practice" Revised Second Edition New Age International Publishers, 2006.
7. S. Drabowitch, "Modern Antennas" Second Edition, Springer Publications, 2007.
8. Robert S.Elliott "Antenna Theory and Design" Wiley Student Edition, 2006.
9. H.Sizun "Radio Wave Propagation for Telecommunication Applications", First Indian Reprint, Springer Publications, 2007.

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Shri Vaishnav Vidyapeeth Vishwavidyalaya

Bachelor of Technology (Electrical and Electronics Engineering)

SEMESTER V

COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEE 514		IOT IN ELECTRICAL ENGINEERING	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives: The objective of study of IOT in Electrical Engineering is to:

1. Study Telematics devices
2. Study IoT Sensors
3. Study Smart grid and Micro grid
4. Study Smart Space Security System

Course Outcomes:

After the successful completion of this course students will be able to

1. Attain knowledge of IoT in Electrical Engineering
2. Attain knowledge on Telematic Devices
3. Analyze and work on IoT sensors
4. Attain knowledge on Smart grid and Micro grid
5. Learn Smart Space Security System.

Syllabus:

UNIT- I

INTRODUCTION TO IOT **[9 hrs]**

Introduction – Need of IoT in Electrical Engineering – Challenges in Implementation of IoT – Trends in Electrical Engineering – Configuration and Scalability – Efficiency – Quality of Service

UNIT II

TELEMATICS **[9 hrs]**

Smart Devices – Smart Apps – Wearable Technology – Vehicle Telemetry – Smart Homes and Building Automation – Vehicle Charging Station

UNIT III

SMART ENERGY **[9 hrs]**

Generation – Transmission – Distribution and Metering – Storage – Smart Monitoring and Diagnostics System at Major Power Plants –Micro grid and Virtual Power

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UNIT IV

INDUSTRIAL IOT **[9 hrs]**

Real-Time Monitoring and Control of Processes – Deploying Smart Machine – Smart Sensor – Smart Controllers – SCADA – Proprietary Communication

UNIT V

SECURITY MEASURES **[9 hrs]**

Securing Smart Spaces and Smart Grid – Smart Grid – Service that need to be Secure - Security Requirement – Security Smart Spaces – Smart Tracking Firewall – Cryptographic Key in the IoT

Text Books:

1. George Mastorakis , (2016), Internet of Things (IoT) in 5G Mobile Technologies, 1st ed. Edition, Publisher SPRINGER.

Reference Books:

1. Enterprise IoT: Strategies and Best Practices for Connected Products and Services, Dirk Slama, Frank Puhlmann, Jim Morrish, Rishi M Bhatnagar, Publisher O'REILLY

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COURSE CODE	CATEGORY	COURSE NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		Th	T	P	CREDITS
			END SEM University Exam	Two Term Exam	Teachers Assessment*	END SEM University Exam	Teachers Assessment*				
BTEC 502		CELLULAR AND MOBILE COMMUNICATION	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; **C** - Credit;
***Teacher Assessment** shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 10 marks.

Course Objectives :

The subject aims to provide the student with:

1. To impart fundamental concepts in cellular technology, models of mobile radio channels, communication technologies adapted and wireless networks.
2. Be acquainted with different interference factors influencing cellular and mobile communications.
3. To efficiently use the background behind developing different path loss and/or radio coverage in cellular environment.
4. To expose the students to the most recent technological developments in mobile communication systems.

Course Outcomes:

1. Students will get familiar with cellular terminology as mobile station, base station and mobile telephone switching office.
2. Develop the capability to analyze and design propagation models for mobile radio channel.
3. Learn how to reduce co-channel and non co-channel interference.
4. Know about implementation of digital cellular system.

Syllabus:

UNIT-I

Introduction To Cellular Mobile Systems: Limitations of Conventional Mobile Telephone System, Basic Cellular Systems, Performance Criteria, Uniqueness of Mobile Radio Environment, Operation of Cellular Systems, Analog & Digital Cellular Systems.

UNIT-II

Cellular Concept: Concept of Frequency Reuse, Co-channel Interference Reduction Factor, Desired C/I in An Omni-directional Antenna System, Sectoring and Cell Splitting, System Capacity, Trunking and Grade of Service (GOS), Concept of Handoff, Types of Handoff, Queuing of Handoff

UNIT-III

Cell Coverage for Signal and Traffic : Signal Reflections in Flat and Hilly Terrain, Effect of Human Made Structures, Phase Difference between Direct and Reflected Paths, Straight Line

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Path Loss Slope, General Formula for Mobile Propagation Between Two Fixed Station Over Water and Flat Open Area, Near- in and Long Distance Propagation. Mobile to Mobile Propagation.

UNIT-IV

Interference in Cellular Mobile System: Co-channel Interference: Design of an Omni-directional Antenna System and Directional Antenna System, Lowering the Antenna Height, Power Control, Reduction in C/I by Tilting Antenna, Umbrella Pattern Effect. Non Co-channel Interference: Adjacent-Channel Interference, Next Channel Interference and Neighboring Channel Interference, Near-End Far-End Interference, Diversity Receiver

Frequency Management, Channel Assignment: Frequency Management, Frequency-Spectrum Utilization, Set-up Channels, Fixed Channel Assignment Schemes, Dynamic Channel Assignment Schemes,

UNIT-V

Digital Cellular System: Multiple Access Techniques – FDMA/FDD, TDMA/TDD, CDMA, SDMA and OFDMA/SC-FDMA/SOFDMA/MIMO, GSM System Architecture, GSM Radio Subsystem, GSM Channel Types, Frame Structure for GSM, Signal Processing in GSM, GPRS and EDGE.

Text Books:

1. William C. Y. Lee, Mobile Cellular Telecommunications: Analog and Digital Systems, 2nd Edition, Tata McGraw Hill Publication, 1995.
2. Theodore S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson / PHI Publication, 1996.

Reference Books:

1. Iti Saha Misra, Wireless Communications and Networks: 3G and Beyond, 2nd Edition, Tata McGraw Hill Publication, 2013.
2. Gordon L. Stuber, Principles of Mobile Communications, Springer International 2nd Edition, 2007.
3. William Stallings, "Wireless Communications and Networks", 2nd Edition, Pearson Education, 2005.
4. Siegmund M. Redl, Mathias K. Weber, Malcolm W. Oliphant, "An Introduction to GSM", Artech House Publishers, 1998.

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