ACADEMIC REGULATIONS – 2018

UNDERGRADUATE DEGREE PROGRAMMES

Bachelor of Technology

(B.Tech. - Four Years)

(Choice Based Flexible Credit System)

SRM INSTITUTE OF SCIENCE & TECHNOLOGY
(Deemed to be University u/s 3 of UGC Act, 1956)
Kattankulathur, Kancheepuram District 603203,
Tamil Nadu, India

i. Regulations for B.Tech. (Common to all Programmes)

These regulations are applicable to the students admitted from the Academic Year 2018-19 onwards.

As per the recommendation of National Knowledge Commission, University Grants Commission (UGC) and All India Council for Technical Education (AICTE), institutions of higher education need to carry out academic reforms in all areas including admission policy, uniform academic calendar, introduction of Choice Based Flexible Credit System, continuous assessment and grading system. In keeping with these recommendations, SRM Institute of Science and Technology (SRMIST) had adopted the Choice Based Flexible Credit System (CBFCS) in the faculty of Engineering and Technologyin the year 2013 which was improved upon in 2015 and now it is being further refined and implemented from 2018-19 onwards.

Preliminary Definitions and Nomenclature

In these regulations, unless the context otherwise requires:

i. **'Degree'** means that academic award conferred upon a student on successful completion of a four-year programme designed to achieve the defined attributes. It is referred to as Under-Graduate (UG) Degree, that is "Bachelor of Technology" also known as "B.Tech. Degree".

ii. **'Programme'** means cohesive arrangement of courses, co-curricular and extracurricular activities to accomplish predetermined objectives leading to the awarding of a degree. It also means branch or discipline of B.Tech. Degree programme like Civil Engineering, Mechanical Engineering, etc. Some Degree programmes also provide options to specialize in a specific domain of interest. Such B.Tech. Degree programmes are titled as the *Degree along with its specializations* like Biotechnology with specialization in Regenerative Medicine, etc.,

iii. **'Course'** means a combination of theory, tutorials and practice sessions of a subject studied in a semester, like Mathematics, Physics, etc.,

iv. **'Minor'** is an optional secondary concentration of courses that often complements the Degree Programme.

R.1.0 Admission for B.Tech. (Regular) Programme

R 1.1 **Number of Seats:** The number of seats in each branch of the B.Tech. programme for which admission is to be made in the Faculty of Engineering and Technology will be decided by the Board of Management, SRMIST.

R 1.2 **Minimum Eligibility:** The minimum eligibility for Admission to B.Tech. degree programmes (Regular) shall be based on the following two essential criteria:

(a) A pass in the 10+2 (Higher Secondary) examination or any other equivalent examination of any authority, recognized by SRMIST, with a minimum aggregate of marks in Mathematics / Biology / Biotechnology, Physics and Chemistry to be specified by the Admissions Committee.

(b) Qualification in SRM Joint Entrance Examination - Engineering (SRMJEEE) (or) any other Entrance Examination conducted by central/state entrance examination body for the purposes of admission to an engineering degree programme for the respective year of admission.

R 1.3 **Eligibility for SRMJEEE:** The eligibility for appearing for SRMJEEE and the format shall be mentioned in the Application form and would be decided by the Admissions Committee for the respective year of admission.

R 1.4 **Seat Allocation and Admission:** The Admission Committee will prepare a merit list based on the marks scored by the candidates in the SRMJEEE and call the applicants in the merit order for counselling. Seats are allotted based on applicant's interest and seat availability. Only those candidates who have scored the minimum aggregate of marks as specified in R.1.2 (a). will be included in the merit list.

R 1.5 **Admissions under Lateral Entry Scheme:** Under the Lateral entry scheme of Admissions, the following categories of candidates are eligible for admission directly to the 3rd semester of any B.Tech. programme offered by SRMIST.

Minimum Eligibility: A pass in Diploma in Engineering/Technology through:

(i) A minimum of three years of institutional study, after the 10th (SSLC) examination, recognized by SRMIST. (or)

(ii) A minimum of 2 years of institutional study, after the 10+2 (Higher Secondary) examination, recognized by SRMIST. (or)

(iii) ABachelor's degree in Mathematics/Physics/Chemistry, after the 10+2 (Higher Secondary examination, recognized by SRMIST. (or)

(iv) Any other equivalent degree through a minimum of 3 years of institutional study, after the 10+2 (Higher Secondary) examination, recognized by SRMIST.

R 1.6 **Medical Standards for Admission**: Candidates have to fulfil the medical standards required for admission as set out by the Admission Committee.

R 1.7 **Fees for Admission:** The selected candidate will be admitted to the B.Tech. programme after he/she fulfils all the admission requirements as indicated in the letter of admission after making the payment of the prescribed fees within the due date announced.

R 1.8 **Authority for Admission:** Any matter related to admission to the B.Tech. programme, the decision of the Admission Committee is final.

R 1.9 If, at any time after admission, it is found that a candidate has not fulfilled the requirements stipulated in the offer of admission, the Director (Eng. & Tech.) may revoke the admission of the candidate and report the matter to the Vice Chancellor.

R 1.10 In Addition to the above, admissions will be based on the rules and regulations of the UGC/Competent authorities in force at the time of admissions.

R.2.0 Structure of B.Tech. Programme (Common to all Programmes)

R 2.1 **List of Programmes:** The B.Tech. Degree Programmes offered by SRMIST are as follows:

1	Aerospace Engineering (AS)
2	Automobile Engineering (AU)
3	Automobile Engineering with specialization in Automotive Electronics (AE)
4	Biotechnology (BT)
5	Biotechnology with specialization in Regenerative Medicine (RM)
6	Biotechnology with specialization in Genetic Engineering (GE)
7	Chemical Engineering (CH)
8	Civil Engineering (CE)
9	Computer Science and Engineering (CS)
10	Computer Science Engineering with specialization in Artificial Intelligence and Machine Learning (AI)
11	Computer Science Engineering with specialization in Big Data Analytics (BD)
12	Computer Science Engineering with specialization in Cloud Computing (CC)
13	Computer Science Engineering with specialization in Computer Networking (CN)

14	Computer Science Engineering with specialization in Cyber Security (SC)
15	Computer Science Engineering with specialization in Information Technology (IT)
16	Computer Science Engineering with specialization in Internet of Things (IO)
17	Computer Science Engineering with specialization in Software Engineering (SE)
18	Electrical and Electronics Engineering (EE)
19	Electronics and Communication Engineering (EC)
20	Electronics and Communication Engineering with specialization in Biomedical Engineering (BM)
21	Electronics and Communication Engineering with specialization in Instrumentation Engineering (IE)
22	Mechanical Engineering (ME)
23	Mechatronics Engineering (MH)
24	Mechatronics Engineering with specialization in Robotics (RO)
25	Nanotechnology (NT)

R 2.2 **Category of Courses:** The Programme of study will consist of 8 categories of courses distributed over eight semesters (6 semesters for lateral entry students) with two semesters per year as listed below:

No.	Category Code	Course Category
1	H	Humanities and Social Sciences including Management courses
2	B	Basic Science courses
3	S	Engineering Science courses
4	C	Professional Core courses (Compulsory courses)
5	E	Professional Elective courses (Optional courses relevant to chosen branch/specialization)
6	O	Open Elective courses (Optional courses from other technical and/or emerging subjects)
7	P	Project Work, Seminar and Internship in industry or higher institutions
8	M	Mandatory Courses (non-credit courses)

R 2.3 **Outcome Based Education:** The B.Tech. programmes follow the Outcome Based Education (OBE) guidelines and have well defined:

1	Program Educational Objectives (PEO)
2	Program Learning Outcomes (PLO) which includes Program Specific Outcomes (PSO)
3	Mission of the Department to Program Educational Objectives (PEO) Mapping
4	Program Educational Objectives (PEO) to Program Learning Outcomes (PLO) Mapping

5	Structure of Undergraduate Engineering Programme
6	Categorization of Courses (for all four years)
7	Program Articulation Matrix (for all four years)

And, every course has well defined:

1	Course Learning Rationale (CLR)
2	Course Learning Outcomes (CLO) – (Outcome based Objectives)
3	Learning Plan with session-wise Session Learning Outcomes (SLO)
4	Learning Assessment Scheme
5	Course Designer Details

These details are proposed by the respective Board of Studies and approved by the Academic Council.

R 2.4 **Learning Curriculum:**B.Tech. Programmes have a learning curriculum comprising of appropriate combinations of learning from Theory, Tutorials and Practice sessions.

R 2.5 **Learning Credits:** Learning Credits are earned by the learner based on the following pattern:

Learning Environment	Learning Credit (C)
1 Hour* Learning from a Lecture Session per week (L)	1
1 Hour* Learning from a Tutorial Session per week (T)	1
1 Hour* Learning from a Practice Session per week (P)	0.5

(* 1Hour of Learning is usually a 50-60 minute period)

R 2.6 **Minimum Learning Credits for the award of Degree:** For the award of B.Tech. Degree, a student has to acquire a maximum of 160 learning credits by learning and practising the various courses prescribed in the curriculum within the stipulated time duration.

(a) **Learning Credit Requirement for Lateral Entry Students:** For the award of B.Tech Degree for a student who has joined through the Lateral Entry Scheme, the number of learning credits to be acquired will be in accordance with the curriculum of the program concerned and the credit standing at the point of entry (Second year, third semester) to the B.Tech. Program.
For instance, assuming the total credits stipulated for a particular specialisation of first year B.Tech. is 42, and the aggregate of bridge courses – mathematics (2 credits), Physics (2 credits) and Chemistry (2 credits) is 6 credits, then the credit standing would work out to 42-6= 36 credits. In this case the student, has

to earn [160 – 36 = 124 credits, including the credits of bridge courses to receive his/her B.Tech. degree.

Lateral entry students, on admission, shall have to undergo 'Bridge Courses' prescribed by the SRMIST, which they have to pass and the learning credits acquired from these courses are added towards their qualifying degree requirements.

R 2.7 **Classification and Numbering of courses:** The 9 digit Course Code Structure is provided below:

For Example : 18LEH101J

YY DD C L SS A					
YY	DD	C	L	SS	A
2 digits	2 digits	1 digit	1 digit	2 digits	1 digit
Year of Regulation	**Course Offering Department**	**Type of Course**	**Level of the Course**	**Serial No. of the Course**	**Additional Qualifier**
2018 Regulations	LE – English PY – Physics CY – Chemistry MA – Mathematics MB – Management Sciences PD – Career Development Centre AS – Aerospace Engineering AU – Automobile Engineering BT – Biotechnology CH – Chemical Engineering CE – Civil Engineering CS – Computer Science & Eng., EE – Electrical & Electronics Eng., EC – Electronics &Commn. Eng., ME – Mechanical Engineering MH – Mechatronics Engineering NT – Nanotechnology	**H** – **H**umanities, Social Sciences including Mgt. Courses **B** – **B**asic Science Courses **S** – Engineering **S**cience Courses **C** – Professional **C**ore Courses **E** – Professional **E**lective Courses **O** – **O**pen Elective Courses **P** – **P**roject Work, Seminar, Internship etc., **M** – **M**andatory Courses (non-credit)	1 - 1st Level Course 2 - 2nd Level Course 3 - 3rd Level Course 4 - 4th Level Course	01 02 etc.,	T - Theory L - Laboratory I - Industry B - Bridge J - Joint

R 2.8 **Medium of Instruction:** The medium of instruction, examination and project reports will be in English.

R.3.0 Registration / Enrolment for Courses

The process of signing-up for courses is called 'Registration'. Students are enrolled after they pay the prescribed fees. For a student to attend classes he/she has to necessarily complete both registration and enrolment. All students shall formally register for the courses every semester to undergo their learning course work.

R 3.1 **Course Enrolment Requirements:** Enrolment for all courses prescribed as per the curriculum is mandatory.

(a) Registration of any course will be controlled by the respective Heads of Department.

(b) The registration sheet contains the course code, course title, number of credits earned till date, number of credits opted for the current semester, and the remaining number of credits to earn for the award of the degree. The student will make the choice of courses on his own or in consultation with his/her Faculty Advisor.

(c) For the first semester (and III semester in the case of lateral entry students) registration shall be completed within a week prior to the commencement of classes.

(d) For all other semesters, the registration will be done during a specified week immediately after the end semester examination of the previous semester.

(e) Late enrolment would not be encouraged. In case of a late enrolment, special permission is required from the respective Heads of Department.

R 3.2 Break in Studies:A student will not be allowed to enrol for current semester and has to undergo a year of break in studies if he/she:

(a) Does not have a minimum of 75 % attendance in at least 3 or more courses in the previous semester

(b) Has not cleared any pending fee dues to SRMIST, Hostel, Library, NCC etc., in the previous semester

(c) Has been 'Debarred from study' due to any stipulated reason in the previous semester.

(d) Has any 'Pending Disciplinary Actions' against him/her from the previous semesters

(e) Has not registered for previous end semester examinations

R 3.3 During the Break of Studies, a student:

(a) Cannot attend any regular classes
(b) Will not be permitted to stay in the 'Hostel' facility provided by SRMIST
(c) Will not be permitted to participate in any of the SRMIST's activities inside the campus.
(d) Can register for 'Compensatory courses' for such courses in which he/she might have obtained an 'I' grade.
(e) Can reappear for the 'End Semester Final Examination' for such courses in which he/she might have obtained 'F' / 'Ab' grade.

R 3.4 **Enrolment After Break in Studies:** A student who undergoes a break in studies in the current semester (odd/even) can 'Enrol Back to Study' into the B.Tech. Programme only in the subsequent corresponding (odd/even) semester in the next academic year only. And 'Enrol Back from Study' is subject to the approval from Director (Eng. & Tech.).

R 3.5 **Detention in Courses and Compensatory Courses:**
The system of compensatory courses is meant for those students who are unable to cope up with the academic vigour and hence fails to secure 75% attendance in a few courses in a semester. Such students can not appear for end semester examinations of the courses in which their attendance percentage is less than 75% and are deemed to be detained in such courses and awarded 'I' grade in the same (Refer R.8.3). However, such students can register under Compensatory Courses in the next semester subject to the following conditions:

(a) Compensatory courses are conducted only for a student who is 'Detained from Study' due to lack of attendance of 75% minimum.
(b) Compensatory courses may be announced after the publication of results, by the respective School/Department, by the Deans/HODs, with the approval of the Director (Eng. & Tech.)
(c) Student has to register for the Compensatory Course and pay the prescribed fee for the Compensatory Courses within the specified time limit.
(d) A maximum of two Compensatory Courses alone will be permitted to be registered by a student during the semester next to the semester of detainment.
(e) Withdrawal from Compensatory courses is not permitted
(f) These courses will be conducted only for 75% of the hours prescribed in the curriculum and would be held either during weekends or in evenings after the regular class duration.
(g) A student has to obtain a minimum of 75% attendance in each of these courses.

(h) There will be only one end semester final examination, and no continuous learning assessments. The internal marks scored in the detained course will be ignored.

(i) A student has to score the minimum passing criterion to be declared 'Pass' in that course.

(j) Students cannot demand a compensatory course for a course in any semester as a matter of right. Compensatory courses will be conducted subject to availability of faculty, class rooms and logistics.

(k) Students who have done a Compensatory Course will not be considered for rank, medal or distinction.

a. **Adding and dropping courses:** This is applicable only to Professional Elective and Open Elective courses.

(a) A student may withdraw from an elective course without academic penalty only during the first 2 weeks of the semester only.

(b) A course having a Co-requisite course will not be permitted to be dropped. Similarly registering for a new elective course is permitted only during the first two weeks of the semester.

(c) If an elective course is dropped within the first two weeks of the commencement of classes, it does not appear on the academic transcript. In case, the course is dropped any time after 2 weeks unilaterally by the student, for reasons whatsoever, it will be recorded with a mark of "Ab" or "I

(d) When a course is added within the permissible timeframe, the attendance will be calculated from the date of registering the newly added course. No make-up classes need be conducted for the individual student to compensate for the missed classes.

(e) **Registration in graduate level courses by undergraduate students:** Exceptional undergraduate students who are in the fourth year of study and who possess CGPA of not less than 9.0 may enrol in a graduate (Masters) course. In order to do so, students must receive a strong recommendation from the academic advisor and prior approval of the Director (Eng. & Tech.). The according of approval lies solely with the Director (Eng. & Tech.). In any case only ONE master's level course will be permitted. The assessment procedure will remain the same as applicable for the master's level course.

R.4.0 Maximum and Minimum Duration of the Programme

R 4.1 **Semester Duration:**Each semester of study shall normally consist of 90 working days or 450 hours. A student is ordinarily expected to complete the B.Tech. programme in eight semesters for regular programme and in 6

semesters under lateral entry scheme. However, a student may complete the programme at a slower pace by taking more time as specified below:

Regular students: within the time duration of 12 semesters (As per the UGC Norms) for students admitted in a particular year.

Lateral Entry students: within the time duration of 10 semesters (As per the UGC Norms) for students admitted in a particular year.

The above-mentioned time duration is counted excluding semesters withdrawn on medical grounds etc.

R 4.2 In compliance with the rules and norms of UGC, no student will be allowed to complete the B.Tech. degree in less than 8 full-semesters.

R.5.0 Temporary withdrawal from the programme

R 5.1 A student may be permitted by the Director (Eng. & Tech.) to withdraw from the programme for a semester or longer for reasons of ill health or other valid reasons. Normally a student will be permitted to discontinue from the programme only for a maximum continuous period of two semesters or the aggregate of individual discontinuation not exceeding two semesters.

R.6.0 AcademicAdvising : In order to provide academic assistance and individualized attention to students, different levels of advising/attention will be provided by three types of officers.(1) Academic Class Advisors (2) Student Counsellor (3) Faculty Advisors

R 6.1 **Academic Class Advisors:** For every 60 to 70 students, an Academic Class Advisor would be allocated to help the student evaluate and realize educational and career options. The basic responsibilities of the Academic Class Advisor are:

(a) To assist the student in career planning and to refer student to campus resources for such assistance.
(b) To be knowledgeable about the program(s) for which he/she is advising and be familiar with published academic rules and regulations of SRMIST.
(c) To inform the student of the various aspects of degree requirements.
(d) To approve the course registration of the student at the department level
(e) To consider and approve the application for adding / dropping / auditing of courses
(f) To guide the students while applying for readmission / transfer etc.

(g) To help student plan a suitable schedule of classes, at least one semester in advance.

In all of these matters, the Academic Class Advisor or the advisement team must judge whether the student's request is in order, is in the student's best interest, and is feasible under existing regulations.

R 6.2 **Student Counsellors& Faculty Advisors:**In order to motivate the students personally and provide counselling on academic and non-academic matters, a faculty member called Student Counsellor shall be assigned for every 25-30 students. In addition, Faculty Advisors also would advise students time to time.

R.7.0 Conduct and Discipline

R 7.1 **Expected Conduct and Discipline:** Every student is required to:

(a) Demonstrate ethical, professionaland exemplary conduct and decorous behaviour both inside and outside SRMIST campus and not to indulge in any activity that will tend to bring down the prestige of the SRMIST.

(b) Be self-motivated and to be self-disciplined

(c) Make the most of their ability and to contribute to the happiness and well-being of SRMIST community by supporting others.

(d) Treat others in the way that they would wish to be treated themselves

(e) Abide by the orders of the Honourable Supreme Court of India, and not to get involved in any acts of ragging in any form. Ragging is absolutely and completely prohibited in SRMIST.

(f) Avoid Plagiarism, cut and paste jobs, malpractices of any kind in learning assignments including project work and its reports.

R 7.2 **Act of Indiscipline:**A student who does not conduct in the manner expected and as stated above is considered to be performing an act of Indiscipline.

(a) Acts of Indiscipline are dealt with at zero tolerance

(b) Any acts of Indiscipline of a student is first to be considered by the Discipline and Welfare Committee of the Department/School for necessary action. If the issue demands more serious consideration, the act of indiscipline will be reported to the Director (Eng. & Tech.) and he will refer it to the Discipline and Welfare Committee of SRMIST, constituted by the Vice Chancellor. The Committee will enquire into the charges and recommend suitable action if the charges are substantiated. The Director (Eng. & Tech.) will take appropriate

action on the recommendation of the Discipline and Welfare Committee of SRMIST.

(c) Anyone found indulging in ragging or any such acts is liable to be dismissed forthwith.

R 7.3 **Suspension:** Director (Eng. & Tech.) may suspend a student pending inquiry depending upon the prima facie evidence.

R 7.4 **Appeal:** The aggrieved student may appeal to the Vice Chancellor whose decision will be final and binding.

R.8.0 Attendance

R 8.1 Attendance is the physical presence and active learning participation of a student in the class / laboratory / field work etc., It is a well-observed fact that the students who score good grades are those who attend and participate in all the assigned learning activities in the class / laboratory / field work, regularly. Therefore, the students must strive to attend and sincerely participate in all the assigned learning activities without fail.

R 8.2 Every faculty member facilitating a course will take notice of student attendance and their learning participation till the last instruction day in the semester. The percentage of attendance, calculated up to this point, will be indicated by a code number/letter as follows:

Attendance rounded to	Code
95% and above	H
85 to 94%	9
75 to 84%	8
Below 75%	L

R 8.3 A student must maintain an attendance record of at least 75% in individual courses, *exclusive of leave of absence due to medical reasons, on-duty, extra-curricular / extramural activities, permitted assignments such as job interviews, unforeseen emergencies etc.* Without the minimum attendance of 75%, in any course, students become ineligible to appear for the end semester examination in that course. His / Her registration for that course will be treated as cancelled, and he/she shall be awarded 'I' grade (I stands for Incomplete or registration cancelled for want of minimum attendance) in that course. This grade shall appear in the grade card until the course is successfully completed. A student shall register under "Compensatory Courses (R.3.1)" for the courses in which he/she has attendance less than 75% and complete the same.

R 8.4 A student must strive to attend all the classes without fail. However, the minimum attendance requirement of 75% allows a student the facility to use the balance 25% to account for illnesses, permitted assignments such as job interviews, inter university sports meets, inter-collegiate/inter-university competitions, accidents, unforeseen emergencies etc. An attendance of 75% in a course (except in cases governed by R.8.6) is considered to be the minimum required for a student to get just enough input on the course syllabus through class room contact hours to make him / her eligible to appear in the end semester examination for that course.

It is the responsibility of each and every student to keep track / monitor his / her percentage of attendance for each course and ensure that he / she satisfies the attendance norms prescribed by SRMIST. If the student finds any discrepancy / error in the attendance status, he /she should immediately bring it to the attention of the concerned faculty member and seek redressal.

R 8.5 The teacher shall prepare the particulars of all students who have attendance less than 75% in his / her course. Copies of the same should also be sent to the Director (Eng. & Tech.), and Heads of Schools/ Departments concerned. ***The students who have less than 75% attendance will not be permitted to appear in end semester examination, and the same will be informed to the student's parents.***

R 8.6 **Condonation of Attendance**: In rare and genuine cases, a committee consisting of Director and Head of the Department of the concerned department will examine the case, based on the documents submitted by the student, facts and circumstances. Assessment will be done, by the committee, on the merit of the case and spell out their recommendation to the Vice Chancellor. The Vice Chancellor, based on the recommendation of the committee may then give condonation of attendance, only if the Vice Chancellor deems it fit and deserving but in any case, the condonation cannot exceed 10%.

R.9.0 Learning Assessment Procedure

R 9.1 The learning of a student is assessed and evaluated in-house by the course facilitating faculty member/ department except in the case of project work where an external examiner shall be nominated for conducting the viva-voce. All assessments are designed based on Revised Bloom's Taxonomy levels of thinking and learning.

(Anderson, Lorin W, Krathwohl, David R, "A Taxonomy for Learning, Teaching and Assessing: a revision of Bloom's Taxonomy", Longman Publishing, NewYork, 2001)

R 9.2 The student's learning in each course, in general, is assessed (formative) and evaluated (summative) based on *in-semester continuous learning assessment* (internal assessment) and *end-semester final examination*. An *in-semester continuous learning assessment* (also known as internal assessment / comprehensive assessment) is spread through the duration of course and is done by the faculty member facilitating the course. In order to verify the different skills acquired in a student, the continuous learning assessments are (as appropriately) performed through:

(a) Oral Learning Assessments
(b) Written Learning Assessments
(c) Demonstrative Learning Assessments

The end-semester final examination shall have learning assessments from the following perspectives with respect to all courses:

(a) Evaluation with respect to knowledge
(b) Evaluation with respect to Understanding
(c) Evaluation with respect to skill
(d) Evaluation with respect to Applications and/or
(e) Higher Order Thinking Skills

a. The learning assessment weightage in percentages for every course is provided for each course in the respective course syllabus, and follows the template:

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)							Final Examination (50% weightage)	
		CLA-1 (10%)		CLA-2 (15%)		CLA-3 (15%)		CLA-4 (10%)		
		Theory	Practice	Theory	Practice	Theory	Practice		Theory	Practice
Level 1	Remember	%	%	%	%	%	%	%	%	%
	Understand									
Level 2	Apply	%	%	%	%	%	%	%	%	%
	Analyze									
Level 3	Evaluate	%	%	%	%	%	%	%	%	%
	Create									
	Total	100 %		100 %		100 %		100 %	100 %	

Note : For a Pure Theory Course, the Practice Part would be zero and similarly for a Pure Practice Course, the theory part would be appropriately zero.

(a) The ratio between Continuous Learning Assessments and Final Examinations for all courses is 50:50.
(b) A student should definitely attend the Final Examination to be eligible to Pass the course.

(c) For a student to PASS in a course, a student has to score a minimum of 50 marks aggregate.

(d) For the Theory Part of a course or a pure theory course; Continuous Assessments CLA-1 (normally in two learning units / modules or as prescribed by the Course Coordinator), CLA-2 (in two learning units / modules not covered in CLA-1 or as prescribed by the Course Coordinator) and CLA-3 (in all the five learning units / modules) are generally conducted as Written Tests of duration 100 minutes, 100 minutes and 180 minutes respectively each and the final examination is conducted for 180 minutes.

(e) For the Practice Part of a course or a pure Practice course; Continuous Learning Assessments CLA-1, CLA-2 and CLA-3 are generally conducted at periodic intervals, and for certain courses that needs learning verification of oral and skill demonstrative abilities, there would be appropriate oral tests and tests for demonstrations respectively.

(f) CLA-4 is generally a combination from among one or more of these options:

Assignments	Surprise Tests	Seminars	Multiple Choice Quizzes
Tech. Talks	Field Visits	Self-Study	NPTEL/MOOC/Swayam
Mini-Projects	Case-Study	Group Activities	Online Certifications
Presentations	Debates	Conference Papers	Group Discussions

(g) Student learning from the theory and practice portions in a course shall be assessed separately for 100 marks each and consolidated by assigning a weightage of 50% for theory component and 50% for practical component. Grading shall be done for this consolidated mark.

(h) For the Practice Part (Laboratory/Practical) of a course or a pure Practice (Laboratory/Practical) course; due weightage for carrying out experiments, such as observations, collection of data, analysis, interpretation of results, inferences and also timely submission of record work done would all carry due weightage based on the type of laboratories and the course and constitute the CLA-1, CLA-2, CLA-3. The nature of the end semester final examination shall be informed to the students at the commencement of the course.

(i) The Final examination (both theory and practice(Laboratory/Practicals)) would be conducted only after the last working day of the semester.

(j) Final Semester Project Work: The projects undertaken as far as possible should be socially relevant and product oriented. B.Tech. projects can be carried out by individual students or by a group of students with a maximum of five students in a group.

(k) The assessment method for the project work consists of in-semester and end semester evaluations as detailed below:

	Continuous Learning Assessment (50% weightage)			Final Evaluation (50% weightage)	
	Review – 1	Review – 2	Review – 3	Project Report	Viva-Voce
Project Work / Full Internship	5 %	20 %	25 %	20 %	30 %

R 9.3 Whenever there is a deviation from procedures stated under 15.3, as warranted by the unique nature of the course, the same will be specified by the concerned Course Coordinator and approved by the Director (Eng. & Tech.).

R.10.0 Re-appearing for Examination

(a) Students who have secured 'F'(Fail)/'Ab' (Absent) grade in a particular course can reappear when the end semester examination for that course is again conducted provided they satisfy other eligibility conditions such as lack of attendance overcome by attending Compensatory courses and minimum credit / appearance in end semester examinations requirements,

(b) Temporary withdrawal from the programme and Discipline.

(c) For the first two attempts, the internal marks obtained in the first attempt will only be considered and it will be combined with the marks obtained in the end semester examinations for the award of appropriate grade.

(d) The first attempt is that which corresponds to the first registration for the course. If a student gets 'F' or 'Ab' in an attempt that is treated as an attempt.

(e) However, if a student obtains 'F'(Fail)/'Ab' (Absent) grade in a course in the first two attempts, from the third attempt onwards, full weightage (100%) shall be assigned to marks scored in the end semester examinations and the internal assessment marks they have scored during the regular course of study will be ignored.

(f) If a student obtains "F" grade or "Ab" grade or "I" grade in a course for which only internal assessment is applicable like (i) Seminars (ii) Industrial training (iii) and other notified courses from time to time he/she should register for compensatory courses for such courses and earn the internal marks as he/she would have earned normally.

(g) Similarly, for project work, if a student gets a 'F' or 'Ab' or 'I' grade he/she should register under compensatory course, earn marks for reviews and project report as applicable and then appear for the final viva. Under the compensatory course the student shall choose a new project topic (other than the one he/she had been associated with earlier) under the guidance of the allotted faculty member.

(h) If a course has both theory and practical component, then the student shall appear in the end semester examinations of both the theory and practical components.

(i) All applicable fees charged for the purpose of examination will apply for re-appearance courses as well.

R.11.0 Course Wise Grading of Students

R 11.1 Letter Grades and Grade Points (GP) Based on the aggregate of marks obtained through internal assessment and external assessment, each student is awarded a final letter grade at the end of the semester, in each Course. The letter grades and the corresponding grade points, as recommended by UGC, are as follows:

Letter Grade	Grade Points	Mark Range
O (Outstanding)	10	91 - 100
A+ (Excellent)	9	81 – 90
A (Very Good)	8	71 - 80
B+ (Good)	7	61 - 70
B (Above Average)	6	56 - 60
C (Average)	5	50 - 55
F (Fail)	0	<50 Failure due to insufficient marks in the course
Ab (Absent)	0	Failure due to non-appearance in examination
I (Incomplete)	0	Failure due to insufficient attendance in the course.

R 11.2 A student is considered to have successfully completed a course and earned the credits if he / she secured a letter grade other than F or Ab or I in that course. A letter grade F or Ab or I in any course implies a failure in that course.

R 11.3 A course successfully completed cannot be repeated.

R.12.0 Method of Awarding Letter Grades

R 12.1 The internal marks awarded to the students are first normalized and combined with the normalized marks of end semester examination. Subsequently letter grades are awarded for the normalized marks as indicated in the table under section R16.1: The detailed methodology of

normalization of internal marks as well as marks in the end-semester final examinations shall be formulated by the Controller of Examinations.

R 12.2 To pass in a course with earnable credits a student has to score a minimum of 50% of the total normalized marks secured in both the internal and end semester examination. Grades Ab and I will be as per R. 16.1

R.13.0 Declaration of Results

R 13.1 Normalized marks are referred to the Result Passing Board for the finalization of results. Controller of Examinations assigns letter grades and announces the results.

R 13.2 The Ab / I grade once awarded stays in the record of the student and is deleted when he/she completes the course successfully later The grade acquired by the student will be indicated in the grade card of the appropriate academic year with an indication of the month and the year of passing of that course.

R 13.3 'F' grade obtained by a student will be deleted in the grade card once that course is successfully completed. The pass grade acquired by the student will be indicated in the grade card of the appropriate year with an indication of the month and the year of passing. The CGPA will be accordingly revised.

R.14.0 Re-view of answer scripts

In case any student feels aggrieved on the final outcome of the learning assessment in any course, the student shall apply to the Controller of Examinations, along with the prescribed fee, for the review of end semester examination answer script, within the stipulated time after the announcement of the results of the examinations. The Controller of Examinations shall facilitate the review of the answer script jointly to be carried out by the student and the faculty detailed for this purpose. If any discrepancy is noticed during review the same shall be rectified and the originally awarded grade accordingly amended.

R.15.0 Grade Card

R 15.1 The grade card issued by the Controller of Examinations to each student, after the announcement of the results will contain the following:

(a) The credits for each course registered for that semester.

(b) The letter grade obtained in each course

(c) The attendance code in each course

(d) The total number of credits earned by the student up to the end of that semester in each of the course categories

(e) The Cumulative Grade Point Average (CGPA) of all the courses taken from the I semester onwards for regular students and from III semester onwards for lateral entry students. For lateral entry students, the grades awarded in the bridge courses shall also be taken into consideration.

R 15.2 Computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(a) **SGPA** will be calculated according to the formula: $SGPA = \frac{\sum_1^n C_i \times (GP)_i}{\sum_1^n C_i}$

Where C_i = credit for the i^{th} course, $(GP)_i$ = the grade point obtained for the i^{th} course (refer R.5.0), n = total number of courses and the sum is over all the courses taken in that semester, including those in which the student has secured F grades.

(b) **CGPA** (Cumulative Grade Point Average) is calculated using: $CGPA = \frac{\sum_1^r S_i \times (SGPA)_i}{\sum_1^r S_i}$

where S_i = Sum of credits in i^{th} semester, $(SGPA)_i$ = Semester Grade Point Average earned in i^{th} semester and r = number of semesters and the sum is over all the semesters under consideration.

(c) The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

R 15.3 Class/Distinction will be awarded to the students after they successfully complete the B.Tech. programme as per the norms stipulated in the following table:

Regular Student:

Category	CGPA (From I - VIII semesters including bridge courses)	Class / Distinction
Students who successfully complete the B.Tech. programme within the time duration of 8 semesters (R.4.1)	≥ 5.0 &< 5.5	Pass
	≥ 5.5 &< 6.0	Second Class
	≥ 6.0 &< 8.0	First Class
	≥ 8.0 (without 'Ab' or 'F' or 'I' or 'temporary withdrawal' in any Semester)	First Class with Distinction
	≥ 8.0 (with 'Ab' or 'F' or 'I' in any Semester but obtained pass grade ('O' to 'P') subsequently)	First Class
Students who cannot complete the B.Tech. program in 8 semesters but complete it successfully within the time duration of 9 semesters (R.4.1)	≥ 5.0 &< 5.5	Pass
	≥ 5.5 &< 6.0	Second Class
	≥ 6.0	First Class
Students who cannot complete the B.Tech. program in 9 semesters but complete it successfully within the time duration of 12 semesters (R.4.1)	≥ 5.0 &< 5.5	Pass
	≥ 5.5	Second Class

Lateral Entry Student:

Category	CGPA (From III - VIII semesters including bridge courses)	Class / Distinction
Students who successfully complete the B.Tech. programme within the time duration of 6 semesters (R.4.1)	≥ 5.0 &< 5.5	Pass
	≥ 5.5 &< 6.0	Second Class
	≥ 6.0 &< 8.0	First Class
	≥ 8.0 (without 'Ab' or 'F' or 'I' or 'temporary withdrawal' in any Semester)	First Class with Distinction
	≥ 8.0 (with 'Ab' or 'F' or 'I' in any Semester but obtained pass grade ('O' to 'P') subsequently)	First Class
Students who cannot complete the B.Tech. program in 6 semesters but complete it successfully within the time duration of 7 semesters (R.4.1)	≥ 5.0 &< 5.5	Pass
	≥ 5.5 &< 6.0	Second Class
	≥ 6.0	First Class
Students who cannot complete the B.Tech. program in 7 semesters but complete it successfully within the time duration of 10 semesters (R.4.1)	≥ 5.0 &< 5.5	Pass
	≥ 5.5	Second Class

R.16.0 Academic Dishonesty

When a student is found responsible for a violation of the SRMIST code of conduct pertaining to academic dishonesty (Malpractice in Examinations), the Office of Controller of Examinations will initiate action based on the pre-approved procedures. Appropriate penalty or punishment will be awarded to the student and communication sent to the concerned Head of the Department. The matter will be informed to the students parents duly.

R.17.0 Eligibility for Award of the B.Tech. Degree

A student shall be declared to be eligible for the award of the B.Tech degree, if he/she has

(a) Registered and successfully completed the courses and projects as per the curriculum and obtaining an aggregate of learning credit totalling 160.
(b) Successfully acquired the required learning credits as specified in the curriculum corresponding to the branch of his/her study within the stipulated time duration.
(c) No disciplinary action is pending against him/her.

R.18.0 Eligibility for Award of the Minor Certificate :

A student to become eligible for the Award of the Minor Certificate in the chosen area of specialization, he/she has to acquire an additional of 20 credits in the chosen Minor subject area, over and above the credits required for the award of the B. Tech Degree

R.19.0 Change of Regulations

R 19.1 Any regulation can be modified by the Academic Council of SRMIST.

ACADEMIC CURRICULA

UNDERGRADUATE DEGREE PROGRAMMES

Bachelor of Technology

(B.Tech. - Four Years)

(Choice Based Flexible Credit System)

Regulations 2018

Volume - 1

(Revised in March 2019)

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram District 603203, Tamil Nadu, India

14. B.Tech. in Computer Science and Engineering with Specialization in Cloud Computing

14. (a) Mission of the Department

Mission Stmt - 1	*To impart knowledge in cutting edge Computer Science and Engineering technologies in par with industrial standards.*
Mission Stmt - 2	*To collaborate with renowned academic institutions to uplift innovative research and development in Computer Science and Engineering and its allied fields to serve the needs of society*
Mission Stmt - 3	*To demonstrate strong communication skills and possess the ability to design computing systems individually as well as part of a multidisciplinary teams.*
Mission Stmt - 4	*To instill societal, safety, cultural, environmental, and ethical responsibilities in all professional activities*
Mission Stmt - 5	*To produce successful Computer Science and Engineering graduates with personal and professional responsibilities and commitment to lifelong learning*

14. (b) Program Educational Objectives (PEO)

PEO - 1	*Graduates will be able to perform in technical/managerial roles ranging from design, development, problem solving to production support in software industries and R&D sectors.*
PEO - 2	*Graduates will be able to successfully pursue higher education in reputed institutions.*
PEO - 3	*Graduates will have the ability to adapt, contribute and innovate new technologies and systems in the key domains of Computer Science and Engineering.*
PEO - 4	*Graduates will be ethically and socially responsible solution providers and entrepreneurs in Computer Science and other engineering disciplines.*
PEO - 5	*Graduates will possess skills to design computing systems based on Cloud computing.*
PEO - 6	*Graduates will have the ability to develop tools incorporating the skills acquired in cloud computing domain.*

14. (c) Mission of the Department to Program Educational Objectives (PEO) Mapping

	Mission Stmt. - 1	Mission Stmt. - 2	Mission Stmt. - 3	Mission Stmt. - 4	Mission Stmt. - 5
PEO - 1	*H*	*H*	*H*	*H*	*H*
PEO - 2	*L*	*H*	*H*	*H*	*H*
PEO - 3	*H*	*H*	*M*	*L*	*H*
PEO - 4	*M*	*H*	*M*	*H*	*H*
PEO - 5	*H*	*H*	*H*	*H*	*H*
PEO - 6	*H*	*H*	*H*	*H*	*H*

H – High Correlation, M – Medium Correlation, L – Low Correlation

14. (d) Mapping Program Educational Objectives (PEO) to Program Learning Outcomes (PLO)

	Program Learning Outcomes (PLO)														
	Graduate Attributes (GA)												Program Specific Outcomes (PSO)		
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
PEO - 1	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
PEO - 2	*H*	*H*	*H*	*H*	*H*	*L*	*L*	*H*	*L*	*H*	*L*	*H*	*H*	*H*	*H*
PEO - 3	*H*	*H*	*H*	*H*	*H*	*L*	*L*	*L*	*L*	*L*	*H*	*H*	*H*	*H*	*H*
PEO - 4	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
PEO - 5	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
PEO - 6	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*

H – High Correlation, M – Medium Correlation, L – Low Correlation

PSO – Program Specific Outcomes (PSO)

PSO - 1	*Ability to Utilize Hardware / Core Computer Science Principles*
PSO - 2	*Ability to Create Software & Programming*
PSO - 3	*Ability to Develop systems*

14. (e) Program Structure: B.Tech. in Computer Science and Engineering with Specialization in Cloud Computing

1. Humanities & Social Sciences including Management Courses (H)

Course Code	Course Title	Hours/ Week L	T	P	C
18LEH101J	English	2	0	2	3
18LEH102J	Chinese	2	0	2	3
18LEH103J	French				
18LEH104J	German				
18LEH105J	Japanese				
18LEH106J	Korean				
18PDH101T	General Aptitude	0	0	2	1
18PDH102T	Management Principles for Engineers	2	0	0	2
18PDH103T	Social Engineering	2	0	0	2
18PDH201T	Employability Skills & Practices	0	0	2	1
Total Learning Credits					**12**

2. Basic Science Courses (B)

Course Code	Course Title	Hours/ Week L	T	P	C
18PYB103J	Physics: Semiconductor Physics	3	1	2	5
18CYB101J	Chemistry	3	1	2	5
18MAB101T	Calculus and Linear Algebra	3	1	0	4
18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
18MAB201T	Transforms and Boundary Value Problems	3	1	0	4
18MAB204T	Probability and Queueing Theory	3	1	0	4
18MAB302T	Discrete Mathematics for Engineers	3	1	0	4
18BTB101T	Biology	2	0	0	2
Total Learning Credits					**32**

3. Engineering Science Courses (S)

Course Code	Course Title	Hours/ Week L	T	P	C
18MES101L	Engineering Graphics and Design	1	0	4	3
18EES101J	Basic Electrical and Electronics Engineering	3	1	2	5
18MES103L	Civil and Mechanical Engineering Workshop	1	0	4	3
18CSS101J	Programming for Problem Solving	3	0	4	5
18CSS201J	Analog and Digital Electronics	3	0	2	4
18CSS202J	Computer Communications	2	0	2	3
Total Learning Credits					**23**

4. Professional Core Courses (C)

Course Code	Course Title	Hours/ Week L	T	P	C
18CSC201J	Data Structures and Algorithms	3	0	2	4
18CSC202J	Object Oriented Design and Programming	3	0	2	4
18CSC203J	Computer Organization and Architecture	3	0	2	4
18CSC204J	Design and Analysis of Algorithms	3	0	2	4
18CSC205J	Operating Systems	3	0	2	4
18CSC206J	Software Engineering and Project Management	3	0	2	4
18CSC207J	Advanced Programming Practice	3	0	2	4
18CSC301T	Formal Language and Automata	3	0	0	3
18CSC302J	Computer Networks	3	0	2	4
18CSC303J	Database Management Systems	3	0	2	4
18CSC304J	Compiler Design	3	0	2	4
18CSC305J	Artificial Intelligence	3	0	2	4
18CSC350T	Comprehension	0	1	0	1
18CSC208L	Competitive Professional Skills-I	0	0	2	1
18CSC306L	Competitive Professional Skills-II	0	0	2	1
18CSC307L	Competitive Professional Skills-III	0	0	2	1
Total Learning Credits					**51**

5. Professional Elective Courses (E)
(Any 6 Elective Courses)

Course Code	Course Title	Hours/ Week L	T	P	C
18CSE341T	Communication Systems Engineering	3	0	0	3
18CSE342T	Digital Communication Systems	3	0	0	3
18CSE378T	Principles of Cloud Computing	3	0	0	3
18CSE356T	Distributed Operating Systems	3	0	0	3
18CSE377T	Data Centric Networks	3	0	0	3
18CSE343T	Web Application Development	3	0	0	3
18CSE344T	Cloud Architecture	3	0	0	3
18CSE451T	Wireless Sensor Networks	3	0	0	3
18CSE454T	High Performance Computing	3	0	0	3
18CSE456T	Software Defined Networks	3	0	0	3
18CSE460T	Network Design and Management	3	0	0	3
18CSE441T	Cloud Application Development	3	0	0	3
18CSE442T	Cloud Security	3	0	0	3
18CSE443T	Big Data Essentials	3	0	0	3
18CSE444T	Cloud Strategy Planning and Management	3	0	0	3
Total Learning Credits					**18**

6. Open Elective Courses (O)

Course Code	Course Title	Hours/ Week L	T	P	C
18CSO101T	IT Infrastructure Management	3	0	0	3
18CSO102T	Mobile Application Development	3	0	0	3
18CSO103T	System Modeling and Simulation	3	0	0	3
18CSO104T	Free and Open Source Softwares	3	0	0	3
18CSO105T	Android Development	3	0	0	3
18CSO106T	Data Analysis using Open Source Tool	3	0	0	3
18CSO107T	IOS Development	3	0	0	3
Total Learning Credits					**12**

8. Mandatory Courses (M)

Code	Course Title	L	T	P	C
18PDM101L	Professional Skills and Practices	0	0	2	0
18PDM201L	Competencies in Social Skills	0	0	2	0
18PDM203L	Entrepreneurial Skill Development				
18PDM202L	Critical and Creative Thinking Skills	0	0	2	0
18PDM204L	Business Basics for Entrepreneurs				
18PDM301L	Analytical and Logical Thinking Skills	0	0	2	0
18PDM302L	Entrepreneurship Management				
18LEM101T	Constitution of India	1	0	0	0
18LEM102J	Value Education	1	0	1	0
18GNM101L	Physical and Mental Health using Yoga	0	0	2	0
18GNM102L	NSS	0	0	2	0
18GNM103L	NCC				
18GNM104L	NSO				
18LEM109T	Indian Traditional Knowledge	1	0	0	0

7. Project Work, Seminar, Internship In Industry / Higher Technical Institutions (P)

Course Code	Course Title	Hours/ Week L	T	P	C
18CSP101L	Massive Open Online Course - I	0	0	2	1
18CSP102L	Industrial Training-I				
18CSP103L	Seminar - I				
18CSP104L	Massive Open Online Course - II	0	0	2	1
18CSP105L	Industrial Training-II				
18CSP106L	Seminar - II				
18CSP107L	Minor Project	0	0	6	3
18CSP108L	Internship (4-6 weeks)				
18CSP109L	Project	0	0	20	10
18CSP110L	Semester Internship				
Total Learning Credits					**15**

8. Mandatory Courses (M)

Course Code	Course Title	Hours/ Week L	T	P	C
18LEM110L	Indian Art Form	0	0	2	0
18CYM101T	Environmental Science	1	0	0	0

14. (f) Program Articulation: B.Tech. in Computer Science and Engineering with Specialization in Cloud Computing

Course Code	Course Name	Program Learning Outcomes (PLO)														
		Graduate Attributes												PSO		
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
18CSS101J	Programming for Problem Solving	H	H	M	M	H	L	L	M	H	M	L	H	L	H	H
18CSC201J	Data Structures and Algorithms	H	H	H	H	M	L	L	M	H	M	M	H	L	H	H
18CSC202J	Object Oriented Design and Programming	H	H	H	H	H	M	L	M	H	H	M	H	L	H	H
18CSC203J	Computer Organization and Architecture	H	M	H	M	L	L	L	M	L	L	L	M	H	M	M
18CSC204J	Design and Analysis of Algorithms	H	H	H	H	M	M	L	M	M	M	M	H	L	H	H
18CSC205J	Operating Systems	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
18CSC206J	Software Engineering and Project Management	H	H	H	H	H	H	H	H	H	H	H	H	L	H	M
18CSC207J	Advanced Programming Practice	H	H	M	M	H	L	L	M	H	M	L	H	L	H	H
18CSC301T	Formal Language and Automata	H	H	H	H	L	L	L	L	M	M	L	H	H	H	H
18CSC302J	Computer Networks	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
18CSC303J	Database Management Systems	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
18CSC304J	Compiler Design	H	H	H	H	M	L	L	L	M	M	L	H	H	H	H
18CSC305J	Artificial Intelligence	H	H	H	H	M	M	L	L	M	M	L	H	H	H	H
18CSC208L	Competitive Professional Skills-I	H	H	H	H	H	L	L	M	H	H	M	H	H	H	H
18CSC306L	Competitive Professional Skills-II	H	H	H	H	H	L	L	M	H	H	M	H	H	H	H
18CSC307L	Competitive Professional Skills-III	H	H	H	H	H	L	L	M	H	H	M	H	H	H	H
18CSE341T	Communication Systems Engineering	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
18CSE342T	Digital Communication Systems	H	H	H	H	H	H	M	H	H	H	M	H	H	M	H
18CSE378T	Principles of Cloud Computing	H	H	H	H	H	M	M	H	H	H	M	H	H	H	H
18CSE356T	Distributed Operating Systems	H	H	H	H	H	M	L	M	H	M	M	H	H	H	H
18CSE377T	Data Centric Networks	H	H	H	H	H	M	M	M	H	H	M	H	H	H	H
18CSE343T	Web Application Development	M	H	H	H	H	H	M	H	H	H	H	H	L	H	H
18CSE344T	Cloud Architecture	H	H	H	H	H	H	H	H	H	H	H	H	H	H	H
18CSE451T	Wireless Sensor Networks	H	H	H	H	M	M	M	M	M	H	L	H	H	H	H
18CSE454T	High Performance Computing	H	H	H	H	H	L	L	M	H	H	L	H	H	H	H
18CSE456T	Software Defined Networks	H	H	H	H	H	M	M	M	M	H	M	H	H	H	H
18CSE460T	Network Design and Management	H	H	H	H	M	M	M	M	M	H	L	H	H	H	H
18CSE441T	Cloud Application Development	M	H	H	H	H	H	M	H	H	H	H	H	H	H	H
18CSE442T	Cloud Security	H	H	H	H	H	M	M	H	H	H	M	H	H	H	H
18CSE443T	Big Data Analytics	H	H	H	H	H	H	M	H	H	H	H	H	M	H	H
18CSE444T	Cloud Strategy Planning and Management	H	H	H	H	H	H	H	H	H	H	H	H	H	M	H
18CSP101L	Massive Open Online Course - I	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP102L	Industrial Training-I	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP103L	Seminar - I	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP104L	Massive Open Online Course - II	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP105L	Industrial Training-II	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP106L	Seminar - II	H	M	M	M	M	M	M	M	H	H	H	M	H	H	H
18CSP107L	Minor Project	H	H	H	H	H	M	M	H	H	H	H	H	H	M	M
18CSP108L	Internship (4-6 weeks)	H	H	H	H	H	M	M	H	H	H	H	H	H	M	M
18CSP109L	Project	H	H	H	H	H	M	M	H	H	H	H	H	H	M	M
18CSP110L	Semester Internship	H	H	H	H	H	M	M	H	H	H	H	H	H	M	M
	Program Average	H	H	M	H	M	L	M	L	M	M	M	H	M	M	M

14. (g) Implementation Plan: B.Tech. in Computer Science and Engineering with Specialization in Cloud Computing

Semester - I

Code	Course Title	Hours/ Week L	T	P	C
18LEH101J	English	2	0	2	3
18MAB101T	Calculus and Linear Algebra	3	1	0	4
18PYB103J	Physics: Semiconductor Physics	3	1	2	5
18MES101L	Engineering Graphics and Design	1	0	4	3
18EES101J	Basic Electrical and Electronics Engineering	3	1	2	5
18PDM101L	Professional Skills and Practices	0	0	2	0
18LEM101T	Constitution of India	1	0	0	0
18GNM101L	Physical and Mental Health using Yoga	0	0	2	0
	Total Learning Credits				**20**

Semester - II

Code	Course Title	Hours/ Week L	T	P	C
18LEH10XJ	Chinese / French / German / Japanese/ Korean	2	0	2	3
18MAB102T	Advanced Calculus and Complex Analysis	3	1	0	4
18CYB101J	Chemistry	3	1	2	5
18CSS101J	Programming for Problem Solving	3	0	4	5
18MES103L	Civil and Mechanical Engineering Workshop	1	0	4	3
18PDH101T	General Aptitude	0	0	2	1
18LEM102J	Value Education	1	0	1	0
18GNM102L	NSS	0	0	2	0
18GNM103L	NCC				
18GNM104L	NSO				
	Total Learning Credits				**21**

Semester - III

Code	Course Title	Hours/ Week L	T	P	C
18MAB201T	Transforms and Boundary Value Problems	3	1	0	4
18BTB101T	Biology	2	0	0	2
18CSS201J	Analog and Digital Electronics	3	0	2	4
18CSC201J	Data Structures and Algorithms	3	0	2	4
18CSC202J	Object Oriented Design and Programming	3	0	2	4
18CSC203J	Computer Organization and Architecture	3	0	2	4
18PDH102T	Management Principles for Engineers	2	0	0	2
18PDM201L	Competencies in Social Skills	0	0	2	0
18PDM203L	Entrepreneurial Skill Development				
	Total Learning Credits				**24**

Semester - IV

Code	Course Title	Hours/ Week L	T	P	C
18MAB204T	Probability and Queueing Theory	3	1	0	4
18CSS202J	Computer Communications	2	0	2	3
18CSC204J	Design and Analysis of Algorithms	3	0	2	4
18CSC205J	Operating Systems	3	0	2	4
18CSC206J	Software Engineering and Project Management	3	0	2	4
18CSC207J	Advanced Programming Practice	3	0	2	4
18CSC208L	Competitive Professional Skills-I	0	0	2	1
18PDH103T	Social Engineering	2	0	0	2
18PDM202L	Critical and Creative Thinking Skills	0	0	2	0
18PDM204L	Business Basics for Entrepreneurs				
18CYM101T	Environmental Science	1	0	0	0
	Total Learning Credits				**26**

Semester - V

Code	Course Title	Hours/ Week L	T	P	C
18MAB302T	Discrete Mathematics for Engineers	3	1	0	4
18CSC301T	Formal Language and Automata	3	0	0	3
18CSC302J	Computer Networks	3	0	2	4
18CSC306L	Competitive Professional Skills-II	0	0	2	1
	Professional Elective – 1	3	0	0	3
	Professional Elective – 2	3	0	0	3
	Open Elective – 1	3	0	0	3
18CSP101L	Massive Open Online Course - I	0	0	2	1
18CSP102L	Industrial Training-I				
18CSP103L	Seminar - I				
18PDM301L	Analytical and Logical Thinking Skills	0	0	2	0
18PDM302L	Entrepreneurship Management				
18LEM109T	Indian Traditional Knowledge	1	0	0	0
	Total Learning Credits				**22**

Semester - VI

Code	Course Title	Hours/ Week L	T	P	C
18CSC303J	Database Management Systems	3	0	2	4
18CSC304J	Compiler Design	3	0	2	4
18CSC305J	Artificial Intelligence	3	0	2	4
18CSC350T	Comprehension	0	1	0	1
18CSC307L	Competitive Professional Skills-III	0	0	2	1
	Professional Elective – 3	3	0	0	3
	Professional Elective – 4	3	0	0	3
	Open Elective – 2	3	0	0	3
18CSP104L	Massive Open Online Course - II	0	0	2	1
18CSP105L	Industrial Training-II				
18CSP106L	Seminar - II				
18PDH201T	Employability Skills and Practices	0	0	2	1
18LEM110L	Indian Art Form	0	0	2	0
	Total Learning Credits				**25**

Semester - VII

Code	Course Title	Hours/ Week L	T	P	C
	Professional Elective – 5	3	0	0	3
	Professional Elective – 6	3	0	0	3
	Open Elective – 3	3	0	0	3
18CSP107L	Minor Project	0	0	6	3
18CSP108L	Internship (4-6 weeks)				
	Total Learning Credits				**12**

Semester - VIII

Code	Course Title	Hours/ Week L	T	P	C
18CSP109L	Project	0	0	20	10
18CSP110L	Semester Internship				
	Total Learning Credits				**10**

ACADEMIC CURRICULA

Humanities and Social Sciences

including Management Courses

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18PDH102T	Course Name	MANAGEMENT PRINCIPLES FOR ENGINEERS	Course Category	H	Humanities and Social Sciences including Management	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Acquire knowledge about the fundamental concepts of organization and management	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Make decision strategies, planning process, tools and techniques			
CLR-3 :	Inculcate the traits needed to be an effective leader and familiarize with the organizational structures and design			
CLR-4 :	Gain valuable insights into strategic process, formulation and implementation			
CLR-5 :	Utilize the intricacies involved in cultural and ethical issues of people			
CLR-6 :	Utilize the dimensions of the planning-organizing-leading-controlling (P-O-L-C) framework			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		3	80	75	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Observe and evaluate the various influencing factors on the current practice of organization and management				Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-2 :	Use the techniques and tools of planning and make prudent decisions	2	80	75	-	H	-	-	-	L	-	H	H	M	-	M	-	-	-
CLO-3 :	Identify how organizations adapt to uncertain environment, identify techniques managers use to influence and control the internal environment	2	80	75	-	M	-	-	-	H	-	H	H	M	-	H	-	-	-
CLO-4 :	Apply and execute management goals	2	80	75	-	L	-	-	-	M	-	H	H	H	-	M	-	-	-
CLO-5 :	Manage people and deal with cultural and ethical issues	3	80	75	-	L	-	-	-	M	-	H	M	H	-	M	-	-	-
CLO-6 :	Utilize the basic fundamentals of managing organizations and utilize optimal resources	3	80	75	-	H	-	-	-	H	-	H	H	H	-	H	-	-	-
		3	80	75	-	H	-	-	-	M	-	M	M	H	-	M	-	-	-

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Organization	Information technology and the new workplace	Organisational control	Strategic management	People Management
	SLO-2	The Individual and the Organization	Precautious Measures	Control in the Business Setting	Role of Strategy in Management	Importance of people
S-2	SLO-1	Management	Information and decision making	Motivation	Evaluating the Business Environment	Attracting a Quality Workforce
	SLO-2	Primary Functions of Management	Styles of Decision Making	Importance of Employee Motivation	Common Frameworks for Situational Analysis	Recruiting process
S-3	SLO-1	Role of management in organisation	The decision-making process	Leadership	Goals and Process	Employee Diversity
	SLO-2	Advantages of Managing People Well	Barriers to Individual Decision Making	Effective Leader	strategic competitiveness	Conflict Management
S-4	SLO-1	Types of Managers	Planning	Organising	Different Strategies	Organisational Culture
	SLO-2	Role of managers	Planning and Mission	Purpose of Organization	Stages and Types of Strategy	Influences on Organizational Culture
S-5	SLO-1	management Thought	The planning process	organisational design	Strategy formulation	Initiating and Fostering Cultural Change

	SLO-2	*Management Roles*	*The Planning Cycle*	*Common Organizational Structures*	*Bridging the Gaps*	*Putting It Together: Culture and Diversity*
S-6	SLO-1	*Environmental Factors*	*tools, techniques and processes*	*Factors Impacting Organizational Design*	*Strategy implementation*	*Ethics*
	SLO-2	*Internal and External Factors*	*Putting It Together: Planning and Mission*	*Contingencies*	*Overcoming Hindrances*	*Cultural Issues*

Learning Resources	1. *Schermerhorn, J.R., Introduction to Management, 13th ed., Wiley; 2017* 2. *Harold Koontz, Heinz Weihrich, Essentials of management: An International & Leadership Perspective, 10th ed., Tata McGraw -Hill Education, 2015*	3. *Stephen Robbins, Mary Coulter, Fundamentals of Management , 9th ed., Pearson Education, 2016* 4. *Samuel C. Certo, Tervis Certo, Modern management: concepts and skills, 12th ed., Pearson, 2012* 5. *Charles W. L. Hill, Steven Mcshane, Principles of Management McGraw Hill Education, 2017*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Pratap Iyer, Study Abroad Mentors, Mumbai, pratap.iyer30@gmail.com	*1. Dr. A.K. Sheik Manzoor, Anna University, sheikmanzoor@annauniv.edu*	*1. Mr. Mohamed Ibrahim. A. U., SRMIST*
2. Mr. Ajay Zenner, Career Launcher, ajay.z@careerlauncher.com	*2. Dr. Devamainthan, University of Madras*	*2. Mr. Muthu Manivannan, SRMIST*

Course Code	18PDH103T	Course Name	SOCIAL ENGINEERING	Course Category	H	Humanities and Social Sciences including Management	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	create personal awareness and responsibility	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-2 :	learn about environment and approach towards social issues																		
CLR-3 :	train students on social competencies to become self reliant, resourceful and industrious																		
CLR-4 :	understand social entrepreneurship																		
CLR-5 :	develop a mindset to contribute to the society																		
CLR-6 :	apply knowledge, passion and skills in the pursuit of humanitarian goals																		
CLO-1 :	identify and addresses needs of social responsibilities	2	80	75	-	-	-	-	-	M	M	H	H	H	-	-	-	-	-
CLO-2 :	resolve social problems	3	80	75	-	-	-	-	-	H	L	M	H	M	-	-	-	-	-
CLO-3 :	understand social responsibility competencies and CSR activities	2	80	75	-	-	-	-	-	M	L	L	H	H	-	-	-	-	-
CLO-4 :	build a business plan to meet social needs	3	80	75	-	-	-	-	-	M	L	H	H	M	-	-	-	-	-
CLO-5 :	gain real time experience through student social responsibility project and presentation	3	80	75	-	-	-	-	-	H	M	H	H	M	-	-	-	-	-
CLO-6 :	possess an in-depth knowledge of social engineering and effect a social change in the society	3	80	75	-	-	-	-	-	H	M	M	M	M	-	-	-	-	-

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Introduction	Environment and society	Social responsibility competencies	Social entrepreneurship	Student Social responsibility
	SLO-2	Importance of Social Engineering	Contribution towards environment	Social responsibility competencies	Social entrepreneurship	Student Social responsibility
S-2	SLO-1	Personal awareness	Social issues	Social responsibility competencies- Profiles	Social Entrepreneur	Project Presentation
	SLO-2	Types of responsibilities	Social issues	Social responsibility competencies- Facets	Types of Social Entrepreneurs	Project Presentation
S-3	SLO-1	Social Change	Group discussion on social Issues	Contributing to community	Success stories of social entrepreneur	Project Presentation
	SLO-2	Social Change	Group discussion on social Issues	Contributing to community	Impact of social entrepreneurs in society	Project Presentation
S-4	SLO-1	Vision towards society	Group discussion on social Issues	Value diversity and Building relationships	Business Plan	Project Presentation
	SLO-2	Mission towards society	Group discussion on social Issues	Value diversity and Building relationships	Business Plan	Project Presentation
S-5	SLO-1	Individual social responsibility(ISR)	Social Marketing	Corporate social responsibility	Business Plan	Report Analysis
	SLO-2	Individual social responsibility(ISR)	Social Marketing	Types of CSR	Business Plan	Report Analysis

S-6	SLO-1	*Case study*	*Non profitable organizations*	*Government Policies on CSR*	*Business Plan*	*Report Analysis*
	SLO-2	*Case study*	*Types of NGO*	*Government Policies on CSR*	*Business Plan*	*Report Analysis*

Learning Resources	**1.** *Joel Makeower, Beyond The Bottom Line: Putting Social Responsibility to work for your Business and the World,Oct,1995* 2. *Simen Sinek, Start with Why, How great leaders Inspire Everyone to Take Action, Penguin UK, 2011* 3. *Adam Grant, Give and Take: Why Helping others drives our success, Orion Publishing Group, 2014* **4.** *David Bornstien, How to change the world, Oxford University Press, 2007*	5. *Nicholls,Alex,ed., Social Entrepreneurship – New Models of Sustainable Social Change, Oxford University Press, 2008* 6. *Ronald R. Sims, Ethics and Corporate Social Responsibility: Why Giants fall, 2003* 7. *Robert A. Rohm, Positive Personality Profiles, Personality Insights, Inc, 2006*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Vijay Nair – Director, Education Matters, vijayn@edmat.org	*1. Dr. A.K. Sheik Manzoor, Anna University, sheikmanzoor@annauniv.edu*	*Mrs. Kavitha Srisaran, SRMIST*
2. Mr. Ajay Zenner, Career Launcher, ajay.z@careerlauncher.com	*2. Dr Vanitha. J., Loyola College, vanithaj@loyolacollege.edu*	*Mr. Priyanand P., SRMIST*

ACADEMIC CURRICULA

Basic Science Courses

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18BTB101T	Course Name	BIOLOGY	Course Category	B	Basic Sciences	L	T	P	C
							2	0	0	2

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Recall the cell structure and function from its organization			
CLR-2 :	Discuss molecular and biochemical basis of an organism			
CLR-3 :	Compare enzyme reaction and photosynthesis			
CLR-4 :	Explain different types of biosensors			
CLR-5 :	Analyze the different types of bioremediation			
CLR-6 :	Relate the concept of nervous and immune system pertaining to diseases			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Describe the cell growth, metabolism and reproduction.	1	80	80	L	H	H	H	-	M	L	H	H	H	-	H	L	H	H
CLO-2 :	Explain the concepts and experiments in biochemistry	2	85	75	M	H	H	M	-	-	M	H	L	H	-	H	L	H	H
CLO-3 :	Recognize the significance of photosynthesis	2	75	80	M	H	M	H	M	M	-	M	H	H	-	H	L	H	H
CLO-4 :	Discuss the different methods in enzyme catalytic functions	2	85	80	L	H	H	H	-	-	H	L	L	H	-	H	M	H	H
CLO-5 :	Analyze the role of biosensors and its applications	3	85	75	L	H	H	M	-	M	H	H	H	L	-	H	H	H	H
CLO-6 :	Explain the concepts of nervous system disorder and the diseases associated with it	2	80	80	M	H	H	H	L	H	M	M	H	H	-	H	H	H	H

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Basics of cell biology: Relevance to Engineers	Biochemistry: Macromolecules, Biodiversity and its importance	Bioenergetics and metabolism	Molecular machines and motors	Nervous system:History of neuroscience
	SLO-2	Cell basic unit of life, Evidence for cell theory	Chemistry of life	Enzymes as biological catalysts, Significance of enzymes	Properties of ATP based protein molecular machines	Glial cells, Neurons
S-2	SLO-1	Cell structure and function	Biochemistry and human biology, DNA replication	Thermodynamics of enzymes	F0F1 ATP synthase motors, Coupling and coordination of motors	Action potential, Organization of nervous system
	SLO-2	Genetic Information, Protein structure	Transcription, Protein synthesis	Factors affecting enzyme activity, Effect of inhibitors on enzyme activity	Bacterial flagellar motor, Cytoskeleton	Central Nervous system, Peripheral nervous system
S-3	SLO-1	Cell metabolism	Eukaryotic and prokaryotic protein synthesis difference	Mechanism of enzyme action	Microtubules	Diseases of nervous system
	SLO-2	Carbohydrate metabolism, Fatty acid metabolism	Concept of genetic code, Stem cells	Enzyme strategies, Restriction enzymes	Microfilaments, Intermediate filaments	Computer- based neural networks
S-4	SLO-1	Homeostasis	Source of stem cells, Classification of stem cells	NMP kinases, Photosynthesis	Kinesin linear motor, Dynein motor	Immune system
	SLO-2	Pathways that alter homeostasis, Cell growth	Human embryonic stem cell, Importance and applications of stem cells	Light reactions, Photosystems	Biosensor	Fluid systems of the body, Innate immune system
S-5	SLO-1	Reproduction	Therapeutic cloning	ATP synthesis in chloroplasts	Resonant biosensors, Glucose biosensors	Cells of innate immune system, Adaptive immunity

	SLO-2	*Eukaryotic cell division, Mitosis*	*Regenerative medicine*	*Calvin cycle*	*Bio detectors, Biosensor detection in pollutants*	*Diseases of immune system, Immune engineering*
S-6	SLO-1	*Meiosis, Cell differentiation*	*Bone tissue engineering*	*Significance of photosynthesis*	*Bioremediation*	*Cell signaling*
	SLO-2	*Neural crest*	*Gene therapy*	*Metabolism, Glycolysis*	*Bioventing and bio augmentation*	*Cell- surface receptors*

Learning Resources	**1.** *S. Thyagarajan, N.Selvamurugan, R.A.Nazeer et.al., Biology for engineers McGraw Hill Education. 2012*	2. *Norman Lewis, Gabi Nindl Waite, Lee R. Waite et.al., Applied Cell and Molecular Biology for Engineers. McGraw-Hill Education. 2007*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences,ramchand@saksinlife.com	*1. Dr. K Subramaniam, IITM Chennai, subbu.iitm.ac.in*	*Dr. S. Thyagarajan, SRMIST*
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	*2. Dr. R. B. Narayanan, SVCE Chennai, rbn@svce.ac.in*	*Dr.S.Barathi, SRMIST*

Course Code	18BTB103T	Course Name	HUMAN PHYSIOLOGY AND HEALTH	Course Category	B	Basic Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	18BTC102J -Cell biology, 18BTC106J -Immunology
Course Offering Department	Biotechnology	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Devise understanding of human physiological systems for a better comprehension of the problems faced by human	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Create an understanding about nervous system that controls and maintains homeostasis			
CLR-3 :	Analyze about circulatory and respiratory system			
CLR-4 :	Analyze about digestive and excretory system			
CLR-5 :	Create an understanding about endocrine and reproductive system			
CLR-6 :	Create an understanding about how human body functions			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Describe the structure and function of cell, communication and gene expression and homeostasis	1	80	70	H	H	H	H	-	M	L	H	H	H	-	H	H	H	H
CLO-2 :	Describe the classification of nervous system, function and diseases associated with it	2	80	70	H	H	H	H	-	H	M	H	H	H	-	H	H	H	H
CLO-3 :	Discuss the structure and function of heart, lung, abnormal functioning	2	80	70	M	H	M	H	M	M		M	H	H	-	H	H	H	H
CLO-4 :	Describe anatomy and function of digestive system and urinary system and its disturbances	2	80	70	H	H	H	H	-	L	H	L	H	H	-	H	H	H	H
CLO-5 :	Describe the types of endocrine system, its role in maintaining homeostasis and reproductive biology	2	80	70	H	H	H	H	-	M	H	H	H	L	-	H	H	H	H
CLO-6 :	Explain how human body function and reproduce with maintaining homeostasis	2	80	70	H	H	H	H	L	M	M	M	H	H	-	H	H	H	H

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Cell structure and function	Classification of Nervous System	Heart: Structure, Chambers, valve	Anatomy of Digestive system	Endocrine organs and structure
	SLO-2	Adaptation, Degeneration and aging	Neuron structure and function	Cardiac cycle and Electro cardio gram	Mouth and Salivary glands	Pituitary gland: Parts
S-2	SLO-1	Cell junctions – Gap, Tight and contact	Nerve fibers classification and properties.	chronotropic, ionotropic agents, dromotropic, bathmotropic agents	Stomach: Parts, Structure, Glands, Functions, Properties	Pituitary gland: Regulation, Histology
	SLO-2	Active, Passive transport	Glial cells types, structure and function	Blood vessels – thromboembolism	composition and functions of gastric juice	Pituitary gland: Hormones secreted, functions
S-3	SLO-1	Types of transport	Synapse – Classification	atherosclerosis and arteriosclerosis	Pancreas, Liver	Thyroid gland: Histology and function
	SLO-2	Special type of transport of molecules across biological membranes	Synapse - Anatomy	Septal and valvular defects.	Gall bladder – Role in digestive system	Thyroid gland: Hormones
S-4	SLO-1	Homeostasis– Chemical equilibrium	Synapse - Functions (IPSP and EPSP	Circulation – Systemic and Pulmonary	Small intestine, large intestine	Synthesis of Thyroxine
	SLO-2	Tonicity and osmolality	Synapse - properties	Properties of cardiac muscle: Excitability – electrical potential and action potential	Digestion of Biomolecules	Parathyroid gland structure and function
S-5	SLO-1	control of homeostasis	Neurotransmitters synthesis	Rhythmicity – Natural and artificial pacemakers	Movements of gastrointestinal tracts and disorders	Mode of action and function - disorders

	SLO-2	*Role of ions in homeostasis*	*Neurotransmitters – Types and function*	*Conductivity, Contractility and Refractory period*	*Digestion of carbohydrates protein and lipid.*	*Adrenal gland structure*
S-6	SLO-1	*Positive feedback regulation of Homeostasis*	*Action potential*	*Cardiac cycle and heart sounds and Heart disease*	*Gastrointestinal hormones*	*Cortical and medullary - functions*
	SLO-2	*Negative feedback regulation of Homeostasis*	*graded potential*	*Respiratory system: Introduction*	*Digestive system disorders*	*Endocrine functions of pancreas*
S-7	SLO-1	*Acid-Base Balance: Hydrogen Ion and pH.*	*Brain anatomy and function*	*Types – external and internal respiration*	*Kidney structure and function*	*Insulin and glucagon*
	SLO-2	*Regulation by buffer systems*	*Spinal cord anatomy– Grey and White matter*	*Inspiration and expiration, Anatomy, functional unit*	*nephron structure*	*Diabetes*
S-8	SLO-1	*Acidosis*	*Limbic system: Autonomic Nervous System*	*Non-respiratory functions of respiratory tract*	*Role of hormone in urinary system.*	*Male reproduction organ structure*
	SLO-2	*Alkalosis.*	*Effects on various organ systems.*	*Mechanics of respiration, Pulmonary function tests: Lung volume – Tidal*	*Juxtaglomerular apparatus functions*	*Female reproduction organ structure*
S-9	SLO-1	*Regulation of gene expression*	*Nervous system disease and disorders*	*Inspiratory, Expiratory, Residual volumes; Lung capacities*	*Process of urine formation*	*Oogenesis*
	SLO-2	*Cell signaling and Signal transduction*	*Parkinson's disease,*	*Inspiratory, vital, Functional residual, Total lung capacities.*	*Factors affecting urine formation*	*Spermatogenesis*

Learning Resources	**1.** *K. Sembulingam, Prema Sembulingam, Essentials of Medical Physiology, Jaypee brothers medical publishers, 7th ed., 2016*	2. *Guyton and Hall, Textbook of Medical Physiology, (Guyton Physiology), Saunders, 13th ed., 2015)*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences, ramchand@saksinlife.com	*1. Dr. K Subramaniam, IITM Chennai, subbu.iitm.ac.in*	*Dr. S. Thyagarajan, SRMIST*
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	*2. Dr. Tamil Selvan, Anna University,Chennai, tamilselvan@annauniv.edu*	*Dr. S. Nageswaran, SRMIST*

Course Code	18MAB201T	Course Name	TRANSFORMS AND BOUNDARY VALUE PROBLEMS	Course Category	B	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB102T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Describe types of Partial differential equations interpret solutions relate PDE to the respective branches of engineering			
CLR-2 :	Relate Fourier series expansion in solving problems under RMS value and Harmonic Analysis.			
CLR-3 :	Infer the most general form to the PDE and relate to half range sine and cosine series, as the case may be			
CLR-4 :	Evaluate the various types of integral transforms			
CLR-5 :	Conclude that the purpose of studying z transform is to solve linear difference equations having constant coefficients			
CLR-6 :	Predicting the importance of PDE, Fourier series, Boundary value problems and Fourier ,Z – transform applications			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Determine Partial differential equation	2	85	80	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-2 :	Explain the expansion of a discontinuous function as an infinite form of trigonometric sine and cosine series.	2	85	80	M	H	-	M	M	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Decide a proper form of solution for the differential equations which are of hyperbolic and parabolic type	2	85	80	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	justify the relationship between aperiodic signals and linear combination of exponentials.	2	85	80	M	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Relate signal analysis with that of z transform	2	85	80	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Relate PDE, Fourier series, Boundary value problems, Fourier and Z transforms	2	85	80	L	L	L	H	H	H	L	H	H	H	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Formation of partial differential equation by eliminating arbitrary constants	Introduction of Fourier series - Dirichlet's conditions for existence of Fourier Series	Classification of second order partial differential equations	Introduction of Fourier Transforms	Introduction of Z-transform
	SLO-2	Formation of partial differential equation by eliminating two or more arbitrary constants	Fourier series –related problems in $(0,2\pi)$	Method of separation of variables	Fourier Transforms- problems	Z-transform-elementary properties
S-2	SLO-1	Formation of partial differential equation by eliminating arbitrary functions	Fourier series –related problems in $(-\pi,\pi)$	One dimensional Wave Equation and its possible solutions	Properties of Fourier transforms	Z-transform- change of scale property, shifting property
	SLO-2	Formation of partial differential equation by eliminating two or more arbitrary functions	Change of interval Fourier series –related problems in $(0,2l)$	One dimensional Wave Equation-initial displacement with zero initial velocity-type 1 Algebraic function	Standard results of Fourier transform	Z-transform of $a^n, \frac{1}{n}, \frac{1}{n+1}$
S-3	SLO-1	Formation of partial differential equation by eliminating arbitrary functions of the form $\phi(u,v)=0$	Fourier series –related problems in $(-l,l)$	One dimensional Wave Equation-initial displacement with zero initial velocity-type 2 Trigonometric function	Fourier Sine Transforms - problems	Z-transform of $\frac{1}{n^2}, \frac{1}{(n+1)^2}$
	SLO-2	Solution of first order non-linear partial differential equations-standard type I F(p,q)=0	Fourier series –half range cosine series related problems$(0,\pi)$	One dimensional Wave Equation-initial displacement with zero initial velocity-type 3 – Midpoint of the string is displaced	Fourier Cosine Transforms - problems	Z-transform of $r^n \cos n\theta$
S-4	SLO-1	Problem solving using tutorial sheet 1	Problem solving using tutorial sheet 4	Problem solving using tutorial sheet 7	Problem solving using tutorial sheet 10	Problem solving using tutorial sheet 13
	SLO-2					

S-5	SLO-1	*Solution of first order nonlinear partial differential equations-standard type –II Clairaut's form*	*Fourier series –half range cosine series related problems* $(0, l)$	*One dimensional Wave Equation-initial displacement with non-zero initial velocity Type 1 Algebraic function*	*Properties of Fourier sine Transforms*	*Z-transform of* $r^n \sin n\theta$
	SLO-2	*Solution of first order non-linear partial differential equations-standard type III F(z, p, q)=0*	*Fourier series –half range sine series related problems* $(0, \pi)$	*One dimensional Wave Equation-initial displacement with non-zero initial velocity Type 2 Trigonometric function*	*Fourier sine Transforms applications*	*Initial value theorem*
S-6	SLO-1	*Solution of first order non-linear partial differential equations-standard type-IV separation of variable f(x, p) = g(y, q)*	*Fourier series –half range sine series related problems* $(0, l)$	*Wave Equation-initial displacement with non-zero initial velocity Type 3 split function*	*Properties of Fourier cosine Transforms*	*Finial value theorem*
	SLO-2	*Lagrange's linear equation: Method of grouping*	*Parseval's Theorem (without proof)-related problems in Fourier series*	*One dimensional heat equation and its possible solutions*	*Fourier cosine Transforms applications*	*Inverse Z-transform- long division method*
S-7	SLO-1	*Lagrange's linear equation: Method of multipliers*	*Parseval's Theorem (without proof)-related problems in cosine series*	*One dimensional heat equation related problems*	*Convolution of two function*	*Inverse Z-transform, related problems, long division method*
	SLO-2	*More problems in Lagrange's linear equation: Method of multipliers*	*Parseval's Theorem (without proof)-related problems in sine series*	*One dimensional heat equation -Steady state conditions*	*Convolution Theorem*	*Inverse Z-transform, Partial fraction method*
S-8	SLO-1 SLO-2	*Problem solving using tutorial sheet 2*	*Problem solving using tutorial sheet 5*	*Problem solving using tutorial sheet 8*	*Problem solving using tutorial sheet 11*	*Problem solving using tutorial sheet 14*
S-9	SLO-1	*Linear Homogeneous partial differential equations of second and higher order with constant coefficients-CF and PI Type 1:* e^{ax+by}	*Introduction to Harmonic Analysis*	*One dimensional heat equation -Steady state conditions more problems*	*Parseval's Identity for Fourier transform*	*Inverse Z-transform, Partial fraction method related problems*
	SLO-2	*PI Type2.: sin(ax+by) or cos(ax+by)*	*Harmonic Analysis for finding harmonic in* $(0,2\pi)$	*One dimensional heat equation -Steady state conditions with zero velocity*	*Parseval's Identity for Fourier sine & cosine transforms*	*Inverse Z-transform - residue theorem method*
S-10	SLO-1	*Type 3: PI of polynomial*	*Harmonic Analysis for finding harmonic in* $(0,2l)$	*One dimensional heat equation -Steady state conditions with zero velocity more problems*	*Parseval's Identity for Fourier sine & cosine transforms applications*	*Inverse Z-transform - residue theorem method-problems*
	SLO-2	*Type 4 Exponential shifting* $e^{ax+by}f(x,y)$	*Harmonic Analysis for finding harmonic in periodic interval* $(0,T)$	*One dimensional heat equation -Steady state conditions with zero velocity more related problems*	*Fourier Transforms Using Differentiation property*	*Convolution theorem (without proof)*
S-11	SLO-1	*Linear Homogeneous partial differential equations of second and higher order with constant coefficients type 5 General rule*	*Harmonic Analysis for finding cosine series*	*Steady state conditions and Non-zero boundary conditions- related problems*	*Solving integral equation*	*Convolution theorem applications*
	SLO-2	*Applications of Partial differential equations in Engineering*	*Harmonic Analysis for finding sine series*	*Steady state conditions and Non-zero boundary conditions- more problems*	*Self-reciprocal using Fourier Transform, sine and cosine transform*	*Solution of linear difference equations with constant coefficients using Z-transform*
S-12	SLO-1	*Problem solving using tutorial sheet 3*	*Problem solving using tutorial sheet 6*	*Problem solving using tutorial sheet 9*	*Problem solving using tutorial sheet 12*	*Problem solving using tutorial sheet 15*
	SLO-2	*Problem solving using tutorial sheet 3*	*Problem solving using tutorial sheet 6*	*Problem solving using tutorial sheet 9*	*Problem solving using tutorial sheet 12*	*Problem solving using tutorial sheet 15*

Learning Resources	1. *B. H. Erwin kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons,2006* 2. *B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43rd Edition, 2015* 3. *Veerarajan T., Transforms and Partial Differential Equations, Tata McGraw-Hill, New Delhi,2012*	4. *Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 3rd Edition, 2010* 5. *N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, for third semester, Laxmi Publications, 3rd Edition, 2014*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

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Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. V. Maheshwaran, CTS, Chennai, maheshwaranv@yahoo.com	*1. Dr. K. C. Sivakumar, IIT, Madras, kcskumar@iitm.ac.in*	*1. Dr. A. Govindarajan, SRMIST*
2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	*2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com*	*2. Prof. Ganapathy Subramanian K S, SRMIST*

Course Code	18MAB202T	Course Name	NUMERICAL METHODS FOR ENGINEERS	Course Category	B	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB102T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Acquire ability in solving mathematical problems numerically as applied to the respective branches of Engineering	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Apply the concept of interpolation for finding intermediate values of a well-known data			
CLR-3 :	Study the concept of numerical differentiation and integration			
CLR-4 :	Apply the numerical techniques for solutions of ordinary differential equations			
CLR-5 :	Apply the numerical techniques for solutions of partial differential equations			
CLR-6 :	Acquire analytical ability in solving mathematical problems numerically applied to the respective branches of Engineering			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		2	85	80	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Solve the algebraic, transcendental and simultaneous equations.	2	85	80	L	-	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-2 :	Find the finite differences and interpolation.	2	85	80	L	-	-	M	M	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Solve numerical Differentiation and integration.	2	85	80	-	M	-	-	-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	Solve the numerical solutions of ordinary differential equations.	2	85	80	L	M	-	M	-	-	-	-	M	-	-	H	-	-	-
CLO-5 :	Solve the numerical solutions of partial differential equations	2	85	80	-	M	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Solve the problems numerically in science and engineering	2	85	80	H	-	H	-	-	-	-	-	H	-	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Method of Least Squares – Curve fitting.	First and Higher order differences.	Numerical Differentiation.	Numerical solutions for ordinary differential equations.	Numerical solutions for partial differential equations.
	SLO-2	Fitting a straight line.	Forward differences and backward differences.	Newton's forward difference formulae to compute first and higher order derivatives.	Solution by Taylor's series method.	Classification of partial differential equations.
S-2	SLO-1	Fitting a parabola.	Central Differences.	Newton's backward differences formulae to compute first and higher order derivatives.	Solutions of First order simultaneous differential equations by Taylor's series method.	Solution of Elliptic Equations.
	SLO-2	Calculation of the sum of the squares of the residuals of straight line and parabola.	Operators– Relations between the operators.	Problems by Newton's forward and backward differences formulae.	Euler's method.	Solution of Laplace Equations by Leibmann's Iterative process.
S-3	SLO-1	Solution of Algebraic and Transcendental equations.	Interpolation – Newton-Gregory Forward Interpolation formulae.	Applications of Newton's forward difference formulae to compute first and higher order derivatives.	Applications of Euler's method.	Solution of Laplace Equations by Leibmann's Iterative process.
	SLO-2	Newton-Raphson method.	Interpolation – Newton-Gregory Backward Interpolation formulae.	Applications of Newton's backward difference formulae to compute first and higher order derivatives.	Improved Euler's method.	Solution of Poisson Equations.
S-4	SLO-1	Problem solving using tutorial sheet 1.	Problem solving using tutorial sheet 4.	Problem solving using tutorial sheet 7.	Problem solving using tutorial sheet 10. Modified Euler's method	Problem solving using tutorial sheet 13.
	SLO-2					

S-5	SLO-1	*Bisection method and its applications.*	*Additional problems using Newton-Gregory Forward Interpolation formulae.*	*Additional problems for Newton's forward formulae to compute the application problems.*	*Applications of Improved and Modified Euler's method.*	*Problems for Poisson Equations.*
	SLO-2	*Problems using bisection method.*	*Additional problems using Newton-Gregory Backward Interpolation formulae.*	*Additional problems for Newton's backward formulae to compute the application problems.*	*Runge-Kutta method of fourth order.*	*Additional problems for Poisson Equations.*
S-6	SLO-1	*Regula-Falsi method.*	*Divided differences.*	*Numerical Integration.*	*Solution by Runge-Kutta method of fourth order.*	*Solution of Parabolic equations.*
	SLO-2	*Problems using false position method.*	*Formation of divided difference table.*	*Trapezoidal rule.*	*Additional problems using Runge-Kutta method of fourth order.*	*Bender-Schmidt formula*
S-7	SLO-1	*Solution of system of equations Direct Method - Gauss Elimination method.*	*Properties of Divided differences.*	*Simpson's one third rule.*	*Predictor-Corrector Methods.*	*Bender-Schmidt formula*
	SLO-2	*Solution of system of equations Direct Method – Gauss-Jordan method.*	*Properties of Divided differences.*	*Simpson's three eighth rule.*	*Milne-Thomson Method.*	*Bender-Schmidt formula*
S-8	SLO-1	*Problem solving using tutorial sheet 2.*	*Problem solving using tutorial sheet 5.*	*Problem solving using tutorial sheet 8.*	*Problem solving using tutorial sheet 11. Problems for Milne-Thomson Method.*	*Problem solving using tutorial sheet 14.*
	SLO-2					
S-9	SLO-1	*Solution of system of equations Iterative Method – Gauss- Jacobi method.*	*Newton's Divided difference formula.*	*More problems using Trapezoidal rule.*	*Application of Milne-Thomson Method.*	*Crank-Nicolson formula.*
	SLO-2	*Problems using Gauss-Jacobi method.*	*Problems by Newton's Divided difference formula.*	*More problems using Simpson's one third rule.*	*Adam's Bashforth method.*	*Crank-Nicolson formula.*
S-10	SLO-1	*Solution of system of equations Iterative Method – Gauss-Seidal method.*	*Additional problems by Newton's Divided difference formula.*	*More problems using Simpson's three eighth rule.*	*Problems using Adam's Bashforth method.*	*Crank-Nicolson formula.*
	SLO-2	*Problems using Gauss- Seidal method.*	*Lagrange's Interpolation formula.*	*Applications of Trapezoidal rule – Simpson's one third rule and Simpson's three eighth rules.*	*Application of Adam's Bashforth method.*	*Solution of Hyperbolic equations.*
S-11	SLO-1	*Power method.*	*Problems by Lagrange's Interpolation formula.*	*Application problems for Trapezoidal rule – Simpson's one third rule and Simpson's three eighth rules.*	*Additional problems for Milne-Thomson Method.*	*Solution of Hyperbolic equations by Explicit formula.*
	SLO-2	*Finding Eigen values by power method.*	*Inverse interpolation.*	*Applications problems for Trapezoidal rule – Simpson's one third rule and Simpson's three eighth rules.*	*Additional problems for Adam's Bash forth Method*	*More problems in Hyperbolic equations using Explicit formula.*
S-12	SLO-1	*Problem solving using tutorial sheet 3.*	*Problem solving using tutorial sheet 6.*	*Problem solving using tutorial sheet 9.*	*Problem solving using tutorial sheet 12.*	*Problem solving using tutorial sheet 15.*
	SLO-2	*Applications of numerical techniques to solve algebraic, transcendental and simultaneous equations*	*Application of interpolation for finding intermediate values of a well-known data*	*Applications of Numerical integration.*	*Applications of ordinary differential equation.*	*Applications of partial differential equation.*

Learning Resources	1. *B.S. Grewal, Numerical Methods in engineering and science, Khanna Publishers, 42nd edition, 2012* 2. *S.S. Sastry, Introductory Methods of Numerical Analysis, PHI, 4th edition, 2005* 3. *E. Balagurusamy, Computer Oriented Statistical and Numerical Methods – Tata McGraw Hill., 2000*	4. *M.K.Jain, SRK Iyengar and R.L.Jain, Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Ltd., 4th edition, 2003* 5. *Dr. M.K. Venkataraman, Numerical Methods in Science and Engineering, National Publishing Co., 2005*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

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2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	*2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com*	*2. Dr. Sundarammal kesavan, SRMIST*

Course Code	18MAB203T	Course Name	PROBABILITY AND STOCHASTIC PROCESSES	Course Category	B	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB102T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Describe the applications on discrete and continuous random variables.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Assess the applications of two dimensional random variables.			
CLR-3 :	Infer the various modes of convergence of random variables and their limit theorems.			
CLR-4 :	Relate the specialized knowledge in random processes in signals and systems.			
CLR-5 :	Determine the applications of spectral density functions and linear time invariant systems			
CLR-6 :	Interpret random variables and stochastic processes in the application of practical engineering problems.			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Compare the fundamentals between discrete and continuous random variables.	3	85	80	M	H	L	-	-	-	-	-	M	L	-	H	-	-	-
CLO-2 :	Choose the model and analyze systems using two dimensional random variables.	3	85	80	M	H	-	M	M	-	-	-	M	-	-	H	-	-	-
CLO-3 :	Describe limit theorems using various inequalities.	3	85	80	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	Interpret the characteristics of random processes.	3	85	80	M	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Evaluate problems on spectral density functions and linear time invariant systems.	3	85	80	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Explain how random variables and stochastic processes can be described and analyzed.	3	85	80	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	One dimensional random variable: Discrete Case-Probability function, Cumulative Distribution Function	Two dimensional random variables-Discrete case	Limit theorems--Markov's inequality	Random Processes-Introduction	Power spectral density function- properties
	SLO-2	Continuous random variable-Probability density function	Probability function of (X,Y)-Marginal probability distribution	Chebyshev's inequality without proof	Classification of random processes	Proof of properties
S-2	SLO-1	Cumulative distribution function-properties	Conditional probability distribution of (X,Y)	Chebyshev's inequality - Applications	Distribution of the process	Problems on power spectral density function
	SLO-2	Problems on one dimensional random variables	Problems on discrete random variables	Chebyshev's inequality – Applications using Binomial distribution	Averages of the process	Problems on power spectral density function
S-3	SLO-1	Expectation, variance	Continuous random variables-Joint PDF	Chebyshev's inequality– Applications using Exponential distribution	Stationary, SSS,WSS processes	Power density spectrum
	SLO-2	Moments-raw and central moments	Marginal Probability distributions	The weak law of large numbers	Problems on stationary and SSS processes	Problems based on power density spectrum
S-4	SLO-1 SLO-2	Problem solving using tutorial sheet 1	Problem solving using tutorial sheet 4	Problem solving using tutorial sheet 7	Problem solving using tutorial sheet 10	Problem solving using tutorial sheet 13
S-5	SLO-1	Characteristic function - properties	Conditional probability distribution of (X,Y)	Central limit theorem without proof	Problems on WSS process	Linear system with random inputs
	SLO-2	Characteristic function	Problems on continuous two dimensional random variables	Central limit theorem - Applications	Problems on WSS process	Representation of system in the form of convolution
S-6	SLO-1	Binomial distribution -moments	Independent random variables	Central limit theorem- Applications using Poisson random variables	Autocorrelation function -properties	Unit impulse response of the system

	SLO-2	*Binomial distribution-Applications*	*Cumulative distribution function-properties of F(x,y)*	*Central limit theorem- Applications using Exponential random variables*	*Proof of properties*	*Properties*
S-7	SLO-1	*Poisson distribution-moments*	*Expected values of two dimensional random variables*	*The strong law of large numbers*	*Problems on autocorrelation function*	*Applications of unit impulse function*
	SLO-2	*Poisson distribution -Applications*	*Covariance and correlation*	*The strong law of large numbers*	*Application of autocorrelation function*	*Einstein Weiner- Khinchine Relationship*
S-8	SLO-1 SLO-2	*Problem solving using tutorial sheet 2*	*Problem solving using tutorial sheet 5*	*Problem solving using tutorial sheet 8*	*Problem solving using tutorial sheet 11*	*Problem solving using tutorial sheet 14*
S-9	SLO-1	*Exponential distribution-moments*	*Conditional expected values*	*One sided Chebychev's inequality*	*Cross correlation- properties*	*Problems on Khinchine relationship*
	SLO-2	*Exponential distribution-Applications*	*Problems on uncorrelated random variables*	*Cauchy Schwartz inequality*	*Proof of properties*	*Cross power density spectrum-properties*
S-10	SLO-1	*Normal Distribution-moments*	*Functions of two dimensional random variables*	*Chernoff bounds*	*Problems on cross correlation function*	*Properties of Power Spectral Density*
	SLO-2	*Normal Distribution-Applications*	*Probability density functions of the type Z=XY*	*Chernoff bounds for the standard normal variate*	*Ergodicity*	*Cross power density spectrum-problems*
S-11	SLO-1	*Function of a random variable*	*Probability density functions of the type Z=X-Y*	*Chernoff bounds for the Poisson random variate*	*Mean ergodic process*	*Cross power density spectrum*
	SLO-2	*Function of a random variable*	*Probability density functions of the type Z=X/Y*	*Jenson's inequality*	*Mean ergodic theorem*	*Cross power density spectrum*
S-12	SLO-1	*Problem solving using tutorial sheet 3*	*Problem solving using sheet 6*	*Problem solving using tutorial sheet 9*	*Problem solving using tutorial sheet 12*	*Problem solving using tutorial sheet 15*
	SLO-2	*Applications of random variables in engineering*	*Application of two dimensional random variables in Engineering*	*Applications of Central limit Theorem in engineering*	*Applications of random process in engineering*	*Applications of Power spectral density functions in engineering*

Learning Resources	1. *A. Papoulis, S. Uniikrishna Pillai, Probability, Random Variables and Stochastic Processes 4th ed., Mcgraw Hill, 2002* 2. *Henry Stark, Probability and Random Processes with Applications to Signal Processing, 3rd ed., Pearson, 2002* 3. *Sheldon Ross, A first course in Probability, 6th ed., 2011*	4. *S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 11th ed., 2015* 5. *Veerarajan T., Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks, 4th ed., McGraw-Hill Education, 2015*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. V. Maheshwaran, CTS, Chennai, maheshwaranv@yahoo.com	*1. Dr. K. C. Sivakumar, IIT, Madras, kcskumar@iitm.ac.in*	*1. Dr. A. Govindarajan, SRMIST*
2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	*2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com*	*2. Dr. V. Srinivasan, SRMIST*

Course Code	18MAB204T	Course Name	PROBABILITY AND QUEUEING THEORY	Course Category	B	Basic Sciences	L	T	P	C
							3	1	0	4

Pre-requisite Courses	18MAB102T	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mathematics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Apply and evaluating probability using random variables			
CLR-2 :	Gain the knowledge and acquire the application of distribution to find the probability using Theoretical distributions			
CLR-3 :	To Assess the appropriate model and apply and soling any realistic problem situation to determine the probability			
CLR-4 :	To interpret the decision using Markov queueing applications			
CLR-5 :	To construct chain of decisions from the past situations using Monrovians			
CLR-6 :	Interpret random variables and Queuing theory in engineering problems.			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Solving problems on Discrete and Continuous Random variables	3	85	80	M	H	L	-	-	-	-	-	M	-	-	H	-	-	-
CLO-2 :	Identifying Distribution and solving the problems in Discrete and Continuous Distribution	3	85	80	M	H		M	M	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Decision Models using sampling techniques in Large and Small samples	3	85	80	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-
CLO-4 :	Solving Queuing problems using Kendall's notation	3	85	80	M	H	-	-	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	To Evaluate the probability in uncertain situations using Markov chain rule	3	85	80	M	H	L	M	-	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Solving and analyzing the problems in random variables and Queuing theory.	3	85	80	M	H	-	-	-	-	-	-	M	-	-	H	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Probability Basic concepts and Axioms	Discrete Probability distribution	Sampling distribution, Null Hypothesis, Alternate Hypothesis	Introduction to F-test	Markov Process and Introduction of a Markov Chain
	SLO-2	Conditional probability, Multiplication theorem	Introduction to Binomial distribution	One tailed test, two tailed test	Problems on F-test	Past and Future -Step and State
S-2	SLO-1	Discrete and continuous Random variables	MGF, Mean, Variance of Binomial distribution	Level of significance,Critical region	Chi square test -Goodness of fit	One step Transition Probability N step transition Probability
	SLO-2	Probability mass function, cdf	Applications of Binomial distribution	Large samples test	Problems on Chi square test -Goodness of fit	Chapman-kolmogorov theorem definition
S-3	SLO-1	Continuous Random variables	Fit a Binomial distribution.	Student - t testSingle Proportion	Problems on Chi-square test Independent-Attributes	Initial Probability distribution problems Using Markov Chain
	SLO-2	pdf and cdf applications	Introduction to Poisson Distribution	Two Sample proportions	Problems on Chi-square test Independent-Attributes with standard distributions	Initial Probability distribution problems Using Markov Chain
S-4	SLO-1 SLO-2	Problem solving using tutorial sheet 1	Problem solving using tutorial sheet 4	Problem solving using tutorial sheet 7	Problem solving using tutorial sheet 10	Problem solving using tutorial sheet 13
S-5	SLO-1	Expectation and Variance	MGF , Mean , Variance of Poisson distribution	Large sample test-Single Mean	Introduction to Queueing Theory and Applications. Kendall, notation	Classification of States of a Markov Chain
	SLO-2	Problems on Expectation and Variance	Applications of Poisson Distribution	Difference of Means	Introduction toM/M/1 : infinity/ FIFO	Irreducible, Non irreducible, a period, Persistent, Non null Persistent
S-6	SLO-1	Moment Generating Function	Fit a Poisson Distribution	Problems on difference of Means	Ls, Lq, Ws,Wq	Problems on Classification of a Markov Chain

	SLO-2	*Problems on MGF*	*Introduction , MGF Mean, Variance of Geometric distribution*	*Applications of Difference of Means*	*M/M/1 :Infinity /FIFO problems*	*Problem on Classification of a Markov Chain*
S-7	SLO-1	*Functions of Random variables*	*Applications of Geometric Distribution, problems on Memory less property*	*Introduction to small samples*	*M/M/1 :Infinity /FIFO problems*	*Classification of states of a Markov Chain*
	SLO-2	*Problems on Functions of Random variable*	*Introduction , MGF, Mean, Variance of Uniform Distribution*	*Introduction to small Samples*	*M/M/1 :Infinity /FIFO problems*	*Stationary and steady state*
S-8	SLO-1	*Problem solving using tutorial sheet 2*	*Problem solving using tutorial sheet 5*	*Problem solving using tutorial sheet 8*	*Problem solving using tutorial sheet 11*	*Problem solving using tutorial sheet 14*
	SLO-2					
S-9	SLO-1	*Tchebycheffs inequality*	*Applications of Uniform Distribution problems*	*Problems on single mean -small samples*	*Single Server Model with Finite System Capacity, Characteristics of the Model (M/M/1) : (K/FIFO)*	*Problems on Classification-State-stationary using Markov Chain*
	SLO-2	*Introduction to theoretical distribution*	*Introduction , MGF, Mean, Variance of Exponential distribution*	*Problems on single mean -small samples*	*Effective arrival rate*	*Problems on Stationary and steady state*
S-10	SLO-1	*Formula and application of Tchebycheffs inequality*	*Applications of Exponential distribution problems*	*Problems on difference of mean-small samples*	*Problems on Model (M/M/1) : (K/FIFO)*	*Problems on Ergodicity using Markov Chain*
	SLO-2	*Applications of chebychevs inequality*	*Introduction to Normal distribution*	*Problems on difference of mean-small samples*	*Problems on Model (M/M/1) : (K/FIFO)*	*Problems on Ergodicity using Markov Chain*
S-11	SLO-1	*Applications of chebychevs inequality using distribution*	*Applications of Normal distribution problems*	*Applications of paired - t test*	*Problems on Model (M/M/1) : (K/FIFO)*	*Problems on Ergodicity*
	SLO-2	*Problems practice using chebychevs inequality*	*Practical applications of Normal distribution*	*Problems of paired - t test.*	*Problems on Model (M/M/1) : (K/FIFO)*	*Problems on Ergodic and Non Ergodic Using Markovchains*
S-12	SLO-1	*Problem solving using tutorial sheet 3*	*Problem solving using tutorial sheet 6*	*Problem solving using tutorial sheet 9*	*Problem solving using tutorial sheet 12*	*Problem solving using tutorial sheet 15*
	SLO-2	*Applications of random variables in engineering*	*Applications of distribution to find the probability using Theoretical distributions*	*Applications of solving any realistic problem situation to determine the probability*	*Applications of Queueing decision models*	*Applications of constructing chain of decisions from the past situations using Monrovians*

Learning Resources	1. *Veerarajan T, Probability , Statistics and Random Processes, Tata Mc.Graw Hill, 1st Reprint 2004* 2. *S.C. Gupta, V.K.Kapoor, Fundamentals of Mathematical Statistics, 9th ed.,, Sultan Chand & Sons, 1999* 3. *Gross. D and Harri.C.M. Fundamentals of Queuing theory, John Wiley and Sons, 1985*	4. *Trivedi K S, Probability and Statistics with reliability, Queueing and Computer Science Applications, prentice Hall of India, New Delhi, 1984* 5. *Allen .A.O. , Probability Statistics and Queueing theory, Academic Press*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. V. Maheshwaran, CTS, Chennai, maheshwaranv@yahoo.com	*1. Dr. K. C. Sivakumar, IIT, Madras, kcskumar@iitm.ac.in*	*1. Dr. A. Govindarajan, SRMIST*
2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	*2. Dr. Nanjundan, Bangalore University, nanzundan@gmail.com*	*2. Dr. V. Srinivasan, SRMIST*

ACADEMIC CURRICULA

Engineering Science Courses

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18CHS201J	Course Name	PHYSICAL AND ANALYTICAL CHEMISTRY	Course Category	S	*Engineering Sciences*	L	T	P	C
							3	0	2	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Chemical Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Describe the ideal and non-ideal behavior of liquids; learn colligative properties and their applications*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Elucidate the concepts of chemical equilibrium and the effect of various factors on equilibrium constant*			
CLR-3 :	*Illustrate the difference in behavior of different states of matter essential for separation operations*			
CLR-4 :	*Elucidate the properties and applications of colloids; Understand the kinetics of photochemical reactions*			
CLR-5 :	*Explain the principles of analytical instruments along with their limitations*			
CLR-6 :	*Utilize the physical behavior of atoms and molecules at the microscopic scale*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	*Analyze ideal, non-ideal behavior of fluids; Apply colligative properties to find the molecular weight of unknown compounds*	*2*	*80*	*75*	*H*	*H*	*L*	*L*	-	-	-	-	-	-	-	-	*H*	-	-
CLO-2 :	*Describe the significance of Gibbs' free energy and equilibrium constants*	*2*	*75*	*70*	*H*	*H*	*L*	*L*	-	-	-	-	-	-	-	-	*M*	-	-
CLO-3 :	*Apply Gibbs' phase rule and draw the phase diagram of one- and three-component systems*	*2*	*75*	*70*	*H*	*H*	*M*	*L*	-	-	-	-	-	-	-	-	*M*	-	-
CLO-4 :	*Analyze the distinct properties of colloids and photochemical reactions*	*2*	*85*	*80*	*H*	*H*	-	*L*	-	-	-	-	-	-	-	-	*L*	-	-
CLO-5 :	*Explain the suitable analytical technique for analyzing various types of compounds*	*2*	*80*	*75*	*H*	-	-	*L*	*L*	-	*L*	-	-	-	-	-	*L*	-	-
CLO-6 :	*Apply the concepts of physical chemistry to various processes in chemical engineering*	*2*	*75*	*70*	*H*	*H*	*M*	*H*	*H*	*M*	*M*	-	-	-	-	*M*	*H*	-	-
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Introduction to solutions, Raoult's law*	*Introduction to Chemical equilibria*	*Introduction to Phase equilibria*	*Introduction to Colloids*	*Instrumental Methods of Analysis*
	SLO-2	*Vapour pressures of ideal solutions*	*Gibbs' free energy and Chemical potential*	*Component, phase and degrees of freedom*	*General properties of colloids: Tyndall effect and Brownian movement*	*Accuracy, precision, common errors (system/manual)*
S-2	SLO-1	*Vapour pressures of non-ideal solutions*	*Free energy of a spontaneous reaction*	*Conditions for equilibrium between phases*	*Electrical properties of colloids: electrical double layer, Zeta potential*	*Calibration curves*
	SLO-2	*Deviations from ideality of Type I, Type II and Type III solutions*	*Law of mass action*	*Derivation of Gibbs' phase rule*	*Electrokinetic properties of colloids: electrophoresis and electro-osmosis*	*Classification of instrumental methods - spectroscopy, electrochemical and chromatography*
S-3	SLO-1	*Completely miscible binary solutions: Vapor pressure-Composition and Boiling point-Composition curves of Type I solutions*	*Law of chemical equilibrium*	*Representation of one component systems using phase diagrams*	*Gels and emulsions*	*Electro-magnetic (EM) spectrum, Interaction of EM radiation with matter*
	SLO-2	*Vapor pressure-Composition and Boiling point-Composition curves of Type II solutions*	*Thermodynamic derivation of the law of chemical equilibrium*	*One component system - water system*	*Applications of colloids*	*Generalities of optical methods (light source/ monochromator / sample introduction / detector / signal generator)*
S 4-5	SLO-1	*Lab 1: Determine critical solution temperature (CST) of phenol-water system*	*Lab 4: Estimate aspirin drug in tablets using pH meter*	*Lab 7: Repeat class*	*Lab 10: Determine the rate constant of acid catalyzed hydrolysis of an ester*	*Lab 13: Determine fatty acid methyl ester using gas chromatography*
	SLO-2					
S-6	SLO-1	*Vapor pressure-Composition and Boiling point-Composition curves of Type III solutions*	*Problems on Gibbs' free energy*	*One component system - CO_2 system*	*Introduction to Photochemistry*	*Principle, Instrumentation, Working, Applications, and Limitations of analytical techniques*

	SLO-2	*Fractional distillation of binary liquid systems; The Lever rule*	*Problems on Gibbs' free energy*	*One component system - Sulphur system*	*Laws of photochemistry*	*UV –Vis spectroscopy*
S-7	SLO-1	*Distillation of immiscible liquids*	*Significance of equilibrium constant*	*Three component systems -Triangular phase diagram*	*Quantum yield*	*Infra-red spectroscopy*
	SLO-2	*Steam ditillation*	*Equilibrium constants: K_p, K_c,and, K_x*	*Three component system: acetic acid-chloroform-water system*	*Photochemical reactions*	*Atomic absorption spectroscopy*
S-8	SLO-1	*Partially miscible liquids*	*Relationship between K_p, K_c,and, K_x*	*Three component system: two salts and water system*	*Photochemical rate law*	*Chromatographic techniques: General principle*
	SLO-2	*Critical solution temperature; Phenol-water system*	*Temperature dependence of Equilibrium constant - Van't Hoff Equation*	*The Nernst distribution law and distribution co-efficient*	*Determination of quantum yields*	*Column chromatography*
S 9-10	SLO-1 SLO-2	*Lab 2: Determine molecular weight by Rast method*	*Lab 5: Estimate sulphate by nephelometry*	*Lab 8: Determine partition co-efficient of benzoic acid between benzene and water*	*Lab 11: Determine the amount of manganese in the given sample of ore*	*Lab 14: Repeat class*
S-11	SLO-1	*Solutions of gases in liquids : Factors influencing solubility of a gas, Henry's law*	*Pressure dependence of equilibrium constants*	*Conditions for the validity of the distribution law*	*Problems on Beer Lambert's law*	*Paper chromatography*
	SLO-2	*Colligative Properties*	*Problems on equilibrium constants*	*Association of the solute in one of the solvents*	*Problems on quantum yield*	*Thin layer chromatography*
S-12	SLO-1	*Relative lowering of vapour pressure, Osmosis and osmotic pressure*	*Problems on equilibrium constants*	*Dissociation of the solute in one of the solvents*	*Kinetics of hydrogen-chlorine reaction: Mechanism*	*Gas chromatography*
	SLO-2	*Elevation in boiling point, Depression in freezing point*	*Le Chatelier's Principle*	*Applications of Nernst distribution law*	*Kinetics of hydrogen-chlorine reaction: Derivation*	*High Performance Liquid Chromatography*
S-13	SLO-1	*Determination of molecular weight from colligative properties*	*Effect of change in concentration, temperature, and pressure*	*Problems on Nernst distribution law*	*Kinetics of hydrogen-bromine reaction: Mechanism*	*Open-ended problems on choice and usage of analytical instruments*
	SLO-2	*Effect of association/dissociation on colligative properties*	*Le Chatelier's principle and physical equilibria*	*Problems on Nernst distribution law*	*Kinetics of hydrogen-bromine reaction: Derivation*	*Open-ended problems on choice and usage of analytical instruments*
S 14-15	SLO-1 SLO-2	*Lab 3: Determine strength of the given acid mixture by conductometric titration*	*Lab 6: Phase diagram of three component system*	*Lab 9: Estimate amount of iron present in a sample using UV-Vis spectrophotometer*	*Lab 12: Determine the amount of reducing sugar by DNS method*	*Lab 15: Practical Model Examination*

Learning Resources	*1.B. R. Puri, L. R. Sharma, Madan S. Pathania, Principles of Physical Chemistry, 47th ed., Vishal Publishing Co., 2015* ***2.**Arun Bahl, B. S. Bahl, G. D. Tuli, Essentials of Physical Chemistry, S. Chand & Company Ltd., 2009.*	***3.** Douglas A. Skoog, F. James Holler, Timothy A. Nieman. Principles of Instrumental Analysis, Thomson Learning Inc., 1998*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
Level 2	Apply Analyze	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
Level 3	Evaluate Create	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Mr. A. Subramaniam, PESCO Beam Environmental Solutions Pvt. Ltd.	*1. Dr. Lima Rose Miranda, Anna University email: limamiranda2007@gmail.com*	*1. Dr. M.P. Rajesh, SRMIST*	*3. Dr. S. Prabhakar, SRMIST*
2. Mr. S. T. Kalaimani, CPCL, Chennai	*2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College,*	*2. Dr. K. Deepa, SRMIST*	

Course Code	18CHS251T	Course Name	BASIC CHEMICAL ENGINEERING	Course Category	S	*Engineering Sciences*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Chemical Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Describe the basic principles of process calculation*			
CLR-2 :	*Explain the concepts of Stoichiometry equations and material balances.*			
CLR-3 :	*Illustrate the basics of Engineering thermodynamics and first law of thermodynamics*			
CLR-4 :	*Interpret the Second law of thermodynamics and concept of entropy and its applications in chemical process*			
CLR-5 :	*Write the rate equation and reactor design for processes*			
CLR-6 :	*Formulate the material and energy balance for processes and carry out thermodynamic and kinetic analysis.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Do unit conversions and stoichiometric calculations*	*1*	*90*	*85*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Perform material balance for different process*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-
CLO-3 :	*Calculate the heat and work requirement for processes*	*2*	*80*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-
CLO-4 :	*Analyze the feasibility of processes*	*2*	*75*	*70*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	*H*	-	-
CLO-5 :	*Write the basic rate equation and basic design of ideal gas*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	-	-
CLO-6 :	*Do the material and energy balance and calculate the thermodynamics parameters and kinetic parameters.*	*2*	*80*	*75*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	*H*	*M*	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Units and dimensions*	*Fundamentals of stoichiometry*	*Chemical Engineering Thermodynamics*	*Ideal Gas Processes*	*Basic Terminology in reaction kinetics – Reaction rate*
	SLO-2	*Unit conversions*	*limiting reactant, excess reactant, conversion, selectivity, yield*	*System, surrounding, boundary, Work, Energy, Heat, Internal energy*	*Equation for process calculations (for an ideal gas in any mechanically reversible closed system processes)*	*Factors affecting reaction rate, Rate equation*
S-2	SLO-1	*Problems solving on unit conversions*	*Problems solving on limiting and excess reactant*	*Intensive and Extensive properties*	*Problems solving on ideal gas*	*Concentration –Dependent term of a Rate Equation*
	SLO-2	*Problems solving on unit conversion*	*Problems solving on conversion and selectivity*	*State and path functions*	*Problems solving on ideal gas*	*Rate constant, order and molecularity of reaction*
S-3	SLO-1	*mole, mole fraction (or percent) and mass fraction (or percent)*	*Introduction to material balance*	*First Law of Thermodynamics-Mathematical statement*	*Statement of Second Law of Thermodynamics*	*Classification of Reactions*
	SLO-2	*Problems solving on mole fraction and mass fraction*	*Steady state and unsteady state material balance*	*Limitations of First Law of Thermodynamics*	*Heat engine*	*Classification of Reactions*
S-4	SLO-1	*concentrations*	*material balance - Drying*	*Reversible process, Equilibrium*	*Concept of Entropy*	*Problems – To Calculate Activation Energy*
	SLO-2	*molarity, molality, normality and ppm*	*Problems solving on drying*	*Types of Equilibrium*	*Mathematical statement of entropy*	*Problems – To Calculate Activation Energy*
S-5	SLO-1	*Density calculation*	*Problems solving on drying*	*Energy balance for closed system*	*Problems solving on entropy*	*Effect of Temperature dependency on reaction rate-Arrhenius equation*
	SLO-2	*Problems solving on density calculation*	*Problems solving on drying with recycle*	*Energy balance for closed system*	*Problems solving on*	*Effect of Temperature dependency on*

						reaction rate-Arrhenius equation
S-6	SLO-1	*concentrations*	*material balance - extraction*	*Reversible process, Equilibrium*	*Concept of Entropy*	*Problems – To Calculate Activation Energy*
	SLO-2	*molarity, molality, normality and ppm*	*Problems solving on drying with recycle*	*Types of Equilibrium*	*Mathematical statement of entropy*	*Problems – To Calculate Activation Energy*
S-7	SLO-1	*Problems solving on molarity, molality and normality*	*Problems solving on extraction*	*Derivation for constant volume processes*	*Entropy change of an ideal gas undergoing a mechanical reversible process in a closed system*	*Reactor design -basics*
	SLO-2	*Problems solving on molality*	*Problems solving on extraction*	*Derivation for constant pressure processes*	*Entropy change of an ideal gas undergoing a mechanical reversible process in a closed system*	*Classification of ideal reactors for single reactions*
S-8	SLO-1	*Problems solving on Normality*	*material balance - Crystallization*	*Enthalpy*	*Problems solving on entropy change of an ideal gas*	*Ideal Batch reactor*
	SLO-2	*Problems solving on ppm*	*Problems solving on crystallization*	*Heat capacity: Derivation for heat capacity at constant volume and constant pressure processes*	*Problems solving on entropy change of an ideal gas in a closed system*	*Design of Ideal Batch Reactor*
S-9	SLO-1	*predicting P-V-T properties of gases using ideal gas law*	*Problems solving on crystallization with evaporator*	*Energy Balance for Steady state flow processes*	*Problems solving on entropy change of system*	*Space-Time and Space -velocity*
	SLO-2	*Problems solving on P-V-T properties of gases*	*Problems solving on crystallization with recycle stream*	*Energy Balance for Steady state flow processes*	*Third Law of Thermodynamics*	*Steady state mixed flow and plug flow reactor*

Learning Resources	1. *David M. Himmelblau, Basic Principles and Calculations in Chemical Engineering, 6th ed., Prentice-Hall of India,1998* 2. *Bhatt B.I.,Vora S.M., Stoichiometry, 3rd ed., Tata McGraw-Hill Publishing Company, 1996*	3. *Smith, J.M., Van Ness, H.C., Abbott, M.M., Introduction to Chemical Engineering Thermodynamics, 6th ed.,, McGraw Hill International Edition, 2001* 4. *Octave Levenspiel, Chemical Reaction Engineering, 3rded.,John Wiley & Sons India,2011*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Mr. S. T. Kalaimani, CPCL, Chennai	*2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College,*	*2. Ms. S. Kiruthika, SRMIST*

Course Code	18CHS252T	Course Name	CHEMICAL ENGINEERING PRINCIPLES	Course Category	S	*Engineering Sciences*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Chemical Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Describe the various modes of heat transfer and evaluate the rate of steady state heat transfer*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Explain and analyze the basic concepts of natural and forced convection as applied to various flows and geometry*			
CLR-3 :	*Illustrateprinciples of mass transfer, Diffusion phenomena of mass transfer operations, mass transfer coefficients and calculate mass transfer rates*			
CLR-4 :	*Elucidate the principles of drying, different types of driers and calculate drying time for different drying periods*			
CLR-5 :	*Clarify the concept of distillation and various types of distillation and extraction*			
CLR-6 :	*Introduce the basic principles of heat and mass transfer processes, and its applications*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	*Calculate the rate of heat transfer, and analyze steady state heat conduction.*	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	M	M	-
CLO-2 :	*Apply the basic concepts and calculate the heat transfer coefficient*	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	M	M	-
CLO-3 :	*Use mass transfer principles to solve simple diffusion problems*	2	80	70	H	H	-	-	-	-	-	-	-	-	-	-	M	M	-
CLO-4 :	*Calculate drying time for different types of dryer*	2	80	70	H	H	H	-	-	-	-	-	-	-	-	-	M	M	-
CLO-5 :	*Differentiate the various types of distillation and the basics of extraction*	2	80	75	H	H	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-6 :	*Explain the basic principles of heat and mass transfer processes, and its applications*	2	80	75	H	H	M	-	-	-	-	-	-	-	-	-	M	M	-
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to various modes of heat transfer*	*Concept of heat transfer by convection. Natural and forced convection*	*Introduction to Mass Transfer operations*	*Introduction, Importance of drying in processes*	*Introduction to Distillation, principle*
	SLO-2	*Concept of rate of heat transfer, heat flux.*	*Newton's law of cooling*	*Diffusion, Types, Ficks I law of Diffusion.*	*principles of drying, wet Basis, dry basis*	*Raoult's law*
S-2	SLO-1	*Concept of resistance to heat transfer*	*Application of dimensional analysis for natural convection*	*Steady – state molecular diffusion in fluids at rest and in laminar flow: molecular diffusion in gases.*	*Free moisture, equilibrium moisture, bound and unbound moisture*	*relative volatility*
	SLO-2	*Fourier's law of heat conduction*	*Significance of dimensionless numbers used in natural convection*	*Molecular diffusion in gases: steady state diffusion of A through non-diffusing B*	*Mechanism of drying*	*Methods of distillation: With reflux and without reflux condition*
S-3	SLO-1	*Thermal conductivity*	*Application of dimensional analysis for forced convection*	*Problems solving using molecular diffusion*	*Constant and falling rate period*	*Types of distillation*
	SLO-2	*Steady state heat conduction through a plane wall*	*Significance of dimensionless numbers used in forced convection*	*Gas phase equimolar counter diffusion. Diffusion in Multicomponent gas mixtures*	*Rate of drying curve, critical moisture content*	*Mechanism of batch distillation*
S-4	SLO-1	*Tutorial*	*Empirical correlations for natural convection*	*Problems solving using equimolar counter diffusion*	*Calculation of drying time under constant drying conditions: constant rate period*	*Rayleigh's equation*
	SLO-2	*Steady state heat conduction through a hollow cylinder*	*Problems solving using empirical correlations*	*Problems solving on diffusion in multicomponent gas mixtures*	*Calculation of drying time under constant drying conditions: falling rate period. Total drying time*	*Mechanism of flash distillation*

S-5	SLO-1	*Problems solving on conduction*	*Problems solving using empirical correlations*	*Molecular diffusion in liquids: steady state diffusion of A through non-diffusing B*	*Problems solving using constant rate of drying condition*	*Operating line equation for flash distillation*
	SLO-2	*Problems solving on conduction*	*Empirical correlations for forced convection*	*Problems solving using molecular diffusion*	*Problems solving using falling rate of drying condition*	*Mechanism of steam distillation*
S-6	SLO-1	*Steady state heat conduction through a composite plane wall*	*Problems solving using empirical correlations*	*Problems solving using molecular diffusion*	*Problems solving using total drying rate of drying condition*	*Mechanism of vacuum distillation*
	SLO-2	*Problems solving on composite plane wall*	*Problems solving using empirical correlations*	*Liquid phase equimolal counter diffusion*	*Classification of dryers, solids handling in dryers*	*Mechanism of extractive distillation*
S-7	SLO-1	*Problems solving on hollow cylinder*	*Individual and overall heat transfer coefficient concept*	*Problems solving on equimolar counter diffusion*	*equipments for batch and continuous drying processes*	*Mechanism of azeotropic distillation*
	SLO-2	*Problems solving on concentric hollow cylinder*	*Fouling coefficients*	*Problems solving on equimolar counter diffusion*	*Working principle of tray drier*	*Comparison between extractive and azeotropic distillation*
S-8	SLO-1	*Steady state heat conduction through coaxial cylinders*	*Problems solving on individual heat transfer coefficient*	*Effect of temperature and pressure on diffusivity*	*Working principle of rotary drier*	*Mechanism of Continuous distillation*
	SLO-2	*Problems solving on coaxial cylinder*	*Problems solving on individual heat transfer coefficient*	*Problems solving on effect of temperature and pressure on diffusion*	*Working principle of spray drier*	*General principles of extraction*
S-9	SLO-1	*Problems solving on coaxial cylinder*	*Problems solving on overall heat transfer coefficient*	*Introduction to Mass transfer coefficients*	*Working principle of fluidized bed drier*	*Choice of a solvent*
	SLO-2	*Problems solving on coaxial cylinder*	*Problems solving on overall heat transfer coefficient*	*Types of mass transfer coefficients*	*Concept of freeze drying*	*Working principle of mixer-settler*

Learning Resources	1. *Warren L. McCabe, Julian C. Smith, Peter Harriott, Unit Operations of Chemical Engineering, 7th ed., McGraw Hill Education, 2014* 2. *Christie John Geankoplis, Transport Processes and Separation Process Principles (Includes Unit Operations), 4th ed., Pearson India, 2015*	3. *Binay K Dutta, Heat Transfer: Principles and Applications, PHI Publishers, Delhi,2010* 4. *Robert E. Treybal, Mass-Transfer Operations, 3rd ed., McGraw Hill Education, 2012* 5. *Binay K. Dutta, Principles of Mass transfer and Separation Processes, Prentice- Hall of India, 2007*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

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1 Mr. A. Subramaniam, PESCO Beam Environmental Solutions Pvt. Ltd.	*1. Dr. Lima Rose Miranda, Anna University email: limamiranda2007@gmail.com*	*1. Ms. E. Kavitha, SRMIST*
2. Mr. S. T. Kalaimani, CPCL, Chennai	*2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College,*	*2. Ms. E. Poonguzhali, SRMIST*

Course Code	18CHS204T	Course Name	ENGINEERING THERMODYNAMICS	Course Category	S	*Engineering Sciences*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Chemical Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Describe the basic concepts and laws of thermodynamics, as applied to various systems and processes*			
CLR-2 :	*Illustrate the PVT behavior and various equation of state.*			
CLR-3 :	*Explain the second law of thermodynamics and the concept of entropy*			
CLR-4 :	*Demonstrate the thermodynamic properties and relations, and thermodynamic diagrams*			
CLR-5 :	*Elucidate the applications of thermodynamics concepts.*			
CLR-6 :	*Elucidate the concept of Energy balance and its applications*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Comprehend the basic concepts and laws of thermodynamics as applied for different processes.*	*1*	*90*	*85*	*H*	-	*L*	*H*	*H*	*H*	*M*	-	-	-	-	*H*	-	-	-
CLO-2 :	*Understand the volumetric behavior and calculate the properties using equation of state.*	*1*	*90*	*85*	*H*	*M*	*M*	*M*	*H*	*H*	*M*	-	*H*	-	-	*H*	-	-	-
CLO-3 :	*Comprehend the second law of thermodynamics and the concept of entropy*	*1*	*90*	*85*	*H*	*M*	*M*	*M*	*H*	*H*	*H*	*H*	*L*	*L*	*H*	*M*	*M*	*L*	*M*
CLO-4 :	*Derive the thermodynamic properties and relations and interpret the thermodynamic diagrams*	*2*	*90*	*85*	*H*	*L*	*L*	*L*	*L*	*M*	*H*	*L*	*L*	*L*	*L*	*M*	*M*	*L*	*M*
CLO-5 :	*Apply the thermodynamic principles to various flow processes and refrigeration.*	*2*	*90*	*85*	*H*	*L*	*M*	*L*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*M*	*M*	*L*	*M*
CLO-6 :	*Apply the conservation of energy in various chemical engineering processes.*	*2*	*90*	*85*	*H*	*L*	*L*	*L*	*L*	*M*	*H*	*L*	*L*	*L*	*L*	*M*	*M*	*L*	*M*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Basic concepts of Engineering Thermodynamics.*	*PVT behavior of pure substances: PT diagram*	*Introduction to second law of thermodynamics*	*Fundamental Property relations for a homogeneous fluid of constant composition in a closed system*	*Duct flow of compressible fluids.*
	SLO-2	*Work, heat and energy. Internal energy*	*PV diagram*	*Statements of second law of thermodynamics*	*Fundamental Property relations for a homogeneous fluid of constant composition in a closed system*	*Pipe flow*
S-2	SLO-1	*Thermodynamic properties and its classification.*	*Ideal gas, equations for process calculations (mechanically reversible process in closed system)*	*Heat Engine, Heat pump*	*Maxwell's relations and property estimation.*	*Nozzles*
	SLO-2	*Process and its characterization*	*Isothermal process, isobaric process, isochoric process*	*Carnot's theorem*	*Maxwell's relations and property estimation.*	*Throttling process*
S-3	SLO-1	*Equilibrium*	*Adiabatic process, and polytropic heat capacity*	*Carnot's cycle*	*Enthalpy and entropy as functions of T and P*	*Turbines*
	SLO-2	*Reversible process*	*Problems solving on PVT behavior*	*Ideal-gas temperature scale*	*Enthalpy and entropy as functions of T and P*	*Compression processes: Compressors*
S-4	SLO-1	*First law of thermodynamics*	*Problems solving on PVT behavior*	*Carnot's equation*	*Internal energy and entropy as functions of T and V.*	*Pumps*
	SLO-2	*Energy balance for closed systems*	*Introduction to cubic equations of state:*	*Concept of entropy*	*Internal energy and entropy as functions of*	*Introduction to ejectors*

					T and V.	
S-5	SLO-1	Problem solving on closed systems	Vander Waals equation	Entropy changes of an ideal gas in a closed system	Two-phase systems: temperature dependence of the vapor pressure of liquids	Power cycles
	SLO-2	Problem solving on closed systems	Redlich/Kwong equation	Entropy changes of an ideal gas in a closed system	Two-phase systems: temperature dependence of the vapor pressure of liquids	Rankine cycle.
S-6	SLO-1	Constant volume processes and Constant pressure processes.	Problems solving on equation of state	Problems solving on Carnot's equation	Problems solving on fundamental properties	Otto engine
	SLO-2	Enthalpy, heat capacity	Problems solving on equation of state	Problems solving on entropy	Problems solving on fundamental properties	Diesel engine
S-7	SLO-1	Problems solving on enthalpy	Virial equations of state,	Problems solving on entropy	Thermodynamic diagrams.	Principles of refrigeration
	SLO-2	Problems solving on heat capacity	Application of the virial equations	Mathematical statement of the second law	Joule Thomson expansion	Heat Pump
S-8	SLO-1	Energy balance for steady-state flow processes	Problems solving using Virial equation	Entropy balance for open systems	Joule Thomson expansion - applications.	Carnot refrigerator
	SLO-2	Energy balance for steady-state flow processes	Problems solving using Virial equation	Statement of the third law of thermodynamics.	Liquefaction processes	Vapor-compression cycle
S-9	SLO-1	Problems solving for open system	Theorem of corresponding states, acentric factor	Problems solving using third law of Thermodynamics	Linde liquefaction process	Absorption refrigeration
	SLO-2	Problems solving for open system	Problems solving using acentric factor	Problems solving using third law of Thermodynamics	Claude liquefaction process	Absorption refrigeration

Learning Resources		
	1. Smith, J.M., Van Ness, H.C., Abbott, M.M., Introduction to Chemical Engineering Thermodynamics, 7th ed., McGraw Hill	**2.** Rao .Y.V.C, Chemical Engineering Thermodynamics, University Press (I) Ltd.,1997

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

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2. Mr. S. T. Kalaimani, CPCL, Chennai	2. Dr. T. R. Sundararaman, Rajalakshmi Engineering College,	2. Dr. S. Sam David, SRMIST

Course Code	18CSS201J	Course Name	ANALOG AND DIGITAL ELECTRONICS	Course Category	S	*Engineering Sciences*	L	T	P	C
							3	0	2	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Identify the applications of analog electronics*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Identify the applications of digital logic families*			
CLR-3 :	*Design the combinational and sequential logic circuits*			
CLR-4 :	*Implement the combinational and sequential logic circuits*			
CLR-5 :	*Analyze the design of counters and registers*			
CLR-6 :	*Utilize the concepts in real time scenarios*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Identify the analog and digital components in circuit design*	*1*	*80*	*70*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Analyze the combinational and sequential logic circuits*	*2*	*85*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Apply gates and flip-flops in circuit design*	*2*	*75*	*70*	*H*	-	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Use simulation package and realize*	*2*	*85*	*80*	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	-	-	-
CLO-5 :	*Apply HDL code and synthesize*	*2*	*85*	*75*	*H*	-	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Build the circuits in bread board and demonstrate and FGPA*	*3*	*80*	*70*	-	-	*H*	*H*	-	*H*	-	-	*H*	-	*H*	-	-	-	-

		Introduction to Analog electronics	*Logic Families*	*Combinational Logic Circuits*	*Sequential Logic circuits*	*Registers & Counters*
Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Characteristics of BJT (CB, CE and CC configurations) and DC biasing*	*Transistor as a Switch*	*Quine-McCluskey minimization technique*	*Sequential circuits, Latch and Flip-Flops*	*Registers and Types of Registers- Serial In - Serial Out, Serial In - Parallel out*
	SLO-2	*BJT Uses*	*Characteristics of Digital ICs*	*Combinational Circuits*	*RS Flip-Flops,*	*Parallel In - Serial Out, Parallel In - Parallel Out*
S-2	SLO-1	*Characteristics and uses of JFET (CS, Common Drain and Common Gate)*	*DL, RTL*	*Multiplexer*	*Gated Flip-Flops*	*Universal Shift Register*
	SLO-2	*Differences between BJT and JFET*	*DTL,TTL*	*Demultiplexer*	*Edge-triggered RS FLIP-FLOP*	*Applications of Shift Registers*
S-3	SLO-1	*Transistor Amplifier: CE amplifier*	*ECL*	*Decoder*	*Edge-triggered D FLIP-FLOPs*	*Synchronous Counters*
	SLO-2	*Transistor Amplifier: CC ,CB amplifier*	*IIL*	*Encoder*	*Edge-triggered T FLIP-FLOPs*	*Asynchronous Counters*
S 4-5	SLO-1	*Lab 1: Design and Implement Half and Full Wave Rectifiers using simulation*	*Lab 4: Design and implement transistor as a switch*	*Lab 7: Design and implement code converters using logic gates simulation*	*Lab 10: HDL implementation of Flip-Flop*	*Lab 13: Implement SISO, SIPO, PISO and PIPO shift registers using Flip- flops*
	SLO-2					
S-6	SLO-1	*Power Amplifiers: Different classes of Amplifiers and its operation-Class A*	*Characteristics and uses of MOSFET (CS, Common drain and Common gate)*	*Binary adder*	*Edge-triggered JK FLIPFLOPs*	*Changing the Counter Modulus*
	SLO-2	*Class B, AB and C*	*MOSFET Logic*	*Binary adder as subtractor*	*JK Master-slave FLIP-FLOP*	*Decade Counters*
S-7	SLO-1	*Operational Amplifiers: Ideal v/s practical Op-amp*	*PMOS,NMOS*	*Carry look ahead adder*	*Analysis of Synchronous Sequential Circuit, State Equation, State table*	*Presettable counters*

	SLO-2	*Performance Parameters*	*CMOS Logic*	*Decimal adder*	*State Diagram*	*Counter Design as a Synthesis problem*
S-8	SLO-1	*Applications: Peak detector, Comparator, Inverting, Non-Inverting Amplifiers*	*Propagation delay*	*Magnitude Comparator*	*Synthesis of sequential circuit using Flip-Flops*	*Seven segment Display and A Digital Clock.*
	SLO-2	*Problem solving session*	*Problem solving session*	*Problem solving session*	*Problem solving session*	*Problem solving session*
S 9-10	SLO-1	*Lab 2: Design and implement Schmitt trigger using Op-Amp (simulation)*	*Lab 5: Design CMOS Inverter, measure propagation delay for rising & falling edge*	*Lab 8: Design and implement using simulation the combinational circuits*	*Lab 11: Design and implement using simulation; Synchronous sequential circuits*	*Lab 14: HDL for Registers and Counters*
	SLO-2					
S-11	SLO-1	*Effect of positive and Negative Feedback Amplifiers,*	*Tristate Logic*	*Read Only Memory*	*Asynchronous sequential circuit*	*D/A Conversion*
	SLO-2	*Analysis of Practical Feedback Amplifiers*	*Tristate Logic Applications*	*Arithmetic Logic Unit*	*Transition Table*	*Types of D/A Converters*
S-12	SLO-1	*Oscillator Operation*	*FPGA Basics*	*Programmable Logic Arrays*	*State table*	*Problem*
	SLO-2	*Crystal Oscillator*	*Introduction to HDL and logic simulation*	*HDL Gate and Data Flow modeling*	*Flow table*	*A/D Conversion*
S-13	SLO-1	*Overview of UJT, Relaxation Oscillator,555 Timer*	*HDL System primitives, user defined primitives, Stimulus to the design*	*HDL Behavioral modeling*	*Analysis of asynchronous sequential circuits*	*Types of A/D conversion*
	SLO-2	*Problem solving session*	*Problem solving session*	*Problem solving session*	*Problem solving session*	*Problem solving session*
S 14-15	SLO-1	*Lab 3: Design and implement using simulator a rectangular waveform generator (Op-Amp relaxation oscillator)*	*Lab 6: HDL Program to realize delay and stimulus in simple circuit*	*Lab 9: HDL program for combinational circuits*	*Lab 12: HDL program for Sequential circuits*	*Lab 15: Design and Implement an A/D Converter.*
	SLO-2					

Learning Resources	*1. Robert L. Boylestad& Louis Nashelsky, Electronic Devices & Circuit Theory, 11th ed., Pearson, 2013* *2. Anil K Maini, Varsha Agarwal: Electronic Devices and Circuits, Wiley, 2012* ***3.** Paul Tuinenga, SPICE: A Guide to Circuit Simulation and Analysis Using PSpice, 3rd ed., Prentice-Hall, 1995,*	*4. Douglas A, G.K. Kharate, Digital Electronics, Oxford university Press,2012* *5. M. Morris R. Mano, Michael D. Ciletti, Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog, 6th ed., Pearson, 2018* ***6.** A.P. Malvino, Electronic Principles,7th Edition, Tata Mcgraw Hill Publications, 2013*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Dr. Devi Jayaraman , Virtusa, devij@virtusa.com	*1. Dr. J. Dhalia Sweetlin, Anna University, jdsweetlin@mitindia.edu*	*1. Dr. Annapurani Panaiyappan.K, SRMIST*	
2. Dr. Viswanadhan, Teken BIM Technologies, viswanathan_alladi@yahoo.com	*2. Dr. B. Latha, Sairam Engineering College, hod.cse@sairam. edu.in*	*2. Dr. D. Anitha, SRMIST*	*3. Ms. Kayalvizhi J, SRMIST*

Course Code	18CSS202J	Course Name	COMPUTER COMMUNICATIONS	Course Category	S	*Engineering Sciences*	L	T	P	C
							2	0	2	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the basic services and concepts related to Internetwork*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Understand the layered network architecture*			
CLR-3 :	*Acquire knowledge in IP addressing*			
CLR-4 :	*Exploring the services and techniques in physical layer*			
CLR-5 :	*Understand the functions of Data Link layer*			
CLR-6 :	*Implement and analyze the different Routing Protocols*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Apply the knowledge of communication*	*2*	*80*	*70*
CLO-2 :	*Identify and design the network topologies*	*3*	*85*	*75*
CLO-3 :	*Design the network using addressing schemes*	*3*	*75*	*70*
CLO-4 :	*Identify and correct the errors in transmission*	*1*	*85*	*80*
CLO-5 :	*Identify the guided and unguided transmission media*	*1*	*85*	*75*
CLO-6 :	*Design and implement the various Routing Protocols*	*3*	*80*	*70*

	Program Learning Outcomes (PLO)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*H*	-	*H*	-	-	-	-	-	-	-	-	-	*M*	-	-
CLO-3 :	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*M*	-	*M*
CLO-4 :	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	*M*	-	*M*

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Evolution of Computer Networks, Network categories*	*IPv4 Addressing, Address space*	*Line coding: Unipolar scheme*	*Framing, Flow Control Mechanisms*	*Forward Techniques, Forwarding Process*
	SLO-2	*Data Transmission Modes, Network topologies*	*Dotted Decimal Notation. Classful Addressing*	*Polar schemes, Bipolar schemes*	*Sender side Stop and Wait Protocol, Receiver side Stop and Wait Protocol*	*Routing Table*
S-2	SLO-1	*Circuit Switching and Packet Switching*	*Subnet Mask*	*Amplitude shift keying, Frequency shift keying*	*Goback N ARQ, Selective Reject ARQ*	*Intradomain Routing and Interdomain Routing*
	SLO-2	*Protocols and standards*	*Subnetting*	*Phase shift keying, Pulse code Modulation, Delta Modulation*	*CRC, Checksum*	*Static Routing and Dynamic Routing*
S 3-4	SLO-1	*Lab 1: IP Addressing*	*Lab 4: Router Configuration (Creating Passwords, Configuring Interfaces)*	*Lab 7: RIP v1*	*Lab 10: EIGRP Authentication and Timers*	*Lab 13: Examining Network Address Translation (NAT)*
	SLO-2					
S-5	SLO-1	*Layers in the OSI model, Functions of Physical layer, data link layer*	*Special Addresses*	*Multiplexing: FDM*	*Types of Errors*	*Distance Vector Routing, Problem Solving*
	SLO-2	*Functions of Network layer, Transport layer*	*Special Addresses*	*Multiplexing: FDM*	*Types of Errors*	*Link state Routing*
S-6	SLO-1	*Functions of Session, Presentation layer and Application layer*	*Classless Addressing*	*TDM*	*Forward Error correction*	*Problem solving*
	SLO-2	*TCP/IP protocol suite , Link layer protocols*	*Problem Solving*	*WDM*	*CSMA, CSMA/CD*	*Path vector Routing*

S 7-8	SLO-1 SLO-2	*Lab 2: Subnetting (VLSM)*	*Lab 5: Basic Switch Configuration: Vlan*	*Lab 8: RIP v2*	*Lab 11: Single-Area OSPF Link Costs and Interface*	*Lab 14: BGP Configuration*
S-9	SLO-1	*Network layer protocols*	*Private Address, NAT, Supernetting*	*Guided Media: Twisted Pair, Coaxial Cable Fiber optic cable*	*Hamming Distance*	*RIP v1,RIP v2*
	SLO-2	*Transport layer protocols*	*Hub, Repeaters, Switch*	*Unguided media: Radio waves*	*Correction Vs Detection*	*OSPF*
S-10	SLO-1	*Serial and Parallel Transmissions*	*Bridge*	*Microwaves*	*HDLC*	*EIGRP*
	SLO-2	*Addressing*	*Structure of Router*	*Infrared*	*PPP*	*BGP*
S 11-12	SLO-1 SLO-2	*Lab 3: LAN Configuration using straight through and cross over cables*	*Lab 6: Static and Default Routing*	*Lab 9: EIGRP Configuration, Bandwidth, and Adjacencies*	*Lab 12: Multi-Area OSPF with Stub Areas and Authentication*	*Lab 15: Configuring Static and Default Routes*

Learning Resources	*1. Behrouz A. Forouzan, "Data Communications and Networking" 5th ed., 2010* *2. Bhushan Trivedi," Data Communication and Networks" 2016*	*3. William Stallings, Data and Computer Communications,9th ed., 2010* *4. Todd Lammle, CCNA Study Guide, 7th ed. 2011*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
Level 2	Apply Analyze	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
Level 3	Evaluate Create	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Dr. Viswanadhan, Teken BIM Technologies, viswanathan_alladi@yahoo.com	*1. Dr. J. Dhalia Sweetlin, Anna University, jdsweetlin@mitindia.edu*	*1. Mrs. T. Manoranjtham , SRMIST*	
2. Dr. Devi Jayaraman , Virtusa, devij@virtusa.com	*2. Dr. B. Latha, Sairam Engineering College, hod.cse@sairam. edu.in*	*2. Mr. J. Godwin Ponsam, SRMIST*	*Dr. J.S. Femilda Josephin, SRMIST*

Course Code	18ECS201T	Course Name	CONTROL SYSTEMS	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	18ECC104T	Progressive Courses	Nil
Course Offering Department	Electronics and Communication Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Learn about mathematical modeling techniques of mechanical and electrical systems			
CLR-2 :	Impart knowledge about the transient and steady state error and analysis			
CLR-3 :	Identify and analyze stability of a system in time domain using root locus technique			
CLR-4 :	Know about different frequency domain analytical techniques			
CLR-5 :	Acquire the knowledge of a controller for specific applications			
CLR-6 :	Impart knowledge on controller tuning methods			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO–1: Professional Achievement	PSO – 2: Project Management Techniques	PSO – 3: Analyze & Research
CLO-1 :	Determine Transfer function of a system by mathematical modeling, block diagram reduction and signal flow graphs	1,2	80	80	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-2 :	Identify the standard test inputs, time domain specifications and calculate steady state error	1,2	85	80	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-3 :	Plot a root locus curve and analyze the system stability using Routh array	2,3	90	85	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-4 :	Analyze the frequency domain specifications from bode and polar plots	2,3	90	85	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-5 :	Design a closed loop control system for specific application	1,2,3	80	80	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-
CLO-6 :	Identification of controller parameters and tuning	1,2,3	85	85	H	H	-	-	-	-	-	-	-	-	-	-	H	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Open and closed loop control system	Standard test signals and their expression	Poles and zeros of a system	Frequency domain analysis	Controllers-Significance and Need
	SLO-2	Feedback and Feed forward control systems	Type number and order of a system	Pole zero plot and concept of s plane	Frequency domain specifications	Stability of closed loop systems
S-2	SLO-1	Transfer function of a system and basis of Laplace transforms	Transfer function of First order system for Step and ramp signal	Proper, Strictly Proper and Improper systems	Frequency domain plots, minimum and non minimum phase systems	SISO and MIMO control systems
	SLO-2	Need for mathematical modeling	Transfer function of First order system Impulse and parabolic signal	Characteristic equation	Correlation between time and frequency domain	Types of controllers-ON-OFF,P,I,D
S-3	SLO-1	Representation of mechanical translational systems using differential equation and determination of transfer function	General transfer function of second order system	Concept of stability from pole zero location	Bode plot approach and stability analysis	Composite Controller-PI,PD and PID
	SLO-2		Identification of damping factor and classification based on it	Need for Stability analysis and available techniques	Rules for sketching bode plot	Controller parameters and tuning methods
S-4	SLO-1	Representation of mechanical rotational systems and determination of transfer function	Step response of critically damped second order system	Necessary and sufficient Condition for stability	Bode plot of typical systems	Design Specification, controller configurations- ON-OFF controller
	SLO-2		Step response of under damped second order system	Significance of Routh Hurwitz Technique		

S-5	SLO-1	*Conversions of Mechanical system to Electrical system*	*Step response of over damped second order system*	*Computation of Routh array*	*Bode plot of typical systems*	*Design Specification, controller configurations-PID controller*
	SLO-2	*f-V and f-I electrical analogies*	*Step response of undamped second order system*	*Routh array of stable systems*		
S-6	SLO-1	*Block diagram reduction rules and methodology*	*Time domain specifications and their significance*	*Routh array of Unstable systems*	*Polar plot and significance*	*Design of speed control system for DC motor*
	SLO-2		*Numerical solution*	*Routh array of Unstable systems*	*Nyquist stability criterion*	
S-7	SLO-1	*Evaluation of transfer function using block diagram reduction*	*Transient and steady state error analysis*	*Root locus technique*	*Sketching of polar plot on polar graphs*	*Design of control system for Twin Rotor Multi input Multi output System(TRMS) with one degree of freedom*
	SLO-2		*Static and dynamic Error coefficients*	*Rules for sketching root locus*		
S-8	SLO-1	*Signal flow graphs and evaluation of transfer function*	*Static error constants and evaluation of steady state error*	*Root locus plot of typical systems*	*Polar plot of typical systems*	*Case study 1*
	SLO-2					
S-9	SLO-1	*Block diagram to signal flow conversion*	*Dynamic error constants and evaluation of steady state error*	*Root locus plot of typical systems*	*Polar plot of typical systems*	*Case study 2*
	SLO-2					

Learning Resources	*1.* Nagrath.J and Gopal.M,, "Control System Engineering", 5th Edition, New Age, 2007 *2.* Benjamin C Kuo, "Automatic Control System", 9th edition, John Wiley & Sons, 2010	3. Gopal.M, "Control System Principles and Design", 2nd Edition, TMH, 2002 *4.* Sivanandam and Deepa, "Control system Engineering using MATLAB", 2nd edition, Vikas publishers, 2007

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply / Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate / Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr. Anuj Kumar, Bombard*ier Transportation, Ahmedabad, *kumaranuj.anii@gmail.com*	1. *Dr. Meenakshi, Professo*r of ECE, CEG, Anna University, *meena68@annauniv.edu*	*Dr. T. Deepa, SRMIST*
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	*2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in*	*Mrs. R. Bakhya Lakshmi, SRMIST*

Course Code	18MES201T	Course Name	ENGINEERING MECHANICS	Course Category	S	*Engineering Sciences*	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Mechanical Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Construct mathematical models, formulate and solve static equilibrium problems in engineering and its applications*			
CLR-2 :	*Utilize theory of dry friction in Mechanical Engineering applications*			
CLR-3 :	*Utilize the concept of centroid and moment of inertia in engineering problems and its applications*			
CLR-4 :	*Solve problems on kinematics and kinetics of particles*			
CLR-5 :	*Solve problems on kinematics and kinetics of rigid bodies*			
CLR-6 :	*Apply static and dynamic equilibrium of particles and rigid bodies*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Solve statically determinate equilibrium problems in the field of Engineering*	*2*	*80*	*75*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*
CLO-2 :	*Solve problems related to dry friction and analyze machines that are functioning based on the theory of friction*	*2*	*85*	*75*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*
CLO-3 :	*Determine centroid and moment of inertia for composite objects*	*2*	*85*	*75*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*
CLO-4 :	*Analyze kinematics of particles with rectilinear, curvilinear motions, solve dynamic equilibrium problems in particles*	*2*	*80*	*75*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*
CLO-5 :	*Analyze kinematics of rigid bodies with translation, rotation, general plane motion, solve dynamic equilibrium in rigid bodies*	*2*	*80*	*75*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*
CLO-6 :	*Solve static and dynamic equilibrium of particle and rigid body problems*	*2*	*75*	*70*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Introduction to Mechanics, classification of mechanics*	*Friction and its types, Laws of Friction, coefficient of friction*	*Centre of Gravity and Centroids of lines, areas*	*Rectilinear motion, with non-uniform velocity and acceleration motion*	*Kinematics of rigid bodies: Translation and rotation of rigid bodies,*
	SLO-2	*Fundamental concepts and principles of engineering mechanics*	*Angle of Friction, Angle of repose, limiting friction*	*Centre of Gravity and Centroids of volumes*	*Uniform velocity and uniform acceleration motion*	*Fixed axis rotation - determination of angular displacement, velocity and acceleration*
S-2	SLO-1	*Concurrent forces in a plane, Coplanar forces*	*Equilibrium of a block resting on a rough inclined plane*	*Determination of centroid of line by integration*	*Curvilinear motion, Normal, tangential, radial*	*General plane motion*
	SLO-2	*Vector approach on addition, subtraction of forces*	*Range of force required to maintain equilibrium of block on rough inclined plane*	*Determination of area by integration*	*transverse components of acceleration*	*Relative motion method*
S-3	SLO-1	*Resolution of forces*	*Example problems on dry friction*	*Centroid of composite lines*	*Projectile motion, terminology*	*Velocity analysis of rigid bodies using relative velocity method*
	SLO-2	*Resultant of several concurrent forces in plane (vector approach)*	*Applications of friction in wedges*	*Centroid of composite areas*	*Derivation of equation of trajectory of a projectile*	*Velocity analysis of rigid bodies using relative velocity method*
S-4	SLO-1	*Tutorial on resultant of several concurrent forces*	*Tutorial on dry and wedge friction*	*Tutorial on centroid of composite line and area*	*Tutorial on Projectile motion*	*Tutorials on velocity analysis of general plane motion using relative velocity method*
	SLO-2					
S-5	SLO-1	*Equilibrium of Particle, Free body diagram, Forces in planes, Lami's theorem*	*Application of friction in Ladder*	*Determination of centroid of volume by integration*	*Relative motion*	*Acceleration analysis of rigid bodies using relative acceleration method*
	SLO-2	*Problems on equilibrium of particle in planes*	*Example problems*	*Determination of centroid of volume by integration*	*constrained motion*	*Acceleration analysis of rigid bodies using relative acceleration method*
S-6	SLO-1	*Forces in space: resultant of concurrent*	*Application of friction in flat and V-belts,*	*Determination of centroid of composite*	*Newton's second law of motion,*	*Instantaneous center of rotation in plane*

		forces in space	*Ratio of belt tensions*	*volume*	*D'Alembert's principle*	*motion*
	SLO-2	*Problems on equilibrium of particle in space*	*Application of friction in V-belts, Ratio of belt tensions*	*Theorems of Pappus & Guldinus*	*Problems using Newton's second law*	*examples*
S-7	SLO-1	*Statics of rigid body, Principle of transmissibility*	*Application of friction in screw jack*	*Determination of moment of inertia of area by integration*	*Principle of work and energy*	*Velocity analysis of rigid bodies using Instantaneous center method*
	SLO-2	*Moment of a force, Varignon's Theorem and its applications*	*Terminology in screws, self-locking of screw jack*	*Determination of moment of inertia of area by integration*	*conservative forces, law of conservation of energy*	*Velocity analysis of rigid bodies using Instantaneous center method*
S-8	SLO-1	*Tutorials on Moment of force and couple system*	*Tutorial on Screw and belt friction*	*Tutorial on area moment of Inertia of composite section*	*Tutorial on principle of work energy*	*Tutorial on Velocity analysis of rigid bodies using Instantaneous center of rotation*
	SLO-2					
S-9	SLO-1	*Reduction of system of forces into single force and couple system*	*Effort, Mechanical advantage of a screw jack*	*Radius of gyration*	*Principle of impulse and momentum*	*kinetics of rigid bodies, Angular momentum*
	SLO-2	*Reduction of system of forces into single force and couple system*	*efficiency of a screw jack*	*Parallel and perpendicular axis theorems*	*problems on Impulsive motion*	*Newton's second law*
S-10	SLO-1	*Resultant of non-concurrent forces in plane*	*Problems on simple screw jack*	*Derivation of Mass moment of inertia of plate, prism*	*Problems on impulse*	*Problems using Newton's second law*
	SLO-2	*Types of supports and reactions*	*Problems on simple screw jack*	*Derivation of Mass moment of inertia of cylinder*	*Problems on momentum principle*	*Problems using Newton's second law*
S-11	SLO-1	*Equilibrium of rigid bodies in two dimensions*	*Problems on differential screw jack*	*Derivation of Mass moment of inertia of cone*	*Impact of elastic bodies, direct central*	*Kinetics of rigid bodies using work energy principle*
	SLO-2	*Equilibrium of rigid bodies in two dimensions*	*Problems on differential screw jack*	*Derivation of Mass moment of inertia of sphere*	*oblique central impact of elastic bodies*	*Kinetics of rigid bodies using work energy principle*
S-12	SLO-1	*Tutorial on Equilibrium of a two-force body*	*Tutorial on simple and differential screw jack*	*Tutorial on determination of mass moment of inertia of composite bodies*	*Tutorial on oblique central impact of elastic bodies*	*Tutorial on rigid bodies using work- energy principle*
	SLO-2					

Learning Resources	1. *Ferdinand.P. Beer. E, Russell Johnston Jr., David Mazurek, Philip J Cornwell, Vector Mechanics for Engineers: Statics and Dynamics, McGraw - Hill, 10th ed., 2013* 2. *Meriam J.L and Kraige L.G., Engineering Mechanics, Volume I - statics, Volume II - dynamics, John Wiley & Sons, 7th ed., 2012*	3. *Russel C Hibler, Engineering Mechanics: Statics, Dynamics, Pearson,14th ed., 2015* 4. *Shames.I.H, Krishna MohanaRao.G, Engineering Mechanics (Statics and Dynamics), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 2006* 5. *Timoshenko, Young, Engineering Mechanics, Tata Mc-Graw Hill, 5th ed., 2013*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	18MHS201T	Course Name	THERMODYNAMICS AND HEAT TRANSFER	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Mechatronics Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Utilize the thermodynamic processes with the help of P-V and T-S diagram			
CLR-2 :	Utilize second law of thermodynamics and the performance of Heat pump, engine and refrigeration system			
CLR-3 :	Utilize the properties of air and the working principle of different air conditioning and refrigeration system			
CLR-4 :	Solve the basic calculations involving conduction and convection in Mechatronics system			
CLR-5 :	Identify applications of heat transfer in mechatronics systems, study heat requirements of gas turbines and IC engines.			
CLR-6 :	Utilize fundamentals of thermodynamics and its application in Mechatronics system			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	Identify and describe the energy exchange processes in engineering systems.	2	75	70	H	H	M	M	L	L	L	L	L	L	L	H	M	M	M
CLO-2 :	Understand the second law of thermodynamics and its application to a wide range of systems	2	75	70	H	H	M	M	L	L	L	L	L	L	L	H	M	M	M
CLO-3 :	Extrapolate the psychrometric properties and performance of refrigeration and air conditioning systems	2	75	70	H	H	M	M	L	L	L	L	L	L	L	H	M	M	M
CLO-4 :	Extrapolate the different modes of heat transfer like conduction, convection and radiation.	2	75	70	H	H	M	H	M	M	L	L	L	L	L	H	M	M	M
CLO-5 :	Analyze the heat transfer in refrigeration and air-conditioning systems, internal combustion engine and heat exchangers.	3	75	70	H	H	M	H	M	M	M	L	L	L	L	H	M	M	M
CLO-6 :	Understand the basic laws of thermodynamics and its applications in different engineering systems	3	75	70	H	H	H	M	L	L	L	L	L	L	L	H	M	M	M

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Introduction to thermodynamics	Second law of thermodynamics	Introduction to psychrometric properties	Introduction to heat transfer	Introduction to IC engine and engine components
	SLO-2	Statistical and classical approach.	Kelvin Planck statement, Clausius statement	Dry air, moist air, dry bulb temperature.	Modes of heat transfer: Conduction, convection and radiation	Working principle of two and four stroke of SI and CI engine
S-2	SLO-1	Thermodynamic system, properties, processes and cycles.	Reversible and irreversible processes	Wet bulb temperature, dew point temperature, specific humidity	Fourier law of conduction	Modes of Heat transfer in IC engine
	SLO-2	Thermodynamic equilibrium: Mechanical, chemical and thermal equilibrium.	Second law aspects of heat engine	Calculations of vapor mixtures	General heat conduction equation in Cartesian co-ordinates.	Heat transfer and Engine energy balance
S-3	SLO-1	Quasi-static process, Work and heat transfer	Performance of heat engine	Introduction to Psychrometric chart	Heat stored in the element, heat Conduction with internal heat generation	Problems on heat transfer in IC engine
	SLO-2	Problems on Work and heat transfer	Second law aspects of refrigerator	Psychrometric processes.	Plane wall and cylinder with uniform heat generation	Principle of Heat flux measurement in IC engine
S-4	SLO-1	zeroth law of thermodynamics	CoP of refrigerator	Sensible heating process	Heat Conduction through plane wall	Introduction to turbine, Classifications of turbines
	SLO-2	First law of thermodynamics.	Second law aspects of heat pump	Sensible cooling process	Heat Conduction through composite wall	Merits, demerits and its applications of gas turbine

S-5	SLO-1	*First law of thermodynamics applied to closed systems*	*CoP of heat pump*	*Humidification and dehumidification*	*Heat Conduction through hollow Cylinder*	*Evaluation of Thermodynamics model in pneumatic cylinder*
	SLO-2	*Isobaric process*	*Problems on combination of heat engine, heat pump and refrigerator*	*Cooling and dehumidification*	*Heat Conduction through composite cylinder*	*Analysis of heat transfer between the air and the cylinder wall*
S-6	SLO-1	*Isochoric process*	*Clausius inequality*	*Adiabatic mixing*	*Heat Conduction through hollow Sphere*	*Conduction heat transfer in Electronics equipment heat sink*
	SLO-2	*Isothermal process*	*concept of entropy*	*Solving problems by using psychrometric chart*	*Heat Conduction through composite Sphere*	*Convection heat transfer in electronics equipment heat sink*
S-7	SLO-1	*Isentropic process*	*Entropy changes in different thermodynamics processes*	*Solving problems on sensible heating process*	*Introduction about convection*	*Introduction to heat exchanger and its types*
	SLO-2	*Polytropic process*	*Entropy changes in isobaric process*	*Solving problems on sensible cooling process*	*Characteristics parameters in free convection*	*Heat transfer analysis in heat exchangers*
S-8	SLO-1	*First law of thermodynamics applied to open systems*	*Entropy changes in Isochoric process*	*Solving problems on adiabatic mixing Elements of refrigeration systems.*	*Empirical correlations for free convection with horizontal plate*	*Analysis of heat transfer in refrigeration*
	SLO-2	*Steady flow energy equation for boiler, turbine and heat exchanger*	*Entropy changes in Isothermal process*	*Coefficient of performance*	*Empirical correlations for free convection with horizontal Cylinder*	*Analysis of heat transfer in Air conditioning system*
S-9	SLO-1	*Steady flow energy equation for turbine.*	*Problems on Entropy changes in different thermodynamics processes*	*Air-conditioning systems*	*Forced convection with laminar flow over a flat plate*	*Heat transfer problems on refrigeration system*
	SLO-2	*Limitations of first law of thermodynamics*	*Problems on Entropy changes in combined processes*	*Open and closed system.*	*Forced convection with Turbulent flow over a flat plate*	*Heat transfer problems on Air conditioning system*
S-10	SLO-1	*Introduction to thermodynamics*	*Second law of thermodynamics*	*Introduction to psychrometric properties*	*Introduction to heat transfer*	*Introduction to IC engine and engine components.*
	SLO-2	*Statistical and classical approach.*	*Kelvin Planck statement, Clausius statement*	*Dry air, moist air, dry bulb temperature.*	*Modes of heat transfer: Conduction, convection and radiation.*	*Working principle of two and four stroke of SI and CI engine*
S-11	SLO-1	*Thermodynamic system, properties, processes and cycles.*	*Reversible and irreversible processes*	*Wet bulb temperature, dew point temperature, specific humidity.*	*Fourier law of conduction*	*Modes of Heat transfer in IC engine*
	SLO-2	*Thermodynamic equilibrium: Mechanical, chemical and thermal equilibrium.*	*Second law aspects of heat engine*	*Calculations of vapor mixtures*	*General heat conduction equation in Cartesian co-ordinates.*	*Heat transfer and Engine energy balance*
S-12	SLO-1	*Quasi-static process, Work and heat transfer*	*Performance of heat engine*	*Introduction to Psychrometric chart*	*Heat stored in the element, heat Conduction with internal heat generation*	*Problems on heat transfer in IC engine*
	SLO-2	*Problems on Work and heat transfer*	*Second law aspects of refrigerator*	*Psychrometric processes*	*Plane wall and cylinder with uniform heat generation*	*Principle of Heat flux measurement in IC engine*

Learning Resources	1. *Rajput. R. K. Engineering Thermodynamics, 4th ed., Laxmi Publications (P) Ltd., 2015* 2. *Kumar. D. S, Engineering Thermodynamics, 2nd ed., S.K. Kataria and Sons, 2013* 3. *Holman.J.P, Heat Transfer (In SI Units), 10th edition, McGraw Hill Education, 2016*	4. *Yunus a Cengel Michael a Boles, Thermodynamics, 7th ed., Tata McGraw-Hill, 20115* 5. *Nag.P.K., Engineering Thermodynamics, 5th ed., Tata McGraw-Hill, 2013* 6. *Mechanics Laboratory Manual.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-

	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Mr.G,Vijayaram, TAFE, vijayaram@tafe.com	*2. Dr.M.Baskaran, Associate Professor, KSR College of Technology, baskaranm@ksrct.ac.in*	*2. Dr.S. Senthil Raja, SRMIST*

Course Code	18PYS201T	Course Name	MATERIALS SCIENCE	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Physics	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Understand the structure of crystalline materials.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Gain knowledge on the basics of material structures, properties and strength of materials			
CLR-3 :	Gain knowledge on ceramics, polymers, copolymers and non-crystalline materials			
CLR-4 :	Acquire knowledge on polymer nanocomposites, biomaterials, catalytic materials and corrosion and degradation of materials			
CLR-5 :	Introduce the working principle of various characterization techniques			
CLR-6 :	Understand the structure of crystalline materials			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
CLO-1 :	Acquire the knowledge on structure of crystalline materials	2	80	85
CLO-2 :	Acquire the ability to identify engineering problems using plastic deformation, fatigue, fracture and creep of materials	2	75	80
CLO-3 :	Understand the basic ideas about ceramics, polymers and non-crystalline solids	2	85	80
CLO-4 :	Appreciate the concepts of reinforced matrix interface, corrosion parameters and uses of various nanocomposites.	2	80	75
CLO-5 :	Apply the knowledge for structural and spectroscopic characterization of materials	2	75	85
CLO-6 :	Acquire the knowledge on structure of crystalline materials	2	80	85

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Acquire the knowledge on structure of crystalline materials	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify engineering problems using plastic deformation, fatigue, fracture and creep of materials	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand the basic ideas about ceramics, polymers and non-crystalline solids	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Appreciate the concepts of reinforced matrix interface, corrosion parameters and uses of various nanocomposites.	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge for structural and spectroscopic characterization of materials	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Acquire the knowledge on structure of crystalline materials	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to materials-crystalline and amorphous	Imperfections in solids: point defects	Semi-crystalline materials: introduction and classification	Introduction to composites	Introduction to experimental techniques
	SLO-2	Single crystalline and polycrystalline materials	Equilibrium concentration of vacancies	Structure and configuration of ceramics	Classification of composites	X-Ray Diffraction (Single Crystal method)
S-2	SLO-1	Concept of basis and lattice	Interstitial impurities in solids	Advanced ceramics-functional properties	Polymer nanocomposites materials	Scanning Ion Conductance Microscopy-principle
	SLO-2	Lattice translational vectors	Substitutional impurities in solids	Mechanical behavior of ceramics-flexural strength	Polymer-matrix composites	Scanning Ion Conductance Microscopy-construction and working
S-3	SLO-1	Primitive cell and Bravais lattice	Line defects: edge dislocations	Fabrication and processing of advanced ceramics	Fiber-reinforced composites	Molecular and spectroscopic analysis-introduction
	SLO-2	Seven types of Bravais lattices	Screw dislocations	Applications of advanced ceramic materials	Metal-matrix composites	FTIR spectroscopy
S-4	SLO-1	Symmetry operations in crystals	Surface and volume imperfections	Glass ceramics-introduction	Ceramic-matrix composites	Concept of Raman spectroscopy
	SLO-2	Rotational and translational symmetry	Interfacial defects, stacking faults	Glass forming and glass tempering	Carbon–carbon composites	Raman spectroscopy- instrumentation
S-5	SLO-1	Indexing of crystal planes	Elastic properties-Hooke's law	Polymers-classification	Degradation of polymers	XPS spectroscopy-concept
	SLO-2	Miller indices -directions and planes	Yield strength	Thermoplastic and thermosetting polymers	Recycling of polymers	XPS spectroscopy- instrumentation

S-6	SLO-1	*Various planes in cubic structure*	*Tensile strength*	*Mechanical behavior of polymers-macroscopic deformation*	*Corrosion of metals, forms of corrosion*	*Introduction to Nuclear Magnetic Resonance (NMR)*
	SLO-2	*Directions in cubic structure*	*Ductile and brittle materials*	*Polymer synthesis-addition and condensation polymerization*	*Corrosion prevention*	*Nuclear Magnetic Resonance (NMR)-instrumentation*
S-7	SLO-1	*Packing of atoms inside solids- packing fraction calculation*	*Stress strain behavior of metals*	*Concept of copolymers*	*Biomaterials-introduction*	*Introduction to Thermal analysis*
	SLO-2	*Ionic solids-NaCl crystal structure*	*Stress strain behavior of ceramics and polymers*	*Applications of polymers*	*Classification of biomaterials*	*Thermo Gravimetric Analyzer-instrumentation*
S-8	SLO-1	*Hexagonal close packed (HCP) structure*	*Tensile test, plastic deformation*	*Types of liquid crystals*	*Surface properties of biomaterials*	*Differential Thermal Analyses (DTA)*
	SLO-2	*Estimation of packing fraction in HCP*	*Concept of necking*	*Construction and working of LCD*	*Mechanical properties of biomaterials*	*Differential Scanning Calorimetry (DSC)*
S-9	SLO-1	*Diamond structure-APF*	*Fatigue*	*Non-crystalline materials-metallic glass*	*Catalytic biomaterials –silica, enzymatic hydrogels*	*Dynamic light scattering*
	SLO-2	*Cubic Zinc-Sulfide structure*	*Creep behavior*	*Glass transition-melting and glass transition temperature*	*Applications of biomaterials*	*Particle Size Analysis*

Learning Resources	1. *V. Raghavan, Materials Science and Engineering: A First Course, 5th ed., Prentice Hall India, 2004.* 2. *William D. Callister, Materials Science and Engineering, An Introduction, John Wiley & Sons, 2007*	3. *Kingery, W. D., Bowen H. K., Uhlmann, D. R., Introduction to Ceramics, 2nd ed., John Wiley & Sons, 1976.* 4. *Upadhyaya and A. Upadhyaya, Material Science and Engineering, Anshan Publications, 2007*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Dr. M. Krishna Surendra, Saint-Gobain Research, Krishna.muvvala@saintgobain.com	*2. Prof. D. Arivuoli, Anna University, arivuoli@annauniv.edu*	*2. Sandeep Kumar Lakhera, SRMIST*

Course Code	18NTS101T	Course Name	NANOSCIENCE AND NANOTECHNOLOGY	Course Category	S	Engineering Sciences	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Nanotechnology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Acquire knowledge on basics of nanoscience, classes of nanomaterials and their size and dimensionality dependence			
CLR-2 :	Obtain knowledge on physical properties of nanostructured materials and their size and dimensionality dependence			
CLR-3 :	Understand the physics and chemistry-based experimental approaches to synthesize various types of nanomaterials			
CLR-4 :	Gain knowledge on the basic principles of characterization techniques at nanoscale			
CLR-5 :	Appreciate the potential applications of the nanotechnology			
CLR-6 :	Know the safety and technological issues associated with nanoscience and nanotechnology			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Analyze fundamentals of nanotechnology, different classes of nanomaterials and their sizes and dimensions	2	80	75	H	M	H	H	M	H	H	H	M	H	M	H	H	H	H
CLO-2 :	Describe various physical properties of nanomaterials	2	80	70	H	H	H	M	M	H	H	M	H	H	M	H	H	H	H
CLO-3 :	Apply chemical and physical methods to synthesize and fabricate nanomaterials	2	75	70	H	H	H	H	H	H	H	H	H	H	H	H	H	M	H
CLO-4 :	Distinguish various characterization techniques involved in nanotechnology	2	80	75	H	M	H	H	H	M	H	H	H	H	H	H	M	H	H
CLO-5 :	Identify the potentialities of nanotechnology	2	80	70	M	M	M	H	M	H	H	H	M	H	M	H	H	H	H
CLO-6 :	Perform preliminary level research in nanoscience/nanotechnology	2	80	75	H	M	H	H	H	M	H	H	H	H	M	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Matter at different scales, Moore's Law	Mechanical properties of nanomaterials	Chemical methods: Metal nanocrystals by reduction	Introduction to electron microscopy	Role of nanotechnology in solar energy conversion
	SLO-2	Nanosystems – classification based on time and length scale	Size dependence of material properties	Synthesis of metal nanoparticles by chemical reduction methods and properties	SEM operating principles	Catalytic application of nanoparticles
S-2	SLO-1	Size dependent phenomena: Quantum dots, wells and wires	Nanodispersions, nanocrystalline solids	Hydrothermal and solvothermal synthesis	Field emission scanning electron microscope (FESEM)	Nanotechnology in molecular electronics and nanoelectronics
	SLO-2	Principle behind emission of different colors from different size quantum dots	Amorphous materials: Nanocrystalline materials embedded in amorphous matrix	Photochemical synthesis	Environmental scanning electron microscope (E- SEM)	Printed electronics
S-3	SLO-1	Surface to volume ratio	Thermal properties of nanomaterials	Sonochemical routes	High resolution -transmission electron microscope (HRTEM)	Polymers with a special nano-architecture
	SLO-2	Fraction of surface atoms and surface energy	Violation of second law of thermodynamics for small systems and short timescale	Ball milling, Grinding	Scanning Tunneling Microscopy (STM)	Applications of nanomaterials based liquid crystalline systems
S-4	SLO-1	Surface stress and surface defects	Thermal transport-size dependence	Electrodeposition techniques	SPM image processing and image analysis	Nanotechnology in food storage
	SLO-2	Quantum confinement – exciton confinement in quantum dots	Melting point- size dependence	Fabrication of nanotubes, nanowires and nanorods	Dynamic AFM imaging of biological samples	Nanotechnology in improving environment
S-5	SLO-1	Carbon-based nano materials	Electronic properties of nanomaterials	Spray Pyrolysis	Nanomechanical characterization	Concept of data storage

	SLO-2	*Fullerenes and buckyballs*	*Electronic States: Dependence of size and dimensionality*	*Flame pyrolysis*	*Nanoindentation*	*Nanomaterials for data storage*
S-6	SLO-1	*Carbon nanotubes*	*The electron density of states D(E)*	*Physical Vapor Deposition: Thermal evaporation*	*Raman scattering*	*Chemical sensors*
	SLO-2	*Graphene*	*Luttinger liquid behavior of electrons in 1D metals*	*DC/RF magnetron sputtering*	*Surface enhanced -Raman scattering*	*Biosensors*
S-7	SLO-1	*Metal based nano materials*	*Magnetic properties of nanomaterials: Particle size and magnetic behavior*	*Molecular beam epitaxy (MBE)*	*UV-Vis - absorption spectra of nanoparticles of different sizes*	*Nanomedicine*
	SLO-2	*Nanogold and nanosilver*	*Superparamagnetism: Langevin function, surface effects, magnetoresistance*	*Chemical vapor deposition(CVD)*	*Semiconductor nanoparticles*	*Nanobiotechnology*
S-8	SLO-1	*Metal-oxide based nano materials*	*Optical properties: instances of light absorption in nanomaterials*	*Metal organic chemical vapor deposition (MOCVD)*	*Metal nanoparticle: Surface plasmons*	*Nanotoxicology*
	SLO-2	*Nanocomposites and nanopolymers*	*Red- and blue shift*	*Layer-by-layer growth of highly controlled high-quality ultrathin films deposition*	*Surface plasmon resonance*	*Challenges in nanotoxicology*
S-9	SLO-1	*Nanoglasses and nanoceramics*	*Phenomenon of light absorption, light emission- quantum yield*	*Nanofabrication: Concept of lithography*	*Magnetic measurements*	*Nanotechnology in cosmetics*
	SLO-2	*Biological nanomaterials*	*Photoluminescence and electroluminescence of nanomaterials*	*Photo and electron beam lithography techniques*	*Vibrating sample magnetometer (VSM)*	*Nanotechnology in aviation industry*

Learning Resources

1. *T. Pradeep, A Textbook of Nanoscience and Nanotechnology, Tata McGraw Hill Education Pvt. Ltd., 2012*
2. *Hari Singh Nalwa, Nanostructured Materials and Nanotechnology, Academic Press, 2008*
3. *Edward L. Wolf, Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience. 2nd ed., Wiley-VCH, 2004*
4. *Hans-Eckhardt Schaefer, Nanoscience: The Science of the Small in Physics, Engineering, Chemistry, Biology, and Medicine, Springer-Verlag Berlin Heidelberg, 1st Edition, 2010.*
5. *M. F. Ashby, P.J. Ferreira, D. L. Schodek, Nanomaterials, Nanotechnologies and Design: An Introduction for Engineers and Architects, BH Publishers of Elsevier, 2009*
6. *A. P. Guimaraes, Principles of Nanomagnetism, Spinger, 1stedition, 2009*
7. *B. Zhang, Physical Fundamentals of Nanomaterials, Elsevier, 1st Edition, 2018.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Dr. M. Krishna Surendra, Saint-Gobain Research, Chennai, krishna.muvvala@saint-gobain.com	*2. Prof. S. Balakumar, University of Madras, balakumar@unom.ac.in*	*2. Dr. Debabrata Sarkar, SRMIST*

ACADEMIC CURRICULA

Professional Core Courses

COMPUTER SCIENCE AND ENGINEERING

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18CSC201J	Course Name	DATA STRUCTURES AND ALGORITHMS	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	18CSC204J
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize the different data types; Utilize searching and sorting algorithms for data search	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Utilize linked list in developing applications			
CLR-3 :	Utilize stack and queues in processing data for real-time applications			
CLR-4 :	Utilize tree data storage structure for real-time applications			
CLR-5 :	Utilize algorithms to find shortest data search in graphs for real-time application development			
CLR-6 :	Utilize the different types of data structures and its operations for real-time programming applications			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Identify linear and non-linear data structures. Create algorithms for searching and sorting	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Create the different types of linked lists and evaluate its operations	3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Construct stack and queue data structures and evaluate its operations	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Create tree data structures and evaluate its types and operations	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Create graph data structure, evaluate its operations, implement algorithms to identify shortest path	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-6 :	Construct the different data structures and evaluate their types and operations	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Introduction-Basic Terminology	Array	Stack ADT	General Trees	Graph Terminology
	SLO-2	Data Structures	Operations on Arrays – Insertion and Deletion	Stack Array Implementation	Tree Terminologies	Graph Traversal
S-2	SLO-1	Data Structure Operations	Applications on Arrays	Stack Linked List Implementation	Tree Representation	Topological sorting
	SLO-2	ADT	Multidimensional Arrays- Sparse Matrix	Applications of Stack- Infix to Postfix Conversion	Tree Traversal	Minimum spanning tree – Prims Algorithm
S-3	SLO-1	Algorithms – Searching techniques	Linked List Implementation - Insertion	Applications of Stack- Postfix Evaluation	Binary Tree Representation	Minimum Spanning Tree - Kruskal's Algorithm
	SLO-2	Complexity – Time , Space Trade off	Linked List- Deletion and Search	Applications of Stack- Balancing symbols	Expression Trees	Network flow problem
S 4-5	SLO-1	Lab 1: Implementation of Searching -	Lab 4: Implementation of Array – Insertion,	Lab 7 :Implementation of stack using array	Lab 10: Implementation of Tree using array	Lab 13: Implementation of Graph using
	SLO-2	Linear and Binary Search Techniques	Deletion.	and Linked List		Array
S-6	SLO-1	Algorithms - Sorting	Applications of Linked List	Applications of Stack- Nested Function Calls	Binary Tree Traversal	Shortest Path Algorithm- Introduction
	SLO-2	Complexity – Time , Space Trade off	Polynomial Arithmetic	Recursion concept using stack	Threaded Binary Tree	Shortest Path Algorithm: Dijkstra's Algorithm
S-7	SLO-1	Mathematical notations	Cursor Based Implementation – Methodology	Applications of Recursion: Tower of Hanoi	Binary Search Tree :Construction, Searching	Hashing: Hash functions - Introduction

	SLO-2	*Asymptotic notations-Big O, Omega*	*Cursor Based Implementation*	*Queue ADT*	*Binary Search Tree : Insertion and Deletion*	*Hashing: Hash functions*
S-8	SLO-1	*Asymptotic notations - Theta*	*Circular Linked List*	*Queue Implementation using array*	*AVL Trees: Rotations*	*Hashing : Collision avoidance*
	SLO-2	*Mathematical functions*	*Circular Linked List - Implementation*	*Queue Implementation using Linked List*	*AVL Tree: Insertions*	*Hashing : Separate chaining*
S 9-10	SLO-1	*Lab 2: Implementation of sorting Techniques – Insertion sort and Bubble Sort Techniques*	*Lab 5: Implementation of Linked List - Cursor Based Implementation*	*Lab 8: Implementation of Queue using Array and linked list*	*Lab 11: Implementation of BST using linked list*	*Lab 14 :Implementation of Shortest path Algorithm*
	SLO-2					
S-11	SLO-1	*Data Structures and its Types*	*Applications of Circular List -Joseph Problem*	*Circular Queue*	*B-Trees Constructions*	*Open Addressing*
	SLO-2	*Linear and Non-Linear Data Structures*	*Doubly Linked List*	*Implementation of Circular Queue*	*B-Trees Search*	*Linear Probing*
S-12	SLO-1	*1D, 2D Array Initialization using Pointers*	*Doubly Linked List Insertion*	*Applications of Queue*	*B-Trees Deletions*	*Quadratic probing*
	SLO-2	*1D, 2D Array Accessing using Pointers*	*Doubly Linked List Insertion variations*	*Double ended queue*	*Splay Trees*	*Double Hashing*
S-13	SLO-1	*Declaring Structure and accessing*	*Doubly Linked List Deletion*	*Priority Queue*	*Red Black Trees*	*Rehashing*
	SLO-2	*Declaring Arrays of Structures and accessing*	*Doubly Linked List Search*	*Priority Queue - Applications*	*Red Black Trees Insertion*	*Extensible Hashing*
S 14-15	SLO-1	*Lab 3: Implement Structures using Pointers*	*Lab 6: Implementation of Doubly linked List*	*Lab 9: Applications of Stack, Queue*	*Lab 12:Implementation of B-Trees*	*Lab 15 :Implementation of Minimal Spanning Tree*
	SLO-2					

Learning Resources	1. *Seymour Lipschutz, Data Structures with C, McGraw Hill, 2014* 2. *R.F.Gilberg, B.A.Forouzan, Data Structures, 2nd ed., Thomson India, 2005* 3. *A.V.Aho, J.E Hopcroft , J.D.Ullman, Data structures and Algorithms, Pearson Education, 2003* 4. *Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd ed., Pearson Education, 2015*	5. *Reema Thareja, Data Structures Using C, 1st ed., Oxford Higher Education, 2011* 6. *Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, Introduction to Algorithms 3rd ed., The MIT Press Cambridge, 2014*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Nagaveer, CEO, Campus Corporate Connect, nagaveer@campuscorporateconnect.com	*1. Dr. Srinivasa Rao Bakshi, IITM, Chennai, sbakshi@iitm.ac.in*	*1. Mr. K. Venkatesh, SRMIST*
2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	*2. Dr. Ramesh Babu, N , nrbabu@iitm.ac.in*	*2. Dr.Subalalitha C.N, SRMIST*
	3. Dr.Noor Mahammad, IIITDM, Kancheepuram, noor@iiitdm.ac.in	*3. Ms. Ferni Ukrit, SRMIST*

Course Code	18CSC202J	Course Name	OBJECT ORIENTED DESIGN AND PROGRAMMING	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	18CSS101J	Co-requisite Courses	Nil	Progressive Courses	18CSC207J
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize class and build domain model for real-time programs	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Utilize method overloading and operator overloading for real-time application development programs			
CLR-3 :	Utilize inline, friend and virtual functions and create application development programs			
CLR-4 :	Utilize exceptional handling and collections for real-time object oriented programming applications			
CLR-5 :	Construct UML component diagram and deployment diagram for design of applications			
CLR-6 :	Create programs using object oriented approach and design methodologies for real-time application development			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Identify the class and build domain model	3	80	70	H	H	M	-	-	-	-	-	H	H	-	-	M	H	H
CLO-2 :	Construct programs using method overloading and operator overloading	3	85	75	H	H	H	H	H	-	M	-	H	H	-	-	M	H	H
CLO-3 :	Create programs using inline, friend and virtual functions, construct programs using standard templates	3	75	70	H	H	M	H	H	-	M	-	H	H	-	-	M	H	H
CLO-4 :	Construct programs using exceptional handling and collections	3	85	80	H	H	H	-	-	-	-	-	H	M	-	-	M	H	H
CLO-5 :	Create UML component diagram and deployment diagram	3	85	75	H	M	M	M	M	M	M	-	H	H	-	M	M	H	H
CLO-6 :	Create programs using object oriented approach and design methodologies	3	80	70	H	H	M	-	-	-	-	-	H	H	-	-	M	H	H

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Comparison of Procedural and Object Oriented Programming	Types of constructor (Default, Parameter)	Feature Inheritance: Single and Multiple	Generic - Templates : Introduction	STL: Containers: Sequence and Associative Container
	SLO-2	OOPS and its features	Static constructor and copy constructor	Inheritance: Multilevel	Function templates	
S-2	SLO-1	I/O Operations, Data Types, Variables, static	Feature Polymorphism: Constructor overloading	Inheritance: Hierarchical	Example programs Function templates	Sequence Container: Vector, List
	SLO-2	Constants, Pointers, Type Conversions	Method Overloading	Inheritance: Hybrid	Class Templates	Sequence Container: Deque, Array
S-3	SLO-1	Features: Class and Objects	Example for method overloading	Inheritance: Example Programs	Class Templates	STL : Stack
	SLO-2	UML Diagrams Introduction	Method Overloading: Different parameter with different return values		Example programs for Class and Function templates	
S 4-5	SLO-1	Lab 1: I/O operations	Lab 4: Constructor and Method overloading	Lab 7: Inheritance and its types	Lab 10: Templates	Lab 13: STL Containers
	SLO-2					
S-6	SLO-1	Feature :Class and Objects	Operator Overloading and types	Advanced Functions: Inline, Friend	Exceptional Handling: try and catch	Associative Containers: Map, Multimap
	SLO-2	Examples of Class and Objects	Overloading Assignment Operator	Advanced Functions: Virtual, Overriding	Exceptional Handling: Multilevel exceptional	
S-7	SLO-1	UML Class Diagram and its components	Overloading Unary Operators	Advanced Function: Pure Virtual function	Exceptional Handling: throw and throws	Iterator and Specialized iterator
	SLO-2	Class Diagram relations and Multiplicity	Example for Unary Operator overloading	Example for Virtual and pure virtual function	Exceptional Handling: finally	Functions of iterator

S-8	SLO-1	*Feature Abstraction and Encapsulation*	*Overloading Binary Operators*	*Abstract class and Interface*	*Exceptional Handling: User defined exceptional*	*Algorithms: find(), count(), sort()*
	SLO-2	*Application of Abstraction and Encapsulation*	*Example for Binary Operator overloading*	*Example Program*	*Example Programs using C++*	*Algorithms: search(), merge()*
S 9-10	SLO-1	*Lab 2: Classes and Objects, Class Diagram*	*Lab 5: Polymorphism : Operators Overloading*	*Lab 8: Virtual Function and Abstract class*	*Lab 11: Exceptional Handling*	*Lab 15: STL Associative containers and algorithms*
	SLO-2					
S-11	SLO-1	*Access specifiers – public, private*	*UML Interaction Diagrams*	*UML State Chart Diagram*	*Dynamic Modeling: Package Diagram*	*Function Object : for_each(), transform()*
	SLO-2	*Access specifiers - protected, friend, inline*	*Sequence Diagram*	*UML State Chart Diagram*	*UML Component Diagram*	*Example for Algorithms*
S-12	SLO-1	*UML use case Diagram, use case, Scenario*	*Collaboration Diagram*	*Example State Chart Diagram*	*UML Component Diagram*	*Streams and Files: Introduction*
	SLO-2	*Use case Diagram objects and relations*	*Example Diagram*	*UML Activity Diagram*	*UML Deployment Diagram*	*Classes and Errors*
S-13	SLO-1	*Method, Constructor and Destructor*	*Feature: Inheritance*	*UML Activity Diagram*	*UML Deployment Diagram*	*Disk File Handling Reading Data and Writing Data*
	SLO-2	*Example program for constructor*	*Inheritance and its types*	*Example Activity Diagram*	*Example Package, Deployment, Package*	
S 14-15	SLO-1	*Lab 3: Methods and Constructor, Usecase*	*Lab 6: UML Interaction Diagram*	*Lab 9: State Chart and Activity Diagram*	*Lab12 : UML Component, Deployment, Package diagram*	*Lab15: Streams and File Handling*
	SLO-2					

Learning Resources	1. *Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Object-Oriented Analysis and Design with Applications, 3rd ed., Addison-Wesley, May 2007* 2. *Reema Thareja, Object Oriented Programming with C++, 1st ed., Oxford University Press, 2015* 3. *Sourav Sahay, Object Oriented Programming with C++, 2nd ed., Oxford University Press, 2017*	4. *Robert Lafore, Object-Oriented Programming in C++, 4th ed., SAMS Publishing, 2008* 5. *Ali Bahrami, Object Oriented Systems Development", McGraw Hill, 2004* 6. *Craig Larmen, Applying UML and Patterns, 3rd ed., Prentice Hall, 2004*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc

For the laboratory component the students are advised to take an application and apply the concepts

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Girish Raghavan, Senior DMTS Member, Wipro Ltd.	*1. Dr. Srinivasa Rao Bakshi, IITM Chennai, sbakshi@iitm.ac.in*	*1. Ms. C.G.Anupama, SRMIST*
Ms. Thamilchelvi, Solutions Architect, Wipro Ltd	*2. Dr. Ramesh Babu, N, IITM Chennai, nrbabu@iitm.ac.in*	*2. Mr. C.Arun, SRMIST*
		3. Mr. Geogen George, SRMIST
		4. Mr. Muthukumaran, SRMIST

Course Code	18CSC203J	Course Name	COMPUTER ORGANIZATION AND ARCHITECTURE	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	18CSC207J
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize the functional units of a computer	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Analyze the functions of arithmetic Units like adders, multipliers etc.			
CLR-3 :	Understand the concepts of Pipelining and basic processing units			
CLR-4 :	Study about parallel processing and performance considerations.			
CLR-5 :	Have a detailed study on Input-Output organization and Memory Systems.			
CLR-6 :	Simulate simple fundamental units like half adder, full adder etc			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Identify the computer hardware and how software interacts with computer hardware	2	80	70	H	H	-	-	-	-	-	-	M	L	-	M	-	-	-
CLO-2 :	Apply Boolean algebra as related to designing computer logic, through simple combinational and sequential logic circuits	3	85	75	H	H	H	-	H	-	-	-	M	L	-	M	-	-	-
CLO-3 :	Analyze the detailed operation of Basic Processing units and the performance of Pipelining	2	75	70	H	H	H	H	-	-	-	-	M	L	-	M	-	-	-
CLO-4 :	Analyze concepts of parallelism and multi-core processors.	3	85	80	H	-	-	H	-	-	-	-	M	L	-	M	-	-	-
CLO-5 :	Identify the memory technologies, input-output systems and evaluate the performance of memory system	3	85	75	H	-	H	H	-	-	-	-	M	L	-	M	-	-	-
CLO-6 :	Identify the computer hardware, software and its interactions	3	85	75	H	H	H	H	H	-	-	-	M	L	-	M	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Functional Units of a computer	Addition and subtraction of Signed numbers	Fundamental concepts of basic processing unit	Parallelism	Memory systems -Basic Concepts
	SLO-2	Operational concepts	Problem solving	Performing ALU operation	Need, types of Parallelism	Memory hierarchy
S-2	SLO-1	Bus structures	Design of fast adders	Execution of complete instruction, Branch instruction	applications of Parallelism	Memory technologies
	SLO-2	Memory locations and addresses	Ripple carry adder and Carry look ahead adder	Multiple bus organization	Parallelism in Software	RAM, Semiconductor RAM
S-3	SLO-1	Memory operations	Multiplication of positive numbers	Hardwired control	Instruction level parallelism	ROM,Types
	SLO-2	Memory operations	Problem Solving	Generation of control signals	Data level parallelism	Speed,size cost
S 4-5	SLO-1	Lab 1: To recognize various components of PC- Input Output systems Processing and Memory units	Lab4:Study of TASM Addition and Subtraction of 8-bit number	Lab-7: Design of Half Adder Design of Full Adder	Lab-10: Study of Array Multiplier Design of Array Multiplier	Lab-13: Study of Carry Save Multiplication Program to carry out Carry Save Multiplication
	SLO-2					
S-6	SLO-1	Instructions, Instruction sequencing	Signed operand multiplication	Micro-programmed control-	Challenges in parallel processing	Cache memory
	SLO-2	Addressing modes	Problem solving	Microinstruction	Architectures of Parallel Systems - Flynn's classification	Mapping Functions
S-7	SLO-1	Problem solving	Fast multiplication- Bit pair recoding of Multipliers	Micro-program Sequencing	SISD,SIMD	Replacement Algorithms

	SLO-2	*Introduction to Microprocessor*	*Problem Solving*	*Micro instruction with Next address field*	*MIMD, MISD*	*Problem Solving*
S-8	SLO-1	*Introduction to Assembly language*	*Carry Save Addition of summands*	*Basic concepts of pipelining*	*Hardware multithreading*	*Virtual Memory*
	SLO-2	*Writing of assembly language programming*	*Problem Solving*	*Pipeline Performance*	*Coarse Grain parallelism, Fine Grain parallelism*	*Performance considerations of various memories*
S 9-10	SLO-1	*Lab-2:To understand how different components of PC are connected to work properly Assembling of System Components*	*Lab 5: Addition of 16-bit number Subtraction of 16-bit number*	*Lab-8: Study of Ripple Carry Adder Design of Ripple Carry Adder*	*Lab-11: Study of Booth Algorithm*	*Lab-14: Understanding Processing unit Design of primitive processing unit*
	SLO-2					
S-11	SLO-1	*ARM Processor: The thumb instruction set*	*Integer division – Restoring Division*	*Pipeline Hazards-Data hazards*	*Uni-processor and Multiprocessors*	*Input Output Organization*
	SLO-2	*Processor and CPU cores*	*Solving Problems*	*Methods to overcome Data hazards*	*Multi-core processors*	*Need for Input output devices*
S-12	SLO-1	*Instruction Encoding format*	*Non Restoring Division*	*Instruction Hazards*	*Multi-core processors*	*Memory mapped IO*
	SLO-2	*Memory load and Store instruction in ARM*	*Solving Problems*	*Hazards on conditional and Unconditional Branching*	*Memory in Multiprocessor Systems*	*Program controlled IO*
S-13	SLO-1	*Basics of IO operations.*	*Floating point numbers and operations*	*Control hazards*	*Cache Coherency in Multiprocessor Systems*	*Interrupts-Hardware, Enabling and Disabling Interrupts*
	SLO-2	*Basics of IO operations.*	*Solving Problems*	*Influence of hazards on instruction sets*	*MESI protocol for Multiprocessor Systems*	*Handling multiple Devices*
S 14-15	SLO-1	*Lab -3To understand how different components of PC are connected to work properly Disassembling of System Components*	*Lab-6: Multiplication of 8-bit number Factorial of a given number*	*Lab-9: Study of Carry Look-ahead Adder Design of Carry Look-ahead Adder*	*Lab-12: Program to carry out Booth Algorithm*	*Lab-15: Understanding Pipeline concepts Design of basic pipeline.*
	SLO-2					

Learning Resources	1. *Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5th ed., McGraw-Hill, 2015* 2. *Kai Hwang, Faye A. Briggs, Computer Architecture and Parallel Processing", 3rd ed., McGraw Hill, 2016* 3. *Ghosh T. K., Computer Organization and Architecture, 3rd ed., Tata McGraw-Hill, 2011* 4. *P. Hayes, Computer Architecture and Organization, 3rd ed., McGraw Hill, 2015.*	5. *William Stallings, Computer Organization and Architecture – Designing for Performance, 10th ed., Pearson Education, 2015* 6. *David A. Patterson and John L. Hennessy Computer Organization and Design - A Hardware software interface, 5th ed., Morgan Kaufmann,2014*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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		2. Dr. C. Malathy, SRMIST
		3. Mrs M.S.Abirami, SRMIST

Course Code	18CSC204J	Course Name	DESIGN AND ANALYSIS OF ALGORITHMS	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	18CSC201J, 18CSC202J	Co-requisite Courses	18CSC207J	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Design efficient algorithms in solving complex real time problems	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Analyze various algorithm design techniques to solve real time problems in polynomial time			
CLR-3 :	Utilize various approaches to solve greedy and dynamic algorithms			
CLR-4 :	Utilize back tracking and branch and bound paradigms to solve exponential time problems			
CLR-5 :	Analyze the need of approximation and randomization algorithms, utilize the importance Non polynomial algorithms			
CLR-6 :	Construct algorithms that are efficient in space and time complexities			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	Apply efficient algorithms to reduce space and time complexity of both recurrent and non-recurrent relations	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Solve problems using divide and conquer approaches	3	85	75	M	H	L	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Apply greedy and dynamic programming types techniques to solve polynomial time problems.	3	75	70	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Create exponential problems using backtracking and branch and bound approaches.	3	85	80	M	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Interpret various approximation algorithms and interpret solutions to evaluate P type, NP Type, NPC, NP Hard problems	3	85	75	H	H	M	H	L	-	-	-	M	L	-	H	-	-	-
CLO-6 :	Create algorithms that are efficient in space and time complexities by using divide conquer, greedy, backtracking technique	3	80	70	L	H	M	H	L	-	-	-	L	L	-	H	-	-	-
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Introduction-Algorithm Design	Introduction-Divide and Conquer	Introduction-Greedy and Dynamic Programming	Introduction to backtracking - branch and bound	Introduction to randomization and approximation algorithm
	SLO-2	Fundamentals of Algorithms	Maximum Subarray Problem	Examples of problems that can be solved by using greedy and dynamic approach	N queen's problem - backtracking	Randomized hiring problem
S-2	SLO-1	Correctness of algorithm	Binary Search	Huffman coding using greedy approach	Sum of subsets using backtracking	Randomized quick sort
	SLO-2	Time complexity analysis	Complexity of binary search	Comparison of brute force and Huffman method of encoding	Complexity calculation of sum of subsets	Complexity analysis
S-3	SLO-1	Insertion sort-Line count, Operation count	Merge sort	Knapsack problem using greedy approach	Graph introduction	String matching algorithm
	SLO-2	Algorithm Design paradigms	Time complexity analysis	Complexity derivation of knapsack using greedy	Hamiltonian circuit - backtracking	Examples
S 4-5	SLO-1	Lab 1: Simple Algorithm-Insertion sort	Lab 4: Quicksort, Binary search	Lab 7: Huffman coding, knapsack and using greedy	Lab 10: N queen's problem	Lab 13: Randomized quick sort
	SLO-2					
S-6	SLO-1	Designing an algorithm	Quick sort and its Time complexity analysis	Tree traversals	Branch and bound - Knapsack problem	Rabin Karp algorithm for string matching
	SLO-2	And its analysis-Best, Worst and Average case	Best case, Worst case, Average case analysis	Minimum spanning tree – greedy Kruskal's algorithm - greedy	Example and complexity calculation. Differentiate with dynamic and greedy	Example discussion
S-7	SLO-1	Asymptotic notations Based on growth functions.	Strassen's Matrix multiplication and its recurrence relation	Minimum spanning tree - Prims algorithm	Travelling salesman problem using branch and bound	Approximation algorithm

	SLO-2	*O,O,Θ, ω, Ω*	*Time complexity analysis of Merge sort*	*Introduction to dynamic programming*	*Travelling salesman problem using branch and bound example*	*Vertex covering*
S-8	SLO-1	*Mathematical analysis*	*Largest sub-array sum*	*0/1 knapsack problem*	*Travelling salesman problem using branch and bound example*	*Introduction Complexity classes*
	SLO-2	*Induction, Recurrence relations*	*Time complexity analysis of Largest sub-array sum*	*Complexity calculation of knapsack problem*	*Time complexity calculation with an example*	*P type problems*
S 9-10	SLO-1	*Lab 2: Bubble Sort*	*Lab 5: Strassen Matrix multiplication*	*Lab 8: Various tree traversals, Krukshall's MST*	*Lab 11: Travelling salesman problem*	*Lab 14: String matching algorithms*
	SLO-2					
S-11	SLO-1	*Solution of recurrence relations*	*Master Theorem Proof*	*Matrix chain multiplication using dynamic programming*	*Graph algorithms*	*Introduction to NP type problems*
	SLO-2	*Substitution method*	*Master theorem examples*	*Complexity of matrix chain multiplication*	*Depth first search and Breadth first search*	*Hamiltonian cycle problem*
S-12	SLO-1	*Solution of recurrence relations*	*Finding Maximum and Minimum in an array*	*Longest common subsequence using dynamic programming*	*Shortest path introduction*	*NP complete problem introduction*
	SLO-2	*Recursion tree*	*Time complexity analysis-Examples*	*Explanation of LCS with an example*	*Floyd-Warshall Introduction*	*Satisfiability problem*
S-13	SLO-1	*Solution of recurrence relations*	*Algorithm for finding closest pair problem*	*Optimal binary search tree (OBST)using dynamic programming*	*Floyd-Warshall with sample graph*	*NP hard problems*
	SLO-2	*Examples*	*Convex Hull problem*	*Explanation of OBST with an example.*	*Floyd-Warshall complexity*	*Examples*
S 14-15	SLO-1	*Lab 3: Recurrence Type-Merge sort, Linear search*	*Lab 6: Finding Maximum and Minimum in an array, Convex Hull problem*	*Lab 9: Longest common subsequence*	*Lab 12: BFS and DFS implementation with array*	*Lab 15: Discussion over analyzing a real time problem*
	SLO-2					

Learning Resources	1. *Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, Introduction to Algorithms, 3rd ed., The MIT Press Cambridge, 2014* 2. *Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd ed., Pearson Education, 2006*	3. *Ellis Horowitz, Sartajsahni, Sanguthevar, Rajesekaran, Fundamentals of Computer Algorithms, Galgotia Publication, 2010* 4. *S. Sridhar, Design and Analysis of Algorithms, Oxford University Press, 2015*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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		3. Mr. V. Sivakumar, SRMIST
		4. Ms. R. Vidhya, SRMIST

Course Code	18CSC205J	Course Name	OPERATING SYSTEMS	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Introduce the key role of an Operating system			
CLR-2 :	Insist the Process Management functions of an Operating system			
CLR-3 :	Emphasize the importance of Memory Management concepts of an Operating system			
CLR-4 :	Realize the significance of Device Management part of an Operating system			
CLR-5 :	Comprehend the need of File Management functions of an Operating system			
CLR-6 :	Explore the services offered by the Operating system practically			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Identify the need of an Operating system	1	80	70	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-2 :	Know the Process management functions of an Operating system	1	85	75	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-3 :	Understand the need of Memory Management functions of an Operating system	1	75	70	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-4 :	Find the significance of Device management role of an Operating system	2	85	80	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-5 :	Recognize the essentials of File Management part of an Operating system	2	85	75	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-6 :	Gain an insight of Importance of an Operating system through practical	3	80	70	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Operating System Objectives and functions	PROCESS SYNCHRONIZATION : Peterson's solution, Synchronization Hardware	MEMORY MANAGEMENT: Memory Management: Logical Vs Physical address space, Swapping	VIRTUAL MEMORY– Background	STORAGE MANAGEMENT : Mass storage structure – Overview of Mass storage structure – Magnetic Disks
	SLO-2	Gaining the role of Operating systems	Understanding the two-process solution and the benefits of the synchronization hardware	Understanding the basics of Memory management	Understanding the need of demand paging	Understanding the Basics in storage management
S-2	SLO-1	The evolution of operating system, Major achievements	Process synchronization: Semaphores, usage, implementation	Contiguous Memory allocation – Fixed and Dynamic partition	VIRTUAL MEMORY – Basic concepts – page fault handling	Disk Scheduling
	SLO-2	Understanding the evolution of Operating systems from early batch processing systems to modern complex systems	Gaining the knowledge of the usage of the semaphores for the Mutual exclusion mechanisms	Getting to know about Partition memory management and issues: Internal fragmentation and external fragmentation problems	Understanding , how an OS handles the page faults	Understanding the various scheduling with respect to the disk
S-3	SLO-1	OS Design considerations for Multiprocessor and Multicore	Classical Problems of synchronization – Readers writers problem, Bounded Buffer problem	Strategies for selecting free holes in Dynamic partition	Performance of Demand paging	FILE SYSTEM INTERFACE: File concept, File access methods
	SLO-2	Understanding the key design issues of Multiprocessor Operating systems and	Good understanding of synchronization mechanisms	Understanding the allocation strategies with examples	Understanding the relationship of effective access time and the page fault rate	Understanding the file basics

		Multicore Operating systems				
S 4-5	SLO-1	*LAB 1 : Understanding the booting process of Linux*	*LAB4 : System admin commands – Basics*	*LAB7: Shell Programs – Basic level*	*LAB10 : Overlay concept*	*LAB13:Process synchronization*
	SLO-2					
S-6	SLO-1	*PROCESS CONCEPT– Processes, PCB*	*Classical Problems of synchronization – Dining Philosophers problem (Monitor)*	*Paged memory management*	*Copy-on write*	*File sharing and Protection*
	SLO-2	*Understanding the Process concept and Maintanance of PCB by OS*	*Understanding synchronization of limited resources among multiple processes*	*Understanding the Paging technique.PMT hardware mechanism*	*Understanding the need for Copy-on write*	*Emphasis the need for the file sharing and its protection*
S-7	SLO-1	*Threads – Overview and its Benefits*	*CPU SCHEDULING : FCFS,SJF,Priority*	*Structure of Page Map Table*	*Page replacement Mechanisms: FIFO, Optimal, LRU and LRU approximation Techniques*	*FILE SYSTEM IMPLEMENTATION : File system structure*
	SLO-2	*Understanding the importance of threads*	*Understanding the scheduling techniques*	*Understanding the components of PMT*	*Understanding the Pros and cons of the page replacement techniques*	*To get the basic file system structure*
S-8	SLO-1	*Process Scheduling : Scheduling Queues, Schedulers, Context switch*	*CPU Scheduling: Round robin, Multilevel queue Scheduling, Multilevel feedback Scheduling*	*Example : Intel 32 bit and 64 –bit Architectures*	*Counting based page replacement and Page Buffering Algorithms*	*Directory Implementation*
	SLO-2	*Understanding basics of Process scheduling*	*Understanding the scheduling techniques*	*Understanding the Paging in the Intel architectures*	*To know on additional Techniques available for page replacement strategies*	*Understanding the various levels of directory structure*
S 9-10	SLO-1	*LAB2 : Understanding the Linux file system*	*LAB5: System admin commands – Simple task automations*	*LAB 8: Process Creation*	*LAB11: IPC using Pipes*	*LAB14 : Study of OS161*
	SLO-2					
S-11	SLO-1	*Operations on Process – Process creation, Process termination*	*Real Time scheduling: Rate Monotonic Scheduling and Deadline Scheduling*	*Example : ARM Architectures*	*Allocation of Frames - Global Vs Local Allocation*	*FILE SYSTEM IMPLEMENTATION :Allocation methods*
	SLO-2	*Understanding the system calls – fork(),wait(),exit()*	*Understanding the real time scheduling*	*Understanding the Paging with respect to ARM*	*Understanding the root cause of the Thrashing*	*Understanding the pros and Cons of various disk allocation methods*
S-12	SLO-1	*Inter Process communication : Shared Memory, Message Passing ,Pipe()*	*DEADLOCKS: Necessary conditions, Resource allocation graph, Deadlock prevention methods*	*Segmented memory management*	*Thrashing, Causes of Thrashing*	*FILE SYSTEM IMPLEMENTATION :Free space Management*
	SLO-2	*Understanding the need for IPC*	*Understanding the deadlock scenario*	*Understanding the users view of memory with respect to the primary memory*	*Understanding the Thrashing*	*Understanding the methods available for maintaining the free spaces in the disk*
S-13	SLO-1	*PROCESS SYNCHRONIZATION: Background, Critical section Problem*	*Deadlocks :Deadlock Avoidance, Detection and Recovery*	*Paged segmentation Technique*	*Working set Model*	*Swap space Management*
	SLO-2	*Understanding the race conditions and the need for the Process synchronization*	*Understanding the deadlock avoidance, detection and recovery mechanisms*	*Understanding the combined scheme for efficient management*	*Understanding the working set model for controlling the Working set Model*	*Understanding the Low-level task of the OS*
S 14-15	SLO-1	*LAB3: Understanding the various Phases of Compilation of a 'C' Program*	*LAB6 : Linux commands*	*LAB9: Overlay concept*	*LAB12: IPC using shared memory and Message queues*	*LAB15 : Understanding the OS161 filesystem and working with test programs*
	SLO-2					

Learning Resources	1. *Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating systems, 9th ed., John Wiley & Sons, 2013* 2. *William Stallings, Operating Systems-Internals and Design Principles, 7th ed., Prentice Hall, 2012*	3. *Andrew S. Tanenbaum, Herbert Bos, Modern Operating systems, 4th ed., Pearson, 2015* 4. *Bryant O'Hallaxn, Computer systems- A Programmer's Perspective, Pearson, 2015*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Mr. Balamurugan, Infosys, balams@gmail.com	*1. Dr. Latha Parthiban, Pondicherry University, lathaparthiban@yahoo.com*	*1. Dr.G.Maragatham, SRMIST*	*3. Ms. Aruna S, SRMIST*
		2. Mr. Eliazer M, SRMIST	

Course Code	18CSC206J	Course Name	SOFTWARE ENGINEERING AND PROJECT MANAGEMENT	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Familiarize the software life cycle models and software development process			
CLR-2 :	Understand the various techniques for requirements, planning and managing a technology project			
CLR-3 :	Examine basic methodologies for software design, development, testing, closure and implementation			
CLR-4 :	Understand manage users expectations and the software development team			
CLR-5 :	Acquire the latest industry knowledge, tools and comply to the latest global standards for project management			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Identify the process of project life cycle model and process	1	85	80	H	H	L	-	-	-	L	-	H	H	M	M	-	-	-
CLO-2 :	Analyze and specify software requirements through a productive working Relationship with project stakeholders	2	80	75	H	H	H	H	H	-	M	-	H	H	H-	M	-	-	-
CLO-3 :	Design the system based on Functional Oriented and Object Oriented Approach for Software Design.	3	85	85	H	H	M	H	H	M	M	L	H	H	M	-	-	-	-
CLO-4 :	Develop the correct and robust code for the software products	3	85	85	H	H	H	-	H	-	-	M	H	M	H	-	-	-	-
CLO-5 :	Perform by applying the test plan and various testing techniques	2	85	75	H	M	M	M	M	M	M	-	H	H	-	M	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Introduction to Software Engineering	Software Design - Software Design Fundamentals	Software Construction	Introduction to testing	Product Release
	SLO-2	Software Project Management - life cycle activities	Design Standards - Design Type	Coding Standards	Verification	Product Release
S-2	SLO-1	Traditional – Waterfall, V Model	Design model – Architectural design, Software architecture	Coding Framework	Validation	Product Release Management
	SLO-2	Prototype, Spiral, RAD	Software Design Methods	Reviews - Desk checks (Peer Reviews)	Test Strategy	Product Release Management
S-3	SLO-1	Conventional – Agile,	Top Down , Bottom Up	Walkthroughs	Planning	Implementation
	SLO-2	XP, Scrum	Module Division (Refactoring)	Code Reviews, Inspections	Example: Test Strategy and Planning	Implementation
S 4-5	SLO-1	Lab1:Identify the Software Project, Create Business Case, Arrive at a Problem Statement	Lab 4:Prepare Project Plan based on scope, Find Job roles and responsibilities, Calculate Project effort based on resources	Lab 7:State and Sequence Diagram, Deployment Diagram, Sample Frontend Design (UI/UX)	Lab 10: Module Implementation (Phase 2), Scrum Master to Induce New Issues in Agile Development	Lab 13:Manual Testing
	SLO-2					
S-6	SLO-1	Introduction to Requirement Engineering	Module Coupling	Coding Methods	Test Project Monitoring and Control	User Training
	SLO-2	Requirements Elicitation	Component level design	Structured Programming	Test Project Monitoring and Control	Maintenance Introduction
S-7	SLO-1	Software Project Effort and cost estimation	User Interface Design	Object-Oriented Programming	Test Project Monitoring and Control	Maintenance Types - Corrective
	SLO-2	Cost estimation	Pattern oriented design	Automatic Code Generation	Test Project Monitoring and Control	Adaptive
S-8	SLO-1	Cocomo 1 and 2	Web application design	Automatic Code Generation	Test Project Monitoring and Control	Perfective
	SLO-2	Cocomo 1 and 2	Web application design	Automatic Code Generation	Test Project Monitoring and Control	Preventive

S 9-10	SLO-1 SLO-2	*Lab 2:Stakeholder and User Description, Identify the appropriate Process Model, Comparative study with Agile Model*	*Lab 5:Prepare the Work, Breakdown Structure based on timelines, Risk Identification and Plan*	*Lab 8:Module Description, Module Implementation (phase 1) Using Agile*	*Lab 11:Module Implementation (Phase 3) Scrum Master to Induce New requirements in Agile Development, Scrum Master to Induce New Issues in Agile Development, Code Documentation*	*Lab 14:User Manual, Analysis of Costing, Effort and Resources*
S-11	SLO-1	*Risk Management*	*Design Reuse*	*Software Code Reuse*	*Design –Master test plan, types*	*Maintenance Cost*
	SLO-2	*Risk Management*	*Design Reuse*	*Software Code Reuse*	*Design –Master test plan, types*	*Maintenance Process*
S-12	SLO-1	*Configuration management*	*Concurrent Engineering in Software Design*	*Pair Programming*	*Test Case Management*	*life cycle*
	SLO-2	*Configuration management*	*Concurrent Engineering in Software Design*	*Test-Driven Development*	*Test Case Management*	*Software Release*
S-13	SLO-1	*Project Planning – WBC, planning,*	*Design Life-Cycle Management*	*Configuration Management*	*Test Case Reporting*	*Software Maintenance*
	SLO-2	*scope, risk*	*Design Life-Cycle Management*	*Software Construction Artifacts*	*Test Case Reporting*	*Software Release, Software Maintenance*
S 14-15	SLO-1 SLO-2	*Lab 3:Identify the Requirements, System Requirements, Functional Requirements, Non-Functional Requirements*	*Lab 6:Design a System Architecture, Use Case Diagram, ER Diagram (Database), DFD Diagram (process) (Upto Level 1), Class Diagram (Applied For OOPS based Project), Collaboration Diagram (Applied For OOPS based Project) (Software – Rational Rose)*	*Lab 9:Module Implementation, Scrum Master to Induce New requirements in Agile Development*	*Lab 12:Master Test Plan, Test Case Design (Phase 1)*	*Lab 15: Project Demo and Report Submission with the team*

Learning Resources	1. *Roger S. Pressman, Software Engineering – A Practitioner Approach, 6th ed., McGraw Hill, 2005* 2. *Ian Sommerville, Software Engineering, 8th ed., Pearson Education, 2010* 3. *Rajib Mall, Fundamentals of Software Engineering, 4th ed., PHI Learning Private Limited, 2014* 4. *Ramesh, Gopalaswamy, Managing Global Projects, Tata McGraw Hill, 2005*	5. *Ashfaque Ahmed, Software Project Management: a process-driven approach, Boca Raton, Fla: CRC Press, 2012* 6. *Walker Royce, Software Project Management, Pearson Education, 1999* 7. *Jim Smith Agile Project Management: Creating Innovative Products,Pearson 2008*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
Level 2	Apply Analyze	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
Level 3	Evaluate Create	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Girish Raghavan, Wipro Technologies	*1. Dr. Latha Parthiban, Pondicherry University, lathaparthiban@yahoo.com*	*1. Mrs. Sasi Rekha Sankar, SRMIST*
2. Dr.Mariappan Vaithilingam, *Amazon, Bangalore*	*2. V. Masilamani. IIITDM, masila@iiitdm.ac.in*	*2. Dr. T.S.Shiny Angel, SRMIST*
		3. Mr.N.Arivazhagan, SRMIST
		4. Mrs K.R.Jansi, SRMIST

Course Code	18CSC207J	Course Name	ADVANCED PROGRAMMING PRACTICE	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	18CSC202J	Co-requisite Courses	18CSC204J	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Create Real-time Application Programs using structured, procedural and object oriented programming paradigms			
CLR-2 :	Create Real-time Application Programs using event driven, declarative and imperative programming paradigms			
CLR-3 :	Create Real-time Application Programs using parallel, concurrent and functional programming paradigms			
CLR-4 :	Create Real-time Application Programs using logic, dependent type and network programming paradigms			
CLR-5 :	Create Real-time Application Programs using symbolic, automata based and graphical user interface program paradigm			
CLR-6 :	Create Real-time Application Programs using different programming paradigms using python language			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Create Programs using structured, procedural and object oriented programming paradigms	3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	M	-
CLO-2 :	Create Programs using event driven, declarative and imperative programming paradigms	3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-
CLO-3 :	Create Programs using parallel, concurrent and functional programming paradigms	3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-
CLO-4 :	Create Programs using logic, dependent type and network programming paradigms	3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-
CLO-5 :	Create Programs using symbolic, automata based and graphical user interface programming paradigms	3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-
CLO-6 :	Create Programs using different programming paradigms using python language	3	85	80	H	H	H	H	H	-	-	L	M	M	L	M	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	Structured Programming Paradigm	Event Driven Programming Paradigm	Parallel Programming Paradigm	Logic Programming Paradigm	Symbolic Programming Paradigm
	SLO-2	Programming Language Theory	Event Object, handler, bind	Multi-threading, Multi-Processing	First-class function, Higher-order function, Pure functions, Recursion	Symbolic Maths, algebraic manipulations, limits, differentiation, integration, series
S-2	SLO-1	Bohm-Jacopini structured program theorem	Keypress events, Mouse events	Serial Processing, Parallel Processing	Packages: Kanren, SymPy	SymPy usage for symbolic maths
	SLO-2	Sequence, selection, decision, iteration, recursion	Automatic events from a timer	Multiprocessing module in Python	PySWIP, PyDatalog	Equation Solving, Matrices
S-3	SLO-1	Other languages: C, C++, Java, C#, Ruby	Other languages: Algol, Javascript, Elm	Process class, Pool class	Other languages: Prolog, ROOP, Janus	Other languages: Aurora, LISP, Wolfram
	SLO-2	Demo: Structured Programing in Python	Demo: Event Driven Programming in Python	Demo: Parallel Programming in Python	Demo: Logic Programming in Python	Demo: Symbolic Programming in Python
S 4-5	SLO-1	Lab 1: Structured Programming	Lab 4: Event Driven Programming	Lab 7: Parallel Programming	Lab 10: Logic Programming	Lab 13: Symbolic Programming
	SLO-2					
S-6	SLO-1	Procedural Programming Paradigm	Declarative Programming Paradigm	Concurrent Programming Paradigm	Dependent Type Programming Paradigm	Automata Based Programming Paradigm
	SLO-2	Routines, Subroutines, functions	Sets of declarative statements	Parallel Vs Concurrent Programming	Logic Quantifier: for all, there exists	Finite State Machine, deterministic finite automation (dfa), nfa
S-7	SLO-1	Using Functions in Python	Object attribute, Binding behavior	threading, multiprocessing	Dependent functions, dependent pairs	State transitions using python-automaton
	SLO-2	logical view, control flow of procedural	Creating Events without describing flow	concurrent.futures, gevent, greenlets,	Relation between data and its computation	Initial state, destination state, event

		programming in various aspects		*celery*		*(transition)*
S-8	SLO-1	*Other languages: Bliss, ChucK, Matlab*	*Other languages: Prolog, Z3, LINQ, SQL*	*Other languages: ANI, Plaid*	*Other Languages: Idris, Agda, Coq*	*Other languages: Forth, Ragel, SCXML*
	SLO-2	*Demo: creating routines and subroutines using functions in Python*	*Demo: Declarative Programming in Python*	*Demo: Concurrent Programming in Python*	*Demo: Dependent Type Programming in Python*	*Demo: Automata Based Programming in Python*
S 9-10	SLO-1	*Lab 2: Procedural Programming*	*Lab 5: Declarative Programming*	*Lab 8: Concurrent Programming*	*Lab 11: Dependent Type Programming*	*Lab 14: Automata Programming*
	SLO-2					
S-11	SLO-1	*Object Oriented Programming Paradigm*	*Imperative Programming Paradigm*	*Functional Programming Paradigm*	*Network Programming Paradigm*	*GUI Programming Paradigm*
	SLO-2	*Class, Objects, Instances, Methods*	*Program State, Instructions to change the program state*	*Sequence of Commands*	*Socket Programming: TCP & UDP Connection oriented, connectionless*	*Graphical User Interface (GUI)*
S-12	SLO-1	*Encapsulation, Data Abstraction*	*Combining Algorithms and Data Structures*	*map(), reduce(), filter(), lambda*	*Sock_Stream, Sock_Dgram, socket(), bind(), recvfrom(), sendto(), listen()*	*Tkinter, WxPython, JPython*
	SLO-2	*Polymorphism, Inheritance*	*Imperative Vs Declarative Programming*	*partial, functools*	*Server-Client; send(), recv(), connect(), accept(), read(), write(), close()*	*WxWidgets, PyQT5*
S-13	SLO-1	*Constructor, Destructor*	*Other languages: PHP, Ruby, Perl, Swift*	*Other languages: F#, Clojure, Haskell*	*Other languages: PowerShell, Bash, TCL*	*Other languages: GTK, java-gnome*
	SLO-2	*Example Languages: BETA, Cecil, Lava Demo: OOP in Python*	*Demo: Imperative Programming in Python*	*Demo: Functional Programming in Python*	*Demo: Socket Programming in Python*	*Demo: GUI Programming in Python*
S 14-15	SLO-1	*Lab 3: Object Oriented Programming*	*Lab 6: Imperative Programming*	*Lab 9: Functional Programming*	*Lab 12: Network Programming*	*Lab 15: GUI Programming*
	SLO-2					

Learning Resources	1. *Elad Shalom, A Review of Programming Paradigms throughout the History: With a suggestion Toward a Future Approach, Kindle Edition, 2018* 2. *John Goerzen, Brandon Rhodes, Foundations of Python Network Programming: The comprehensive guide to building network applications with Python, 2nd ed., Kindle Edition, 2010* 3. *Elliot Forbes, Learning Concurrency in Python: Build highly efficient, robust and concurrent applications, Kindle Edition, 2017*	4. *Amit Saha, Doing Math with Python: Use Programming to Explore Algebra, Statistics, Calculus and More, Kindle Edition, 2015* 5. *Alan D Moore, Python GUI Programming with Tkinter: Develop responsive and powerful GUI applications with Tkinter, Kindle Edition, 2018* 6. *https://www.scipy-lectures.org/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Sagar Sahani, Amadeus Software Labs, Bangalore, hello.sagarsahni@gmail.com	*1. Dr. Rajeev Sukumaran, IIT Madras, rajeev@wmail.iitm.ac.in*	*1. Dr. R. Annie Uthra, SRMIST*
2. Mr. Janmajay Singh, Fuji Xerox R&D, Japan, janmajaysingh14@gmail.com	*2. Prof. R. Golda Brunet, GCE, goldabrunet@gcessalem.edu.in*	*2. Dr. Christhu Raj M R, SRMIST*
		3. Ms. K. Sornalakshmi, SRMIST
		4. Mr. C. Arun, SRMIST

ACADEMIC CURRICULA

Professional Core Courses

COMPUTER SCIENCE AND ENGINEERING

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18CSC301T	Course Name	FORMAL LANGUAGE AND AUTOMATA	Course Category	C	Professional Core	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Utilize the mathematics and engineering principles for the basics of Formal Language*			
CLR-2 :	*Acquire knowledge of Automata and minimize with Regular language's*			
CLR-3 :	*Acquire knowledge of Context free Grammar and simplify using normal forms*			
CLR-4 :	*Gain knowledge to push down automata and apply it with CFL*			
CLR-5 :	*Analyze the methods of turning machine*			
CLR-6 :	*Analyze and Design the methods of computational complexity*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge of mathematics and engineering principles for the basics of Formal Language*	*3*	*80*	*70*	*M*	*H*	*-*	*H*	*L*	*-*	*-*	*-*	*L*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-2 :	*Acquire the ability to identify specification of a Regular language's with Automata*	*3*	*85*	*75*	*M*	*H*	*L*	*M*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-3 :	*Acquire knowledge of Context free Grammar and simplify using normal forms*	*3*	*75*	*70*	*M*	*H*	*M*	*H*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-4 :	*Understand the concepts of push down automata and CFL.*	*3*	*85*	*80*	*M*	*H*	*M*	*H*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-5 :	*Apply the knowledge to turning machine and its methods*	*3*	*85*	*75*	*H*	*H*	*M*	*H*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-6 :	*Design the computational and acceptor machines using FA, PDA and Turing machines*	*3*	*80*	*70*	*L*	*H*	*-*	*H*	*L*	*-*	*-*	*-*	*L*	*L*	*-*	*H*	*-*	*-*	*-*

Duration (hour)		11	9	9	9	7
S-1	SLO-1	*Introduction to Automaton*	*Grammars: Introduction: Types of Grammar*	*Pushdown Automata: Definitions Moves*	*Turing Machines: Introduction*	*Undecidability :Basic definitions*
	SLO-2	*Mathematical concepts*	*Context Free Grammars and Languages*	*Instantaneous descriptions*	*Formal definition of Turing machines, Instantaneous descriptions*	*Decidable problems,*
S-2	SLO-1	*Formal Languages: Strings, Languages, Properties*	*Derivations*	*Deterministic pushdown automata*	*Turing Machine as Acceptors*	*Examples of undecidable problems and Problems*
	SLO-2	*Finite Representation : Regular Expressions*	*Ambiguity*	*Problems related to DPDA*	*Problems related to turning machine as Acceptors*	*Rice's Theorem*
S-3	SLO-1	*Problems related to regular expressions*	*Relationship between derivation and derivation trees*	*Non - Deterministic pushdown automata*	*Problems related to turning machine as Acceptors*	*Undecidable problems about Turing Machine- Post's Correspondence Problem*
	SLO-2	*Finite Automata :Deterministic Finite Automata*	*Problems related to Context free Grammar*	*Problems related to NDPDA*		*Problems related to Post's Correspondence Problem*
S-4	SLO-1	*Nondeterministic Finite Automata*	*Simplification of CFG : Elimination of Useless Symbols*	*Problems related to DPDA and NDPDA*	*Turing Machine as a Computing Device*	*Properties of Recursive and Recursively enumerable languages*
	SLO-2	*Finite Automaton with €- moves*			*Problems related to turning Turing Machine as a Computing Device*	
S-5	SLO-1	*Problems related to Deterministic and Nondeterministic Finite Automata*	*Simplification of CFG : Unit productions*	*Pushdown automata to CFL Equivalence*	*Problems related to turning Turing Machine as a Computing Device*	*Introduction to Computational Complexity: Definitions*
	SLO-2	*Problems related to Finite Automaton with €- moves*	*Simplification of CFG : Null productions*	*Problems related to Equivalence of PDA to CFG*		*Time and Space complexity of TMs*

Duration (hour)		11	9	9	9	7
S-6	SLO-1	*Equivalence of NFA and DFA*	*Problems related to Simplification of CFG*	*Problems related to Equivalence of PDA to CFG*	*Techniques for Turing Machine Construction*	*Complexity classes: Class P, Class NP*
	SLO-2	*Heuristics to Convert NFA to DFA*				
S-7	SLO-1	*Equivalence of NDFA's with and without €-moves*	*Chomsky normal form*	*CFL to Pushdown automata Equivalence*	*Considering the state as a tuple Considering the tape symbol as a tuple*	*Complexity classes: Introduction to NP-Hardness*
	SLO-2	*Problems related Equivalence of NDFA's with and without €-moves*	*Problems related to CNF*	*Problems related to Equivalence of CFG to PDA*	*Checking off symbols*	*NP Completeness*
S-8	SLO-1	*Minimization of DFA*	*Greiback Normal form*	*Pumping lemma for CFL*	*Modifications of Turing Machine*	
	SLO-2	*Problems related to Minimization of DFA*			*Multi-tape Turing Machine*	
S-9	SLO-1	*Regular Languages : Equivalence of Finite Automata and Regular Languages*	*Problems related to GNF*	*Problems based on pumping Lemma*	*Non-Deterministic Turing Machine*	
	SLO-2	*Equivalence of Finite Automata and Regular Grammars*			*Semi-Infinite Tape Turing Machine*	
S-10	SLO-1	*Problems related to Equivalence of Finite Automata and Regular Languages and Regular Grammars*				
	SLO-2	*Variants of Finite Automata :Two-way Finite Automaton Mealy Machines*				
S-11	SLO-1	*Properties of Regular Languages: Closure Properties*				
	SLO-2	*Set Theoretic Properties & Other Properties*				
	SLO-3	*Pumping Lemma*				

Learning Resources	
	1. *Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education, 2008.* 2. *Michael Sipser, "Introduction to the Theory of Computation" Cengage Learning, 2012.* 3. *.John.C.Martin, "Introduction to Languages and the Theory of Computation" McGraw-Hill Education, 01- May-2010.* 4. *Kamala Krithivasan, Rama.R," Introduction to Formal Languages, Automata Theory and Computation", Pearson Education India, 01-Sep-2009.* 5. *Peter Linz , "An introduction to formal languages and automata", Jones & Bartlett Learning, 2001.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. *Dr.R.AnnieUthra*
		2. *Dr.Jeyasudha*

Course Code	18CSC302J	Course Name	COMPUTER NETWORKS	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Describe the importance of various Internet protocols like ARP, RARP, ICMP, Multicasting and multi routing, SCTP	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Understand the transport layer protocols , application layer protocol and its characteristics			
CLR-3 :	Learn and Understand IPV6 technologies			
CLR-4 :	Work with client server sockets and develop related applications to communicate with each other.			
CLR-5 :	Understand the wide area network protocols			
CLR-6 :	Learn the basics of DSL,ATM,HDLC,MPLS			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Identify the basics of different types of network and transport layer protocols	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-
CLO-2 :	Design and implement the socket programming	3	85	75	M	H	-	M	L	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Enumerate the types of application layer protocols	3	75	70	M	H	-	H	L	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Analyze and compare the IPv4 and IPv6 protocols	3	85	80	M	H	-	H	L	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Familiarize with wide area technologies	3	85	75	H	H	-	H	L	-	-	-	M	L	-	H	-	-	-
CLO-6 :	Describe the working of DSL,ATM,PPP,	3	80	70	L	H	-	H	L	-	-	-	L	L	-	H	-	-	-

Duration (hour)		15	15	15	15	15
S-1	SLO-1	IP header	Byte ordering	DNS	IPV6 Overview	DSL
	SLO-2	IP fragmentation	Byte ordering conversion functions	DNS in the Internet,	IPV6 Features	Other DSL Technology
S-2	SLO-1	ARP	System calls	DNS Resolution	IPV6 Addressing Modes	DSL Benefits
	SLO-2	RARP	Sockets	DNS Messages	IPV6 Address Types	Cable Technology
S-3	SLO-1	ICMP –introduction	System calls used with Sockets	TELNET	Introduction	Compare DSL Vs Cable
	SLO-2	ICMP-Messages	Iterative and concurrent server	SSH	Address Space Allocation	Frame Relay, VPN
S 4-5	SLO-1	Study of necessary header files with respect to socket programming.	UDP Echo Client Server Communication	Full Duplex Chat Using TCP/IP	ARP implementation Using UDP	Implementation of VPN
	SLO-2					
S-6	SLO-1	Debugging tools	Socket Interface	FTP	Global Unicast Addresses	ATM Introduction
	SLO-2	ICMP package	Structure and Functions of Socket	TFTP	Auto configuration	ATM Cell Format
S-7	SLO-1	UDP Datagram	Remote Procedure Call	WWW Architecture	Renumbering	ATM Layer
	SLO-2	UDP characteristics	RPC Model, Features	WWW Documents	IPV6 Routing Protocols	AAL Layer
S-8	SLO-1	TCP Header	TCP Client Server Program	HTTP	Introduction	ATM Application
	SLO-2	TCP connection establishment process	Input, Output Processing Module	HTTP Request and Reply	IPV6 Packet Format	PPP
S 9-10	SLO-1	Study of Basic Functions of Socket Programming	Concurrent TCP/IP Day-Time Server	Implementation of File Transfer Protocol	Study of IPV6 Addressing & Subnetting	Communication Using HDLC
	SLO-2					
S-11	SLO-1	TCP Error Control	UDP Client Server Program	DHCP Operation	Comparison between IPV4 and IPV6 Header	PPP Services, Components

Duration (hour)		15	15	15	15	15
	SLO-2	*TCP Congestion Control*	*UDP Control block table & Module*	*DHCP Configuration*	*IPV4 to IPV6 Tunneling*	*PPP frame and byte stuffing*
S-12	SLO-1	*TCP Flow Control*	*UDP Input & Output Module*	*SMTP*	*IPV4 to IPV6 Translation Techniques*	*HDLC*
	SLO-2	*Multicasting*	*SCTP Sockets*	*POP3*	*NAT Protocol Translation*	*HDLC Transfer Modes, Frame*
S-13	SLO-1	*Multicasting and Multicast Routing Protocol*	*SCTP Services and Features, Packet Format*	*IMAP*	*IPV6 Mobility*	*Types of HDLC Frame*
	SLO-2	*Stream Control Transmission Protocol*	*SCTP Client/Server*	*MIME*	*Protocols Changed to Support IPV6*	*MPLS*
S 14-15	SLO-1	*Simple TCP/IP Client Server Communication*	*Half Duplex Chat Using TCP/IP*	*Remote Command Execution Using UDP*	*Implementation of NAT*	*Communication Using PPP*
	SLO-2					

Learning Resources	1. *Behrouz A. Forouzan, "TCP IP Protocol Suite " 4th edition, 2010, McGraw-HillISBN: 0073376043* 2. *Douglas E. Comer, Internetworking with TCP/IP, Principles, protocols, and architecture,Vol 1 5th Edition,2006 ISBN: 0131876716, ISBN: 978-0131876712*	3. *Richard Stevens, Unix Network Programming, vol.1, 3rd edition, 2003, McGraw-HillISBN 0-07-246060-1*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20 %*	*20%*	*15 %*	*15%*	*15 %*	*15%*	*15 %*	*15%*	*15 %*	*15%*
Level 2	Apply Analyze	*20 %*	*20 %*	*20 %*	*20%*	*20 %*	*20%*	*20 %*	*20%*	*20 %*	*20%*
Level 3	Evaluate Create	*10 %*	*10%*	*15 %*	*15%*	*15 %*	*15%*	*15 %*	*15%*	*15 %*	*15%*
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Thamaraiselvam.S, Zoho Corporation. thamaraiselvams@gmail.com	*1. Dr.Uma,Anna University ,umaramesh@auist.net*	*1. Dr.K.Venkatesh,SRMIST,2.Dr.G.Usha,SRMIST*
2. Mithun,Cognizant, Mithun.SS@cognizant.com	*2. Dr.KunvarSingh, NIT Trichy,kunwar@nitt.edu*	*2. Dr.J.Kalaivani,SRMIST,4.Mr.GodwinPon,SRMIST*

Course Code	18CSC303J	Course Name	DATABASE MANAGEMENT SYSTEMS	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the fundamentals of Database Management Systems, Architecture and Languages*			
CLR-2 :	*Conceive the database design process through ER Model and Relational Model*			
CLR-3 :	*Design Logical Database Schema and mapping it to implementation level schema through Database Language Features*			
CLR-4 :	*Familiarize queries using Structure Query Language (SQL) and PL/SQL*			
CLR-5 :	*Familiarize the Improvement of the database design using normalization criteria and optimize queries*			
CLR-6 :	*Understand the practical problems of concurrency control and gain knowledge about failures and recovery*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge on DBMS Architecture and Languages*	*3*	*80*	*70*	*H*	*M*	*L*	*L*	-	-	-	-	*L*	*L*	*L*	*H*	-	-	-
CLO-2 :	*Apply the fundamentals of data models to model an application's data requirements using conceptual modeling tools like ER diagrams*	*3*	*85*	*75*	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	*H*	*H*	*H*	-	-	-
CLO-3 :	*Apply the method to convert the ER model to a database schemas based on the conceptual relational model*	*3*	*75*	*70*	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	*H*	*H*	*H*	-	-	-
CLO-4 :	*Apply the knowledge to create, store and retrieve data using Structure Query Language (SQL) and PL/SQL*	*3*	*85*	*80*	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	*H*	*H*	*H*	-	-	-
CLO-5 :	*Apply the knowledge to improve database design using various normalization criteria and optimize queries*	*3*	*85*	*75*	*H*	*H*	*L*	*M*	*L*	-	-	-	*M*	*M*	*M*	*L*	-	-	-
CLO-6 :	*Appreciate the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.*	*3*	*85*	*75*	*H*	*L*	*L*	*L*	*L*	-	-	-	*H*	*L*	*L*	*L*			

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*What is Database Management System*	*Database Design*	*Basics of SQL-DDL,DML,DCL,TCL*	*Relational Algebra – Fundamental Operators and syntax, relational algebra queries, Tuple relational calculus*	*Transaction concepts, properties of transactions,*
	SLO-2	*Advantage of DBMS over File Processing System*	*Design process*	*Structure Creation, alternation*		
S-2	SLO-1	*Introduction and applications of DBMS*	*Entity Relation Model*	*Defining Constraints-Primary Key, Foreign Key, Unique, not null, check, IN operator*		*Serial izability of transactions, testing for serial inability, System recovery,*
	SLO-2	*Purpose of database system*				
S-3	SLO-1	*Views of data*	*ER diagram*	*Functions-aggregation functions Built-in Functions-numeric, date, string functions, string functions, Set operations,*	*Pitfalls in Relational database, Decomposing bad schema Functional Dependency – definition, trivial and non-trivial FD*	*Concurrency Control*
	SLO-2					
S 4-5	SLO-1	*Lab 1: SQL Data Definition Language Commands on sample exercise * The abstract of the project to construct database must be framed*	*Lab4 Inbuilt functions in SQL on sample Exercise.*	*Lab 7 : Join Queries on sample exercise. * Frame and execute the appropriate DDL,DML,DCL,TCL for the project*	*Lab10: PL/SQL Procedures on sample exercise. * Frame and execute the appropriate Join Queries for the project*	*Lab 13: PL/SQL Exception Handling * Frame and execute the appropriate PL/SQL Procedures and Functions for the project*
	SLO-2					
S-6	SLO-1	*Database system Architecture*	*Keys , Attributes and Constraints*	*Sub Queries, correlated sub queries*	*closure of FD set , closure of attributes irreducible set of FD*	*Two- Phase Commit protocol, Recovery and Atomicity*
	SLO-2					
S-7	SLO-1	*Data Independence*	*Mapping Cardinality*	*Nested Queries, Views and its Types*	*Normalization – 1Nf, 2NF, 3NF,*	*Log-based recovery*
	SLO-2					

Duration (hour)		15	15	15	15	15
S-8	SLO-1	*The evolution of Data Models*	*Extended ER - Generalization, Specialization and Aggregation*	*Transaction Control Commands Commit, Rollback, Save point*	*Decomposition using FD- dependency preservation,*	*concurrent executions of transactions and related problems*
	SLO-2					
S 9-10	SLO-1	*Lab 2: SQL Data Manipulation Language Commands * Identification of project Modules and functionality*	*Lab 5: Construct a ER Model for the application to be constructed to a Database*	*Lab 8: Set Operators & Views. * Frame and execute the appropriate In- Built functions for the project*	*Lab 11: PL/SQL Functions * Frame and execute the appropriate Set Operators & Views for the project*	*Lab 14: PL/SQL Trigger * Frame and execute the appropriate PL/SQL Cursors and Exceptional Handling for the project*
	SLO-2					
S-11	SLO-1	*Degrees of Data Abstraction*	*ER Diagram Issues Weak Entity*	*PL/SQL Concepts- Cursors*	*BCNF*	*Locking mechanism, solution to concurrency related problems*
	SLO-2					
S-12	SLO-1	*Database Users and DBA*	*Relational Model*	*Stored Procedure, Functions Triggers and Exceptional Handling*	*Multi- valued dependency, 4NF*	*Deadlock*
	SLO-2					
S-13	SLO-1	*Database Languages*	*Conversion of ER to Relational Table*	*Query Processing*	*Join dependency and 5NF*	*two-phase locking protocol, Isolation, Intent locking*
	SLO-2					
S 14-15	SLO-1	*Lab 3: SQL Data Control Language Commands and Transaction control commands to the sample exercises * Identify the issues that can arise in a business perspective for the application*	*Lab 6: Nested Queries on sample exercise * Construction of Relational Table from the ER Diagram*	*Lab9: PL/SQL Conditional and Iterative Statements * Frame and execute the appropriate Nested Queries for the project*	*Lab 12: PL/SQL Cursors * Frame and execute the appropriate PL/SQL Conditional and Iterative Statements for the project*	*Lab 15 : * Frame and execute the appropriate PL/SQL Cursors and Exceptional Handling for the project * Demo of the project*
	SLO-2					

Learning Resources	
	1. *Abraham Silberschatz, Henry F. Korth, S. Sudharshan, Database System Conceptsll, Sixth Edition, Tata McGraw Hill,2011.*
	2. *Ramez Elmasri, Shamkant B. Navathe, Fundamentals of Database Systemsll, Sixth Edition, Pearson Education,2011.*
	3. *CJ Date,A Kannan,S Swamynathan, An Introduction to Database Systems, Eight Edition, Pearson Education,2006.*
	4. *Rajesh Narang, Database Management Systems, 2nd ed., PHI Learning Private Limited,2011.*
	4. *Martin Gruber, Understanding SQL, Sybex,1990*
	5. *Sharad Maheshwari,Introduction to SQLandPL/SQL,2ded.,LaxmiPublications,2016.*
	6. *RaghuramaKrishnan,Johannes Gehrke,Database Management Systems,3rdEdition,McGrawHill Education,2003.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50%weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	100 %		100 %		100 %		100 %		-	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.Mariappan Vaithilingam, Engineering Leader Amazon, dr.v.m@ieee.org		*1. Ms. Sasi Rekha Sankar SRMIST*
2. Mr. Badinath, SDET, Amzon, sbadhrinath@gmail.com		*2. Mr.Elizer, SRMIST*
		3. Mrs. Hemavathy, SRMIST

Course Code	18CSC304J	Course Name	COMPILER DESIGN	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	*18CSC301T*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Utilize the mathematics and engineering principles for the Design of Compilers*			
CLR-2 :	*Acquire knowledge of Lexical Analyzer from a specification of a language's lexical rules*			
CLR-3 :	*Acquire knowledge of Syntax Analyzer for parsing the sentences in a compiler grammar*			
CLR-4 :	*Gain knowledge to translate a system into various intermediate codes*			
CLR-5 :	*Analyze the methods of implementing a Code Generator for compilers*			
CLR-6 :	*Analyze and Design the methods of developing a Code Optimizer*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Utilize the mathematics and engineering principles for the Design of Compilers*	*3*	*80*	*70*
CLR-2 :	*Acquire knowledge of Lexical Analyzer from a specification of a language's lexical rules*	*3*	*85*	*75*
CLR-3 :	*Acquire knowledge of Syntax Analyzer for parsing the sentences in a compiler grammar*	*3*	*75*	*70*
CLR-4 :	*Gain knowledge to translate a system into various intermediate codes*	*3*	*85*	*80*
CLR-5 :	*Analyze the methods of implementing a Code Generator for compilers*	*3*	*85*	*75*
CLR-6 :	*Analyze and Design the methods of developing a Code Optimizer*	*3*	*80*	*70*

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	*Utilize the mathematics and engineering principles for the Design of Compilers*	*H*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*M*	*M*	*L*	*H*	*H*	*H*	*H*
CLR-2 :	*Acquire knowledge of Lexical Analyzer from a specification of a language's lexical rules*	*H*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*M*	*M*	*L*	*H*	*H*	*H*	*H*
CLR-3 :	*Acquire knowledge of Syntax Analyzer for parsing the sentences in a compiler grammar*	*H*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*M*	*M*	*L*	*H*	*H*	*H*	*H*
CLR-4 :	*Gain knowledge to translate a system into various intermediate codes*	*H*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*M*	*M*	*L*	*H*	*H*	*H*	*H*
CLR-5 :	*Analyze the methods of implementing a Code Generator for compilers*	*H*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*M*	*M*	*L*	*H*	*H*	*H*	*H*
CLR-6 :	*Analyze and Design the methods of developing a Code Optimizer*	*H*	*H*	*H*	*H*	*M*	*L*	*L*	*L*	*M*	*M*	*L*	*H*	*H*	*H*	*H*

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Compilers – Analysis of the source program*	*Syntax Analysis Definition - Role of parser*	*Bottom Up Parsing*	*Intermediate Code Generation*	*Code optimization*
	SLO-2	*Phases of a compiler – Cousins of the Compiler*	*Lexical versus Syntactic Analysis*	*Reductions*	*Intermediate Languages - prefix - postfix*	*Introduction– Principal Sources of Optimization*
S-2	SLO-1	*Grouping of Phases – Compiler construction tools*	*Representative Grammars*	*Handle Pruning*	*Quadruple - triple - indirect triples Representation*	*Function Preserving Transformation*
	SLO-2	*Lexical Analysis – Role of Lexical Analyzer*	*Syntax Error Handling*	*Shift Reduce Parsing*	*Syntax tree- Evaluation of expression - three-address code*	*Loop Optimization*
S-3	SLO-1	*Input Buffering*	*Elimination of Ambiguity, Left Recursion*	*Problems related to Shift Reduce Parsing*	*Synthesized attributes – Inherited attributes*	*Optimization of basic Blocks*
	SLO-2	*Specification of Tokens*	*Left Factoring*	*Conflicts During Shift Reduce Parsing*	*Intermediate languages – Declarations*	*Building Expression of DAG*
S 4-5	SLO-1	*Lab 1 - Implementation of Lexical Analyzer*	*Lab 4Elimation of Ambiguity, Left Recursion and Left Factoring*	*Lab 7 - Shift Reduce Parsing*	*Lab 10-Intermediate code generation – Postfix, Prefix*	*Lab 13 Implementation of DAG*
	SLO-2					
S-6	SLO-1	*Finite automation - deterministic*	*Top down parsing*	*LR Parsers- Why LR Parsers*	*Assignment Statements*	*Peephole Optimization*
	SLO-2	*Finite automation - non deterministic*	*Recursive Descent Parsing, back tracking*	*Items and LR(0) Automaton, Closure of Item Sets,*	*Boolean Expressions, Case Statements*	*Basic Blocks, Flow Graphs*
S-7	SLO-1	*Transition Tables*	*Computation of FIRST*	*LR Parsing Algorithm*	*Back patching – Procedure calls*	*Next -Use Information*
	SLO-2	*Acceptance of Input Strings by Automata*	*Problems related to FIRST*	*Operator Precedence Parser Computation of LEADING*	*Code Generation*	*Introduction to Global Data Flow Analysis*

Duration (hour)		15	15	15	15	15
S-8	SLO-1	State Diagrams and Regular Expressions	Computation of FOLLOW	Computation of TRAILING	Issues in the design of code generator	Computation of gen and kill
	SLO-2	Conversion of regular expression to NFA – Thompson's	Problems related to FOLLOW	Problems related to LEADING AND TRAILING	The target machine – Runtime Storage management	Computation of in and out
S 9-10	SLO-1	Lab 2 conversion from Regular Expression to NFA	Lab 5 -FIRST AND FOLLOW computation	Lab 8- Computation of LEADING AND TRAILING	Lab 11 Intermediate code generation – Quadruple, Triple, Indirect triple	Lab 14 : Implementation of Global Data Flow Analysis
	SLO-2					
S-11	SLO-1	Conversion of NFA to DFA	Construction of a predictive parsing table	SLR Grammars	A simple Code generator	Parameter Passing.
	SLO-2	Simulation of an NFA	Predictive Parsers LL(1) Grammars	SLR Parsing Tables	Code Generation Algorithm	Runtime Environments
S-12	SLO-1	Converting Regular expression directly to DFA	Transition Diagrams for Predictive Parsers	Problems related to SLR	Register and Address Descriptors	Source Language issues
	SLO-2	Minimization of DFA	Error Recovery in Predictive Parsing	Construction of Canonical LR(1) and LALR	Generating Code of Assignment Statements	Storage Organization
S-13	SLO-1	Minimization of NFA	Predictive Parsing Algorithm	Construction of LALR	Cross Compiler – T diagrams	Activation Records
	SLO-2	Design of lexical analysis (LEX)	Non Recursive Predictive Parser	Problems related to Canonical LR(1) and LALR Parsing Table	Issues in Cross compilers	Storage Allocation strategies
S 14-15	SLO-1	Lab 3 Conversion from NFA to DFA	Lab 6 Predictive Parsing Table	Lab9 Computation of LR(0) items	Lab 12 : A simple code Generator	Lab 15: Implement any one storage allocation strategies(heap, stack, static)
	SLO-2					

Learning Resources	1. AlfredVAho,JefferyDUllman,RaviSethi,"Compilers,Principlestechniquesandtools",Pearson Education2011 2. S.GodfreyWinster,S.ArunaDevi,R.Sujatha,"CompilerDesign",YesdeePublishingPvt.Ltd,2016 3. WilliamM.WaiteandGerhardGoos.CompilerConstruction.Springer-Verlag,New York,2013.	4. K.Muneeswaran,,"CompilerDesign",OxfordHigherEducation,Fourthedition2015 5. DavidGalles,"ModernCompilerDesign",PearsonEducation,Reprint2012. 6. RaghavanV.,"PrinciplesofCompilerDesign",TataMcGrawHillEducationPvt.Ltd.,2010

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50%weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	20%	15%	15%	15%	15%	15%	15%	15%	15%
	Understand										
Level 2	Apply	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Analyze										
Level 3	Evaluate	10%	10%	15%	15%	15%	15%	15%	15%	15%	15%
	Create										
	Total	100 %		100 %		100 %		100 %		-	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. Ms.R.Jeya
		2. Mrs.J. Jeyasudha

Course Code	18CSC305J	Course Name	ARTIFICIAL INTELLIGENCE	Course Category	C	Professional Core	L	T	P	C
							3	0	2	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	*Provide a broad understanding of the basic techniques for building intelligent computer systems and an understanding of how AI is applied to problems.*																		
CLR-2 :	*Gain knowledge in problem formulation and building intelligent agents*																		
CLR-3 :	*Understand the search technique procedures applied to real world problems*																		
CLR-4 :	*Understand the types of logic and knowledge representation schemes*																		
CLR-5 :	*Acquire knowledge in planning and learning algorithms*																		
CLR-6 :	*Gain knowledge in AI Applications and advances in Artificial Intelligence*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Formulate a problem and build intelligent agents*	*1*	*80*	*70*	*M*	*M*	*M*	*M*	*H*	-	-	-	*M*	*L*	-	*H*	*L*	*L*	*L*
CLO-2 :	*Apply appropriate searching techniques to solve a real world problem*	*2*	*85*	*75*	*M*	*H*	*H*	*H*	*H*	-	-	-	*M*	*L*	-	*H*	*M*	*L*	*M-*
CLO-3 :	*Analyze the problem and infer new knowledge using suitable knowledge representation schemes*	*2*	*75*	*70*	*M*	*H*	*H*	*M*	*H*	-	-	-	*M*	*L*	-	*H*	*M*	*L*	*M*
CLO-4 :	*Develop planning and apply learning algorithms on real world problems*	*2*	*85*	*80*	*M*	*H*	*M*	*H*	*H*	-	-	-	*M*	*L*	-	*H*	*M*	*M*	*M*
CLO-5 :	*Design an expert system and implement natural language processing techniques*	*3*	*85*	*75*	*M*	*H*	*H*	*H*	*H*	-	-	-	*M*	*L*	-	*H*	*H*	*M*	*H*
CLO-6 :	*Implement advance techniques in Artificial Intelligence*	*3*	*80*	*70*	*L*	*H*	*M*	*M*	*H*	-	-	-	*H*	*L*	-	*H*	*H*	*M*	*H*

Duration (hour)		15	15	15	15	15
S-1	SLO-1	*Introduction to AI-AI techniques*	*Searching techniques- Uniformed search-General search Algorithm*	*Knowledge and reasoning-Approaches and issues of knowledge reasoning*	*Planning- Planning problems, Simple planning agent*	*Expert system-Architecture*
	SLO-2	*Problem solving with AI*	*Uniformed search Methods-Breadth first search*	*Knowledge base agents-Logic Basics*	*Planning languages*	*Pros and Cons of expert system*
S-2	SLO-1	*AI Models, Data acquisition and learning aspects in AI*	*Uniformed search Methods-Depth first search*	*Logic-Propositional logic-syntax ,semantics and inferences*	*Blocks world ,Goal stack planning*	*Rule based systems*
	SLO-2	*Problem solving- Problem solving process, Formulating problems*	*Uniformed search Methods-Depth limited search*	*Propositional logic- Reasoning patterns*	*Mean Ends Analysis*	*Frame based expert system*
S-3	SLO-1	*Problem types and characteristics*	*Uniformed search Methods- Iterative Deepening search*	*Predicate logic – Syntax and semantics, instance and is relationship*	*Non-linear Planning*	*Case study*
	SLO-2	*Problem space and search*	*Bi-directional search*	*Unification and Resolution*	*Conditional planning, Reactive planning*	*Case study*
S 4-5	SLO-1	*Lab 1: Implementation of toy problems*	*Lab4: Implementation and Analysis of DFS and BFS for an application*	*Lab 7: Implementation of unification and resolution for real world problems.*	*Lab 10 :Implementation of block world problem*	*Natural language processing-Levels of NLP*
	SLO-2					
S-6	SLO-1	*Intelligent agent*	*Informed search- Generate and test, Best First search*	*Knowledge representation using rules*	*Learning- Machine learning*	*Syntactic and Semantic Analysis*
	SLO-2	*Rationality and Rational agent with performance measures*	*Informed search-A* Algorithm*	*Knowledge representation using semantic nets*	*Goals and Challenges of machine learning*	*Information retrieval*
S-7	SLO-1	*Flexibility and Intelligent agents*	*AO* research*	*Knowledge representation using frames*	*Learning concepts, models*	*Information Extraction*

Duration (hour)		15	15	15	15	15
	SLO-2	*Task environment and its properties*	*Local search Algorithms-Hill Climbing, Simulated Annealing*	*Inferences*	*Artificial neural network based learning-Back propagation*	*Machine translation*
S-8	SLO-1	*Types of agents*	*Local Beam Search*	*Uncertain Knowledge and reasoning-Methods*	*Support vector machines*	*NLP Applications*
	SLO-2	*Other aspects of agents*	*Genetic Algorithms*	*Bayesian probability and belief network*	*Reinforcement learning*	*NLP Applications*
S 9-10	SLO-1 SLO-2	*Lab 2: Developing agent programs for real world problems*	*Lab 5: Developing Best first search and A* Algorithm for real world problems*	*Lab 8: Implementation of knowledge representation schemes - use cases*	*Lab 11: Implementation of learning algorithms for an application*	*Lab 14:Implementation of NLP programs*
S-11	SLO-1	*Constraint satisfaction problems(CSP)*	*Adversarial search Methods-Game playing-Important concepts*	*Probabilistic reasoning*	*Adaptive learning*	*Advance topics in Artificial Intelligence-Cloud Computing and intelligent agent*
	SLO-2	*Crypto arithmetic puzzles*	*Game playing and knowledge structure*	*Probabilistic reasoning over time*	*Multi agent based learning*	*Business intelligence and analytics*
S-12	SLO-1	*CSP as a search problem-constrains and representation*	*Game as a search problem-Mini max approach*	*Forward and backward reasoning*	*Ensemble learning*	*Sentiment Analysis*
	SLO-2	*CSP-Backtracking, Role of heuristic*	*Mini max Algorithm*	*Other uncertain techniques-Data mining*	*Learning for decision making*	*Deep learning Algorithms*
S-13	SLO-1	*CSP-Forward checking and constraint propagation*	*Alpha beta pruning*	*Fuzzy logic*	*Distributed learning*	*Deep learning Algorithms*
	SLO-2	*CSP-Intelligent backtracking*	*Game theory problems*	*Dempster -shafer theory*	*Speedup learning*	*Planning and logic in intelligent agents*
S 14-15	SLO-1 SLO-2	*Lab 3: Implementation of constraint satisfaction problems*	*Lab 6: Implementation of mini max algorithm for an application*	*Lab 9: Implementation of uncertain methods for an application*	*Lab12: Development of ensemble model for an application*	*Lab 15: Applying deep learning methods to solve an application.*

Learning Resources	
1. *Parag Kulkarni, Prachi Joshi, Artificial Intelligence –Building Intelligent Systems, 1st ed., PHI learning,2015* 2. *DeepakKemhani,FirstcourseinArtificilaIntelligence,McGrawHillPvtLtd,2013* 3. *Stuart J. Russell, Peter Norwig , Artificial Intelligence –A Modern approach, 3rd Pearson Education, 2016*	4. *PrateekJoshi,ArtificialIntelligencewithPhython,1st ed.,PacktPublishing,2017* 5. *DenisRothman,ArtificialIntelligencebyExample,Packt,2018*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	*100 %*		*100 %*		*100 %*		*100 %*		-	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.Jagatheeswaran, Lead, Auxo labs jagatheeswarans.iot@auxolabs.in	*1. Dr. Chitrakala, Anna University, au.chitras@gmail.com*	*1. Dr.M.Pushpalatha, SRMIST*
		2. Dr.G..Vadivu, SRMIST
		3. Dr.C.Lakshmi, SRMIST

Course Code	18CSC350T	Course Name	COMPREHENSION	Course Category	C	Professional Core	L	T	P	C
							0	1	0	1

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design,	Modern Tool Usage	Society & Culture	Environment &	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-1 :	*Acquire skills to solve real world problems in Data Structures and Analysis and Design of Algorithms*																		
CLR-2 :	*Acquire skills to solve real world problems in Object Oriented Design and Programming and advanced programming concepts*																		
CLR-3 :	*Acquire skills to solve real world problems in Operating systems , Computer networking and Formal Language and Automata*																		
CLR-4 :	*Acquire skills to solve real world problems in Compiler Design, Database Management systems and Software Engineering*																		
CLR-5 :	*Acquire skills to solve real world problems for competitive examinations in Mechanical Engineering*																		
CLR-6 :	*Acquire skills to solve real world problems in the broad domain of Mechanical Engineering*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Practice and gain confidence, competence to solve problems in Data Structures and Analysis and Design of Algorithms*	*3*	*85*	*80*	*H*	*H*	*H*	*H*	*M*	*M*	*L*	*L*	*M*	*M*	*L*	*H*	*M*	*L*	*H*
CLO-2 :	*Practice and gain confidence, competence to solve problems in Object Oriented Design, Programming and advanced programming concepts*	*3*	*85*	*80*	*H*	*H*	*M*	*H*	*H*	*M*	*L*	*L*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-3 :	*Practice and gain confidence, competence to solve problems in Operating systems , Computer networking, Formal Language and Automata*	*3*	*85*	*80*	*H*	*H*	*M*	*M*	*M*	*M*	*L*	*L*	*M*	*H*	*L*	*M*	*M*	*H*	*M*
CLO-4 :	*Practice and gain confidence, competence to solve problems in Compiler Design, Database Management systems and Software Engineering*	*3*	*85*	*80*	*H*	*H*	*M*	*H*	*H*	*H*	*L*	*L*	*H*	*H*	*H*	*H*	*M*	*H*	*H*
CLO-5 :	*Practice and gain confidence and competence to solve problems for competitive examinations in Computer Science and Engineering*	*3*	*85*	*80*	*H*	*H*	*H*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*M*	*L*	*M*
CLO-6 :	*Practice and gain confidence and competence to solve problems in the broad domain of Computer Science and Engineering*	*3*	*85*	*80*	*H*	*H*	*M*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*M*	*M*	*M*

Duration (hour)		3	3	3	3	3
S-1	SLO-1	*Tutorial on Linear Data Structures*	*Tutorial on Object Oriented Design*	*Tutorial on Operating Systems*	*Tutorial on Compiler Design*	*Problem Solving*
	SLO-2	*Problem Solving*	*Problem Solving*	*Problem Solving*	*Problem Solving*	*Problem Solving*
S-2	SLO-1	*Tutorial on Non Linear Data Structures*	*Tutorial on Object Oriented Programming*	*Tutorial on Computer networking*	*Tutorial on Database Management systems*	*Problem Solving*
	SLO-2	*Problem Solving*	*Problem Solving*	*Problem Solving*	*Problem Solving*	*Problem Solving*
S-3	SLO-1	*Tutorial on Analysis and Design of Algorithms*	*Tutorial on Advanced Programming concepts*	*Tutorial on Formal Language and Automata*	*Tutorial on Software Engineering*	*Problem Solving*
	SLO-2	*Problem Solving*	*Problem Solving*	*Problem Solving*	*Problem Solving*	*Problem Solving*

Learning Resources	*1. Jushta Jaiswal,Objective "Computer Science & Information Technology", Source books, , 2015* *2. G.K.Mithal, "Objective Computer Science and Information Technology",G.K.Publishing, 10th edition, 2016*	*3. R.Agor, "Computer Science Conventional & Objective type solved questions", Birla Publishing, 2004* *4. Timothy Williams, "MCQs in Computer Science", McGraw Hill, 5th edition, 2017* *5. Surbhi Mitra, "Computer Science and IT",Arihant Handbook series, 2013*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	-	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	-	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	-	-
	Create										
	Total	100 %		100 %		100 %		100 %		-	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Anbu Rathinavel , Chief Design Officer, Design Intellect	*1. Dr. Viraj Kumar, Professor, CSE, PES University*	*1. Dr. B.Amutha, Professor & Head, CSE, SRMIST*
		2. Dr.S.S.Sridhar, Professor,CSE, SRMIST

ACADEMIC CURRICULA

Professional Elective Courses

COMPUTER SCIENCE AND ENGINEERING

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18CSE351T	Course Name	COMPUTATIONAL LOGIC	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the basics of Propositional logic*			
CLR-2 :	*Acquire skills on rules to handle Propositional logic*			
CLR-3 :	*Understand the First order Logic and Meta theorems*			
CLR-4 :	*Learn the art of application of AI Concepts.*			
CLR-5 :	*Master various theorems on Logic*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Apply the skills acquired on propositional logic to solve examples at hand*	*2*	*80*	*85*
CLO-2 :	*Apply the rules learnt towards problem solving*	*2*	*75*	*80*
CLO-3 :	*Acquire mastry over FOL and Meta theorems and apply the same with confidence*	*2*	*85*	*80*
CLO-4 :	*Apply the acquired knowledge on AI under appropriate problem solving contexts*	*2*	*80*	*75*
CLO-5 :	*Attempt to apply the acquired knowledge on logics under appropriate problem solving contexts*	*2*	*75*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*M*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-
H	*M*	*H*	-	-	-	-	-	*M*	-	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Propositional Logic-Introduction*	*Natural Deduction of Propositional Logic: Rules of Conjunction, Disjunction*	*First Order Logic-Introduction*	*Axiomatic System FC: Introduction*	*Modal Logic K-Introduction*
	SLO-2	*Syntax of PL*	*Natural Deduction of Propositional Logic: Implication, Negation*	*First Order Logic-Illustration*	*Axiomatic System FC: Example applications, Illustrations*	*Modal Logic K-Illustration*
S-2	SLO-1	*Is It a Proposition?*	*Natural Deduction of Propositional Logic: Proofs*	*Syntax of FL*	*Monotonicity Theorem-Detail*	*Syntax and Semantics of K*
	SLO-2	*Unique Parsing, PropDet*	*Natural Deduction of Propositional Logic: Examples*	*Scope and Binding*	*Deduction Theorem- Detail*	*Syntax and Semantics of K: Illustration*
S-3	SLO-1	*Sub Propositions, Precedence rules*	*Natural Deduction of Propositional Logic: Problems*	*Scope and Binding-Illustration*	*Theorem-RA, Fitness- Detail*	*Validity and Consequence in K*
	SLO-2	*Proposition: Theorems and Examples*	*Natural Deduction of Propositional Logic: Problems*	*Substitutions*	*Paradox of material Implication-Detail*	*Validity and Consequence in K: Illustration*
S-4	SLO-1	*Interpretations*	*Derived Rules of Propositional Logic: Introduction*	*Substitutions- Illustrations*	*Strong Generalization Theorem:Introduction*	*Axiomatic System KC*
	SLO-2	*Boolean conditions, Truth table*	*Derived Rules of Propositional Logic: Examples*	*Substitutions- Problems*	*Strong Generalization Theorem: Illustration*	*Axiomatic System KC: Illustration*
S-5	SLO-1	*Interpretations: Theorems, Conventions and Lemma*	*Derived Rules of Propositional Logic:Problems*	*Semantics of FL*	*Adequacy of FC to FL*	*Adequacy of KC to K*
	SLO-2	*Interpretations: Examples*	*Derived Rules of Propositional Logic:Problems*	*Semantics of FL: Illustration*	*Adequacy of FC to FL: Illustration*	*Adequacy of KC to K: Illustration*
S-6	SLO-1	*Models: Introduction to terminologies*	*Parse Tree*	*Translating into FL*	*Compactness of FL*	*Natural Deduction in K*
	SLO-2	*Equivalences and Consequences : Introduction to terminologies*	*Sub Formula*	*Translating into FL: Illustrations*	*Compactness of FL: Proof*	*Natural Deduction in K: Illustration*
S-7	SLO-1	*Equivalences and Consequences :*	*Soundness of Propositional Logic*	*Satisfiability and Validity*	*Laws in FL*	*Analytic Tableau for K*

		Examples				
	SLO-2	*Deduction Theorem (DT)-Introduction*	*Soundness of Propositional Logic: Illustration*	*Satisfiability and Validity:Illustrations*	*Laws in FL: Illustration*	*Analytic Tableau for K: Illustration*
S-8	SLO-1	*RA Theorem, Monotonicity Theorem (M)-Introduction*	*Completeness of Propositional Logic*	*Metatheorems: Introduction*	*Natural Deduction*	*Modalities*
	SLO-2	*Fitness Theorem*	*Completeness of Propositional Logic: Illustration*	*Metatheorems: Deduction, Substitution, Chaining*	*Natural Deduction: Illustration*	*Modalities: Illustration*
S-9	SLO-1	*Theorem-Paradox of material Implication*	*Gentzen sequent calculus*	*Metatheorems: Examples*	*Analytic Tableaux*	*Computation Tree Logic*
	SLO-2	*Replacement Laws*	*Gentzen sequent calculus: Illustration*	*Metatheorems: Problems*	*Analytic Tableaux: Illustration*	*Computation Tree Logic: Illustration*

Learning Resources	1. *Arindama Singh,"Logics for Computer Science", PHI Learning Private Ltd,2nd Edition,2018* 2. *Wasilewska & Anita,"Logics for computer science: classical and non-classical",Springer ,2018* 3. *Huth M and Ryan M ," Logic in Computer Science : Modeling and Reasoning about systems",Cambridge University Press, 2005*	4. *Dana Richards & Henry Hamburger,"Logic And Language Models For Computer Science",Third Edition,World Scientific Publishing Co. Pe. Ltd,2018.* 5. *https://www.cs.cornell.edu/courses/cs3110/2012sp/lectures/lec15-logic-contd/lec15.html*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Paventhan Arumugum, Director (R&D), ERNET India		*Mr. T.Senthil Kumar, SRMIST*
Mr Shiv Kumar Ganesh Full stack developer Altemetric, US		*Dr.Kayalvizhi Jayavel, SRMIST*
		Ms. Jeyasudha, SRMIST

Course Code	18CSE352T	Course Name	NEURO FUZZY AND GENETIC PROGRAMMING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the fundamentals of Artificial Neural Networks*			
CLR-2 :	*Learn the various topologies and learning algorithms of ANN*			
CLR-3 :	*Understand the principles and fundamentals of Fuzzy Logic*			
CLR-4 :	*Understand the Fuzzy Rule based systems*			
CLR-5 :	*Understand the basic concepts and techniques of Genetic Algorithms*			
CLR-6 :	*Utilize the Neural, Fuzzy and Genetic Algorithms for real-time application development*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Acquire the knowledge on constructing a neural network*	*3*	*80*	*75*
CLO-2 :	*Identify the basic Neural net and learning algorithm to apply for a real time problem*	*3*	*85*	*75*
CLO-3 :	*Acquire the ability to use Fuzzy operators, membership functions, Fuzzification and Defuzzification Techniques*	*3*	*75*	*70*
CLO-4 :	*Gain Knowledge on applying the Fuzzy rules to different applications*	*3*	*85*	*80*
CLO-5 :	*Acquire the knowledge of fitness functions and Genetic operators*	*3*	*85*	*75*
CLO-6 :	*Apply the Genetic Algorithm to real-time applications*	*3*	*80*	*70*

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge on constructing a neural network*	*L*	*H*	-	*H*	*L*	-	-	-	*L*	*L*	-	*H*	-	-	-
CLO-2 :	*Identify the basic Neural net and learning algorithm to apply for a real time problem*	*M*	*H*	*M*	*M*	*H*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-3 :	*Acquire the ability to use Fuzzy operators, membership functions, Fuzzification and Defuzzification Techniques*	*M*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-4 :	*Gain Knowledge on applying the Fuzzy rules to different applications*	*M*	*H*	*M*	*H*	*H*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-5 :	*Acquire the knowledge of fitness functions and Genetic operators*	*H*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-6 :	*Apply the Genetic Algorithm to real-time applications*	*M*	*H*	*M*	*H*	*H*	-	-	-	*L*	*L*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Biological and Artificial Neuron*	*Delta Rule, Derivation of GDR*	*Crisp sets*	*Fuzzification of Input Variables, Application of Fuzzy operations*	*History of Evolutionary Computing, Genetic Algorithms, basic concepts*
	SLO-2	*History of ANN*	*Backpropagation Algorithm, Local Minima Problem*	*Fuzzy sets*		*GA Cycle , Fitness Function,*
S-2	SLO-1	*ANN architectures*	*Radial Basis Function Neural Network*	*Fuzzy membership functions*	*Evaluation of Fuzzy rules, Aggregation of output Fuzzy sets*	*Introduction to GA Operators Selection Operators, Crossover, Mutation Operations*
	SLO-2	*Learning Algorithms*	*Pattern Association, Auto Associative nets*	*Operations of Fuzzy sets*		
S-3	SLO-1	*Activation Functions, Bias, Threshold and other parameters*	*Hetero Associative nets*	*Fuzzy Relations, Operations*	*Rule based systems, Conventional programs vs Rule based systems*	*Schema Theorem, Example*
	SLO-2	*McCulloch Pitts model,*	*Bidirectional Associative Memory Network*	*Fuzzy Extension Principle*	*Fuzzy Propositions*	
S-4	SLO-1	*Simulation of Logic Functions*	*Hopfield network Competitive networks: Maxnet*	*Crisp Relations, Fuzzy relations, Properties, operations,*	*Fuzzification*	*Classification of Genetic Algorithm*
	SLO-2					
S-5	SLO-1	*Perceptron Network*	*Self Organizing Map Network*	*Propositional Logic*	*Defuzzification*	*Holland Classifier Systems*
	SLO-2	*Hebbian network*	*Learning Vector Quantization*	*Crisp Logic*	*Fuzzy Controller : Air conditioner control, Cruise Controller*	*Genetic Programming*
S-6	SLO-1	*ADALINE networks*	*Adaptive Resonance Theory Network*	*Predicate Logic Rules of Inference*	*Fuzzy Decision making*	*Data Representation*
	SLO-2	*MADALINE networks*		*Fuzzy Truth, Fuzzy Rules*		*Genetic Operators*
S-7,8	SLO-1	*Practice of Neural Network tool :*	*Practice of Neural Network tool : Delta rule*	*Fuzzy Reasoning*	*Introduction to neuro fuzzy system-*	*Application of Genetic Algorithm*

		Simple Logic functions			*Adaptive Neuro-Fuzzy Inference Systems Coactive Neuro-Fuzzy Modeling*	
	SLO-2		*Practice of Neural Network tool : Pattern Classification*	*Practice of Fuzzy Logic tool: Fuzzy functions*	*Recent Applications*	*Practice of Optimization and Genetic algorithm tool*
S-9	SLO-1	*Practice of Neural Network tool : XOR problem*	*Practice of Neural Network tool : Pattern Clustering*	*Practice of Fuzzy Logic tool: Fuzzy operations*	*Practice of Fuzzy Logic tool : Fuzzy controller design and applications*	
	SLO-2					

Learning Resources	1. *Samir Roy, Udit Chakraborty, "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms", Pearson Education, 2013.* 2. *Michael Negnevitsky. Artificial Intelligence: A Guide to Intelligent Systems, 3rd Edition, Pearson Education, 2011.* 3. *Laurene Fausett, "Fundamentals of Neural Networks, Architectures, Algorithms and Applications", Pearson Education, 2008.*	4. *Timothy J. Ross , "Fuzzy Logic with Engineering Applications", John Wiley & Sons Ltd, 2010.* 5. *David E. Goldberg, "Genetic Algorithms-In Search, optimization and Machine Learning", Pearson Education, 2008.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. K. selvaraj, TCS, Bangalore	*1. Dr. A.P. Shanthi, Professor, Dept. of Computer Science & Engineering, Anna University, chennai-600025*	*1. Dr. V. Ganapathy, SRM IST*
2. Mr. Saju G Nair, IBM, Bangalore.	*2. Dr. A, Kannan, Professor Dept. of Computer Science & Engineering, VIT, Vellore*	*2. Dr. D. Malathi, SRM IST*
		3. Dr. Ferni Ukrit, SRM IST

Course Code	18CSE353T	Course Name	DIGITAL IMAGE PROCESSING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*provide deep understanding of basic concepts of digital image acquisition*			
CLR-2 :	*provide deep Understanding of various digital image enhancement techniques*			
CLR-3 :	*Understand image restoration and segmentation methods*			
CLR-4 :	*provide understanding and implementation of image compression techniques*			
CLR-5 :	*Provide understanding and knowledge of image recognition methods*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Understand basics of digital images and tools for image processing*	*2*	*80*	*85*
CLO-2 :	*Learn and implement image Enhancement techniques*	*2*	*75*	*80*
CLO-3 :	*Understand and Learn image Restoration and Segmentation Methods*	*2*	*85*	*80*
CLO-4 :	*Understand and implement Image Compression techniques*	*2*	*80*	*75*
CLO-5 :	*Learn and Implement Image Recognition methods*	*2*	*75*	*85*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*H*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*H*	*H*	*M*	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*H*	*H*	*M*	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*H*	*H*	*M*	-	*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction*	*Introduction to Spatial Domain*	*Noise models – Mean Filters – Order Statistics*	*Wavelets – Subband coding – Multiresolution expansions*	*Boundary representation – Chain Code*
S-2	SLO-1	*Origin- Steps in Digital Image Processing*	*Gray level transformations*	*Adaptive filters – Band reject Filters – Band pass Filters*	*Fundamentals of Compression – Image Compression methods - Error Free Compression*	*Polygonal approximation, signature, boundary segments*
S-3	SLO-1	*Components*	*Histogram processing*	*Inverse Filtering – Wiener filtering Segmentation*	*Variable Length Coding – Bit-Plane Coding – Lossless Predictive Coding*	*Boundary description – Shape number*
S-4	SLO-1	*Elements of Visual Perception*	*Basics of Spatial Filtering*	*Point, Line, and Edge Detection*	*Lossy Compression – Lossy Predictive Coding*	*Fourier Descriptor*
S-5	SLO-1	*Image Sensing and Acquisition*	*Smoothing and Sharpening Spatial Filtering*	*Marr-Hildreth & Canny edge detector*	*Compression Standards-Huffman, Arithmetic coding, LZW coding, Run Length Encoding*	*Regional Descriptors*
S-6	SLO-1	*Image Sampling and Quantization*	*Frequency Domain: Basics of filtering*	*Edge Linking and Boundary detection*	*Compression StandardsHuffman, Arithmetic coding, LZW coding, Run Length Encoding*	*Topological - Texture – Patterns and Pattern classes*
S-7	SLO-1	*Relationships between pixels*	*Smoothing and Sharpening frequency domain filters*	*Local & Regional processing-Region based segmentation*	*Block Transform coding, Wavelet coding, JPEG standard*	*Recognition based on matching*
S-8	SLO-1	*Introduction to Image processing toolbox in MATLAB*	*Smoothing and Sharpening frequency domain filters*	*Morphological processing- Watershed segmentation algorithm*	*MATLAB code for image compression: Huffam coding, Arithmetic coding, wavelet*	*MATLAB code for image representation*

					coding	
S-9	SLO-1	*Tool box practice*	*MATLAB code for histogram equalization*	*MATLAB code for restoring an image after degradation using adaptive and wiener filter*	*MATLAB code for image compression: Huffam coding,*	*MATLAB code for image recognition*
	SLO-2	*Exploring functions*	*MATLAB code for spatial and frequency domain filter.*	*Edge detection operators*	*Arithmetic coding, wavelet coding*	*MATLAB Practice exercises*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Madhan Thandayithapani kutiyappan, Assistant consultantant, TCS - siruseri	*Dr. S. Sridhar, Anna University*	*Dr. G.Niranjana. Associate Professor/CSE*
	Dr. Senthil kumar, Annauniversity	*Mr. Rajasekar Assistant Professor/IT* *Mr. James Joseph Assistant Professor/SWE*

Course Code	18CSE354T	Course Name	NETWORK SECURITY	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the basic concepts of networking devices*			
CLR-2 :	*Understand the concept of IP security*			
CLR-3 :	*Understand the various methods and protocols to maintain E-mail security*			
CLR-4 :	*Understand the various methods and protocols to maintain web security*			
CLR-5 :	*Understand security measures for wireless and cell phone Communications*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Acquire the knowledge of network devices used in data Communication*	*2*	*80*	*85*
CLO-2 :	*Acquire the knowledge of IP security and ability to identify the IP security attack*	*2*	*75*	*80*
CLO-3 :	*Acquire the knowledge of Email security and ability to detect the attacks in e-mail*	*2*	*85*	*80*
CLO-4 :	*Acquire the knowledge of web security attack and prevention mechanism*	*2*	*80*	*75*
CLO-5 :	*Acquire the knowledge of wireless network security and prevention mechanism*	*2*	*75*	*85*

	Program Learning Outcomes (PLO)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*H*									*H*					
CLO-2 :	*H*														
CLO-3 :	*H*														
CLO-4 :	*H*							*H*							
CLO-5 :	*H*							*H*							

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Networking Devices(Layer1,2)*	*Overview of IPSEC- Security Associations, Security Association Database*	*Security Services for E-mail*	*SSL/TLS Basic Protocol*	*Wireless Security:IEEE 802.11 Wireless LAN*
	SLO-2	*Networking Devices(Layer 3)*	*Security Policy databases , AH and ESP*	*Security Services for E-mail*	*SSL/TLS Basic Protocol*	*Wireless Security:IEEE 802.11 Wireless LAN*
S-2	SLO-1	*Different types of network layer attacks*	*Tunnel and Transport mode*	*Establishing keys*	*computing the keys*	*Authentication*
	SLO-2	*Different types of network layer attacks*	*IP header Protection*	*Establishing Public and secret keys*	*computing the keys*	*Authentication and confidentiality*
S-3	SLO-1	*Firewall- ACL*	*IP and IPv6*	*Privacy*	*client authentication*	*Cellphone Security*
	SLO-2	*Packet Filtering*	*IPV4 and IPV6 header*	*End-to end Privacy, Privacy with distribution List Exploders*	*client authentication*	*GSM (2G) Security*
S-4	SLO-1	*DMZ, Alerts*	*Authentication Header*	*Authentication of the source*	*PKI as deployed by SSL*	*Security in UMTS (3G)*
	SLO-2	*Audit Trials*	*Mutable, Immutable and Mutable but predictable*	*Based on public key technology and secret keys and with distribution list*	*PKI as deployed by SSL*	*Security in UMTS (3G)*
S-5	SLO-1	*IDS*	*Encapsulation Security Payload(ESP)*	*Message Integrity*	*SSLAttacks fixed in v3*	*Wireless LAN Vulnerabilities*
	SLO-2	*Advantages and Disadvantages of IDS(Need of IPS)*	*Internet Key Exchange*	*Non-repudiation*	*SSLAttacks fixed in v3*	*Phishing*
S-6	SLO-1	*Advantages of IPS ove IDS*	*Phases of IKE*	*Introduction and Overviw of PGP*	*Exportability*	*Buffer Overflow*
	SLO-2	*IPS*	*Phase I IKE- Modes and key types*	*Efficient Encoding*	*Exportability*	*Buffer Overflow*
S-7	SLO-1	*IPS Types- Signature based*	*Phase I IKE Protocols*	*Certificate and key revocation*	*Encoding*	*Format String Attacks*
	SLO-2	*Anomaly based, Policy based*	*Phase I IKE Protocols*	*Singature types, Private key, Fing types*	*Encrypted Record*	*Cross-site Scripting (XSS)*
S-8	SLO-1	*IPS Types - Honeypot based*	*Phase II IKE*	*Anomalies*	*Handshake messages*	*SQL Injection*

	SLO-2	*Applications*	*Phase II IKE*	*Object Format*	*Changecipherspec and Alerts*	*SQL Injection*
S-9	SLO-1	*Malicious Software*	*ISAKMP/IKE Encoding*	*S/MIME*	*SET*	*Case Studies: Secure Inter-branch Payment Transactions*
	SLO-2	*Malicious Software*	*ISAKMP/IKE Encoding*	*S/MIME*	*SET*	*Virtual Elections*

Learning Resources	1. *Charlie Kaufman, Radia Perlman, Mike Speciner, Network Security, Prentice Hall of India, 2002.* 2. *Bernard Menezes - Network Security and Cryptography- Cengage Learning. 2010.*	3. *William Stallings, Cryptography and Network Security - Principles and Practice, 7th edition, Pearson Publication, 2017* 4. *Cryptography and network security , AtulkahateTata McGraw-Hill Education,2003*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. M. Sudhakar, M.Tech, (Ph.D)-IIT, IT Infrastructure Service, Tata Consultancy Services.	*Dr. P. Yogesh, Associate Professor, Dept of Information Science and Technology, College of Engineering, Guindy,*	*Dr. A. Jeyasekar, Associate Professor* *Dr. J. Femilda, Associate Professor* *Mrs. G. Sujatha, Assistant Professor*

Course Code	18CSE356T	Course Name	DISTRIBUTED OPERATING SYSTEMS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	*To recognize the essential concepts of distributed system.*
CLR-2 :	*To comprehend about the communication that takes place in Distributed systems*
CLR-3 :	*To realize the necessity of synchronization, consistency and Fault tolerance in a Distributed System.*
CLR-4 :	*To value the Process management, File systems, Shared memory*
CLR-5 :	*To acquire apparent scheme regarding distributed object-oriented based systems*

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Characterize the fundamental hardware and software concepts of distributed systems.*	*3*	*80*	*70*
CLO-2 :	*Categorize layered protocols and comprehend the communications in distributed systems*	*3*	*85*	*75*
CLO-3 :	*Implement synchronization of distributed systems using various algorithms.*	*3*	*75*	*70*
CLO-4 :	*Demonstrate process scheduling and fault tolerance of distributed systems.*	*3*	*85*	*80*
CLO-5 :	*Evaluate various Distributed Object-Oriented based systems.*	*3*	*85*	*75*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	*M*	*M*	*H*	*H*	*M*	-	-	*H*	*M*	-	*H*	-	-	-
H	*M*	*H*	*M*	*H*	*M*	-	-	*H*	*M*	-	*H*	-	-	-
H	*H*	*H*	*H*	*H*	*M*	-	-	*H*	*M*	-	*H*	-	-	-
H	*H*	*H*	*H*	*H*	*M*	-	-	*H*	*M*	-	*H*	-	-	-
H	*H*	*H*	*M*	*H*	*M*	-	-	*H*	*M*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction- Distributed Systems*	*Fundamentals of Communication systems*	*Synchronization in Distributed Systems- Fundamentals of Clock Synchronization*	*Processes and Processors in Distributed Operating Systems - Threads*	*Distributed Shared memory - Introduction*
	SLO-2	*Goals of Distributed Systems*		*Logical clock, Physical clock*	*Design issues of Threads package*	*Bus-Based Multiprocessors*
	SLO-2				*Work Station Model*	*Switched Multiprocessors*
S-2	SLO-1	*Hardware Concepts- Bus-based Multiprocessors*	*Layered Protocols*	*Algorithms for Clock synchronization*	*System Model - Introduction*	*Ring-based Multiprocessors*
S-3	SLO-1	*Switched Multiprocessors*	*ATM networks*	*Mutual Exclusion-Centralized Algorithm*	*Using Idle Work Stations*	*Numa Multiprocessors*
	SLO-2					*Comparison of Shared Memory Systems*
S-4	SLO-1	*Bus-based Multicomputers*	*Client Server model - Blocking Primitives*	*Distributed Algorithm*	*Processor Pool Model, Hybrid Model*	*Consistency Models – Strict Consistency, Casual Consistency, PRAM Consistency*
	SLO-2		*Non-Blocking Primitives*	*Token Ring Algorithm*	*Processor Allocation – Allocation Model*	*Weak Consistency, Release Consistency, Entry Consistency*
S-5	SLO-1	*Switched Multicomputers*	*Buffered Primitives*	*Comparison of all three algorithms*	*Design issues for processor Allocation Algorithms*	*Page Based Distributed Shared Memory – Replication, granularity*
	SLO-2		*Unbuffered Primitives*	*Importance of Election Algorithm*	*Example of processor Allocation Algorithms*	*Finding the Owner,Finding the Copies*
S-6	SLO-1	*Software Concepts-Network Operating System*	*Reliable primitives*	*Bully Algorithm*	*Scheduling in Distributed Systems*	*Page Replacement*
	SLO-2		*Unreliable primitives*	*Ring Algorithm*	*Load Balancing and Sharing Approach*	*Synchronization*
S-7	SLO-1	*True Distributed Systems*	*Message passing and its related issues*	*Atomic Transaction- Introduction*	*Fault Tolerance-Component Faults*	*Shared – Variable Distributed Shared*

						memory
	SLO-2			*Transaction Model, Concurrency Control*	*System Failures*	*Object Based Distributed Shared memory – DOO Architecture*
S-8	SLO-1	*Multiprocessors Timesharing Systems*	*Remote Procedure Call and its related issues*	*Deadlock in Distributed Systems*	*Synchronous versus Asynchronous Systems*	*Distributed Object-Oriented Process*
	SLO-2			*Distributed Deadlock Detection*	*Fault tolerance Using Active Replication, Primary-backup*	*Distributed Object-oriented Communication*
S-9	SLO-1	*Design Issues-Distributed Systems*	*Case Studies: SUN RPC, DEC RPC*	*Distributed Deadlock Prevention*	*Real Time Distributed Systems-Communication*	*Case Study - Amoeba*
	SLO-2				*Real Time Scheduling*	*Mach-OS, Chorus*

Learning Resources	1. *Andrew S. Tanenbaum, "Distributed Operating Systems "PearsonEducation, 2011.* 2. *Pradeep K. Sinha "DistributedOperatingSystems Concepts and Design "PHI 2012.*	3. *Mukesh Singhal, Niranjan G Shivratri "Advanced concepts in Operating Systems ", Mc Graw Hill International 2011.* 4. *http://www.seas.gwu.edu/~jstanton/courses/cs251/* 5. *http://cse.yeditepe.edu.tr/~sbaydere/courses new/cse532/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	*100 %*		*100 %*		*100 %*		*100 %*		-	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
JP Vinjamoori, Director, Pavartha Software Pvt.Ltd, jp@pavarthasoftware.com	*Dr. E.Sivasankar,NIT,Trichy*	*Mrs. S. Aruna, Dr.G. Maragatham, Mrs. A. Jackulin Mahriba, SRMIST*

Course Code	18CSE357T	Course Name	BIOMETRICS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer science*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the concept of authentication using biometrics.*			
CLR-2 :	*Gain knowledge on the basics of biometric traits, sensors and data acquisition*			
CLR-3 :	*Gain knowledge on design of biometric security systems*			
CLR-4 :	*Acquire knowledge on pattern recognition systems*			
CLR-5 :	*Introduce the various feature extraction and matching techniques for different biological traits.*			
CLR-6 :	*Understand the real time application of biometrics*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge on various biometric traits*	*1*	*80*	*85*	*H*	*M*	*H*	*H*	-	-	*H-*	-	-	-	-	-	-	-	-
CLO-2 :	*Acquire the ability to identify pattern recognition system and its features*	*1*	*75*	*80*	*H*	*H*	*H*	*H*	-	-	*H*	-	-	-	-	-	-	-	-
CLO-3 :	*Understand the basic ideas about physical and hehaviourial biometric traits*	*1*	*85*	*80*	*H*	*M*	*M*	*M*	-	-	*M*	-	-	-	-	-	-	-	-
CLO-4 :	*Apply the knowledge of biometrics on developing identification system.*	*2*	*80*	*75*	*H*	*M*	*M*	*M*	-	*H*	-	*H*	-	-	-	-	-	-	-
CLO-5 :	*Apply the knowledge for designing biometric sytems*	*2*	*75*	*85*	*H*	*H*	*L*	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Acquire the knowledge on authentication systems for real time security applications*	*1*	*80*	*85*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction of biometric systems*	*Biometrics Sensors and Data Acquisition*	*Introduction to multibiometrics*	*Biometric system authentication*	*Biometric Authentication Applications*
	SLO-2	*Biometric functionalities: verification, identification*	*Biometric data acquisition and database*	*Sources of multiple evidence*	*physiological and behavioral properties of biometric system,*	*access control like a lock or an airport check-in area*
S-2	SLO-1	*The design cycle of biometric systems*	*Biometrics Pre-processing*	*Acquisition sequence*	*Software biometrics systems*	*immigration and naturalization*
	SLO-2	*Building blocks of a generic biometric system*	*The related biometrics preprocessing technologies*	*Processing sequence*	*Hardware biometrics systems*	*welfare distribution*
S-3	SLO-1	*Introduction to unimodal system*	*Image restoration*	*Fusion level*	*Security of biometric systems*	*military application*
	SLO-2	*Introduction to Multimodal biometric system*	*Image segmentation*	*Sensor level fusion*	*Advisory,insider,infrastructure attacks*	*banking, e.g., check cashing, credit card, ATM*
S-4	SLO-1	*Biometric system errors*	*Pattern extraction and classification*	*Feature level fusion*	*Attacks at the user interface*	*computer login; intruder detection; smart card*
	SLO-2	*Performance measures*	*Pattern classification*	*Score level fusion*	*impersonation ,obfuscation, spoofing*	*multi-media Communication; WWW and an electronic purse*
S-5	SLO-1	*Image processing basics*	*Fingerprint Recognition and acquisition*	*Rank level fusion*	*Attacks on biometric processing*	*sensor fusion; decision fusion*
	SLO-2	*what is image, acquisition, type, point operations, Geometric transformations*	*Fingerprint features, matching and synthesis*	*Decision level fusion*	*Attacks on system module and interconnections*	*categorization: e.g., age and gender*
S-6	SLO-1	*First and second derivative*	*Face recognition and acquisition*	*Features Matching and Decision Making*	*Counter measure: Biometric template security*	*industrial automation*

	SLO-2	steps in edge detection, smoothening, enhancement, thresholding, localization,	Face detection, feature extraction and matching	Feature matching: null and alternative hypothesis h0, h1, Error type I/II, Matching score distribution, FM/FNM, ROC curve, DET curve, FAR/FRR curve.	Countermeasure:spoof dectection	gesture interpretation;
S-7	SLO-1	Robert's method, Sobel's method, Perwitts	Iris recognition and acquisition	Introduction to Various matching methods:	Challenges in biometric systems like fool proofing, false positives	efficient enrollment
	SLO-2	Laplacian of Gaussian, Zero crossing	Iris Segmentation, normalization and matching	LDA	Developing Tools for Comparing fingerprints	audio-visual tracking
S-8	SLO-1	Low level feature extraction, Describing image motion	Ear recognition	PCA, Eigen vectors and values, 2D-PCA,	Enhancing pattern when data is minimum	stock market;
	SLO-2	High level feature extraction ,Template matching	Ear detection	generalization to p-dim, covariance and correlation, algebra of PCA, projection of data	Biometric failures in special cases like(too much moisture in hands which system can't read)	on-line shopping
S-9	SLO-1	Hough transform for lines	Hand geometry features	Introduction to decision theory and their examples	Mini project: Fingerprint, Face detection	compact embedded systems
	SLO-2	Hough transform for circles and ellipses	palmprint features	Explanation – examples	Mini project: signature ,iris detection	other commercialized services

Learning Resources	1. James wayman,Anil k.Jain ,Arun A.Ross ,Karthik Nandakumar, —Introduction to. Biometricsll, Springer, 2011 2. Mark S.Nixon, Alberto S.Aguado, Feature Extraction and image processing for computer vision, Third Edition, , Elsevier 2012 3. Digital Image Processing using MATLAB, By: Rafael C. Gonzalez, Richard Eugene Woods, 2nd Edition, Tata McGraw-Hill Education 2010	4. Guide to Biometrics, By: Ruud M. Bolle, Sharath Pankanti, Nalini K. Ratha, Andrew W. Senior, Jonathan H. Connell, Springer 2009 5. Pattern Classification, By: Richard O. Duda, David G.Stork, Peter E. Hart, Wiley 2007 6. Shimon K.Modi , —Biometrics in Identity Management :concepts to applicationsll, Artech House 2011

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Raghuraghavendra s, Chief Executive Officer at Forensic & Biometric Investigation Services FBIS Chennai, Tamil Nadu, India Chennai Area, India	1. Dr. J.Dhalia Sweetlin Designation:Assistant Professor [Sr Grade] Madras Institute of Technology, MIT Road, Radha Nagar,Chromepet, Chennai,Tamil Nadu 600044, India.Email:jdsweetlin@mitindia.edu Area of Specialization: Image Processing, Soft Computing	1. Dr. C. Malathy, SRMIST
		2. M.Gayathri, SRMIST 3.Ms.Meenakshi/IT Dept,SRMIST

Course Code	18CSE358T	Course Name	PATTERN RECOGNITION TECHNIQUES	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the fundamentals of Pattern Recognition techniques*			
CLR-2 :	*Learn Statistical models of Pattern Recognition*			
CLR-3 :	*Understand the principles of Clustering approaches to Pattern Recognition*			
CLR-4 :	*Understand the Syntactic Pattern Recognition techniques*			
CLR-5 :	*Understand the Neural Network approach to Pattern Recognition*			
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Acquire the knowledge on various biometric traits*	2	80	85
CLO-2 :	*Acquire the ability to identify pattern recognition system and its features*	2	75	80
CLO-3 :	*Understand the basic ideas about physical and hehaviourial biometric traits*	2	85	80
CLO-4 :	*Apply the knowledge of biometrics on developing identification system.*	2	80	75
CLO-5 :	*Apply the knowledge for designing biometric sytems*			

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Pattern and features*	*Introduction to StatPR, Statistical models,*	*Formulation of unsupervised problems*	*Syntactic Pattern Recognition, Grammar based approaches,*	*Neural Networks fundamentals, Learning in Neural networks,*
	SLO-2	*Classification, Description, Pattern Mappings*	*Gaussian case and Class Dependence*	*Illustration*	*Formal Grammars, Types of Grammars*	*Physical Neural Networks*
S-2	SLO-1	*Patterns and Feature Extraction*	*Discriminant Functions- Uniform Densities*	*Unsupervised Learning Approaches*	*String generation as Pattern Description*	*Artificial Neural Networks model,*
	SLO-2	*Examples*	*Classifier Performance, Risk and Errors*	*Illustration*	*Example*	*activation functions, weights*
S-3	SLO-1	*Classifiers*	*Supervised learning – Parametric estimation*	*Clustering for unsupervised learning and classification*	*Recognition by String Matching and Parsing,*	*Neural Network based Pattern Associators, CAM*
	SLO-2	*Example*	*Maximum Likelihood Estimation*	*Example*	*Example*	*Linear Associative Mappings, Different approaches*
S-4	SLO-1	*Decision Regions*	*Bayesian parameter estimation*	*c-means algorithm*	*Cocke-Younger-Kasami Parsing Algorithm*	*Heteroassociative memory design*
	SLO-2	*Boundaries*	*Example*	*Illustration*	*Illustation*	*Examples*
S-5	SLO-1	*Training in pattern recognition systems*	*Nonparametric approaches-*	*Learning Vector Quantization,*	*Augmented Transition Networks, High Dimensional Grammars,*	*Hebbian learning*
	SLO-2	*Learning in pattern recognition systems*	*Density estimation*	*Example*	*Example*	*Example*
S-6	SLO-1	*Pattern recognition approaches*	*Parzen Windows*	*Formal Characterization of General Clustering Procedures*	*Stochastic Grammars and applications*	*Feedforward Network Architecture, Training in Feedforward networks,*
	SLO-2	*Statistical pattern recognition, Example*	*k-nn Nonparametric estimation*	*Explanation on procedure*	*Example*	*Explanation*
S-7	SLO-1	*Syntactic pattern recognition*	*Nearest Neighbor Rule*	*Clustering Strategies*	*Graph based structural representations*	*GDR, Derivation of Delta Rule*
	SLO-2	*Examples*	*Example*	*Different scenarios*	*Graph Isomorphism*	*Explanation*

S-8	SLO-1	*Neural pattern recognition*	*Linear Discrimant Functions, Fisher's Linear Discriminant*	*Cluster Swapping Approaches*	*Attributed Graphs, Match Graphs,*	*Backpropagation Algorithm,*
	SLO-2	*Comparison*	*Discrete and Binary Classification problems*	*Examples*	*Examples*	*Explanation*
S-9	SLO-1	*Black Box approaches*	*Techniques to directly obtain Linear Classifiers*	*Hierarchical clustering procedure*	*Cliques, Structural Unification using attributed graphs*	*Pattern Associator for Character Classification*
	SLO-2	Reasoning driven pattern recognition	Illustration	Example	Examples	Example

Learning Resources	1. Robert J, Schalkoff, "Pattern Recognition: Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., New York, Reprint 2014.	2. Earl Gose, Richard Johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India Private Ltd., New Delhi – 110 001,1999. 3. DudaR.O.andHartP.E.,"Pattern Classification and Scene Analysis",Wiley,NewYork,1973

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Deepan Raj, Visteon,Chennai	*Dr.T.Nagarajan, Professor and Head, Dept. of IT, SSN college of Engineering.*	*1. Dr. M. Thenmozhi, SRMIST*
		2. Dr.S Prabakaran, SRMIST
		3. Dr. Alice Nithya , SRMIST

Course Code	18CSE359T	Course Name	NATURAL LANGUAGE PROCESSING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Teach students the leading trends and systems in natural language processing.*			
CLR-2 :	*Make them understand the concepts of morphology, syntax, semantics and pragmatics of the language and that they are able to give the appropriate examples that will illustrate the above mentioned concepts.*			
CLR-3 :	*Teach them to recognize the significance of pragmatics for natural language understanding.*			
CLR-4 :	*Enable students to be capable to describe the application based on natural language processing and to show the points of syntactic, semantic and pragmatic processing.*			
CLR-5 :	*To conceive basics of knowledge representation, inference, and relations to the artificial intelligence.*			
CLR-6	*To understand natural language processing and to learn how to apply basic algorithms in this field*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Understand approaches to syntax and semantics in NLP.*			
CLO-2 :	*Understand approaches to discourse, generation, dialogue and summarization within NLP.*	*2*	*80*	*85*
CLO-3 :	*Understand current methods for statistical approaches to machine translation.*	*2*	*75*	*80*
CLO-4 :	*Understand machine learning techniques used in NLP, including the probabilistic context-free grammars and unsupervised methods, as applied within NLP*	*2*	*85*	*80*
CLO-5 :	*Understand the knowledge of various levels of analysis involved in NLP*	*2*	*80*	*75*
CLO-6	*Gain knowledge in automated Natural Language Generation and Machine Translation*	*2*	*75*	*85*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :															
CLO-2 :	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	*M*	*M*	*H*	*H*	*H*	*H*
CLO-3 :	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	*M*	*M*	*H*	*H*	*H*	*H*
CLO-4 :	*H*	*L*	*M*	*H*	*H*	-	-	-	*H*	*M*	*M*	*H*	*H*	*H*	*H*
CLO-5 :	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	*M*	*M*	*H*	*H*	*H*	*H*
CLO-6	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	*M*	*M*	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Natural Language Processing*	*Syntax Parsing*	*Semantic Relations*	*Information Extraction and its approaches*	*Introduction to Probabilistic Approaches*
	SLO-2	*Steps – Morphology – Syntax – Semantics*	*Dependency Parsing*	*Semantic Role Labeling*		*Statistical Approaches to NLP Tasks*
S-2	SLO-1	*Morphological Analysis (Morphological Parsing)*	*Semantics*	*Semantic Frames*	*Information Retrieval*	*Sequence Labeling*
	SLO-2	*Stemming – Lemmatization*	*Semantic Parsing*	*Ontology and Semantics*		
S-3	SLO-1	*Parts of Speech Tagging*	*Word Sense Disambiguation*	*Semantic Network and Knowledge Graph*	*Semantic Search*	*Problems - Similarity Measures*
	SLO-2					
S-4	SLO-1	*Approaches on NLP Tasks (Rule-based, Statistical, Machine Learning)*	*Lexical Disambiguation*	*Intent Detection and Classification*	*Summarization*	*Word Embeddings*
	SLO-2				*Extractive Vs Abstractive, Summarization*	
S-5	SLO-1	*N-grams*	*Structural Disambiguation*	*Paraphrase Extraction*	*Information Fusion*	*CBOW*
	SLO-2					
S-6	SLO-1	*Multiword Expressions*	*Word, Context and Sentence-level Semantics*	*Discourse*	*Single and Multi-document*	*Skip-gram*
	SLO-2			*Coreference Resolution*	*Summarization – Question Answering*	
S-7	SLO-1	*Collocations (Association Measures, Coefficients and Context Measures)*	*Pronoun Resolution*	*Text Coherence*	*Introduction to Chatbot Applications*	*Sentence Embeddings*
	SLO-2				*Retrieval based- Conversation based*	

S-8	SLO-1	*Vector Representation of Words*	*Semantic Representation of text*	*DiscourseStructure*	*NLU and NLG*	*Recurrent Neural Networks (RNN)*
	SLO-2			*Coherence*		
S-9	SLO-1	*Language Modeling*	*Introduction to Semantic Relations*	*Discourse Planning*	*Machine Translation*	*Long Short-Term Memory (LSTM)*

Learning Resources	1. *DanielJurafskyandPrenticeHallJamesHMartin,"SpeechandLanguageProcessing:An introductionton NaturalLanguage Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition,2018.* 2. *C.Manning and H.Schutze, "Foundations of Statistical Natural Language Processing", MIT Press. Cambridge,MA:,1999*	3. *JamesAllen,Bejamin/cummings,"NaturalLanguageUnderstanding",2ndedition,1995* 4. *YoavGoldberg,Neural Network Methods for Natural Language Processing.* 5. *http://mccormickml.com/2106/04/19/word2vec-tutorial-the-skip-gram-model/* 6. *https://nlp.stanford.edu/pubs/glove.pdf*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. J.Balaji, Associate Manager,Allstate Solutions Pvt Ltd, jagank.balaji@gmail.com	*1. Dr.G.Nagappan, Professor, nagappan@saveetha.ac.in*	*1. Dr. M.Ferni Ukrit, SRMIST*
		2. Dr.A.Pandian, SRMIST
		3.Ms.K.Meenakshi, SRMIST

Course Code	18CSE360T	Course Name	INFORMATION STORAGE AND MANAGEMENT	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the components of storage infrastructure.*
CLR-2 :	*Gain knowledge to evaluate storage architectures including storagesubsystems*
CLR-3 :	*Understand the business continuity, backup and recovery methods.*
CLR-4 :	*Acquire knowledge on information security framework*
CLR-5 :	*Introduce the working principle of storage infrastructure with monitoring principles*
CLR-6 :	*Understand the structure of cloud computing and its techniques*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge on the components of storage infrastructure*	*3*	*80*	*70*	*M*	-	-	-	-	-	-	-	*L*	-	-	*M*	-	-	-
CLO-2 :	*Acquire the ability to evaluate storage architectures including storagesubsystems*	*3*	*85*	*75*	*M*	*M*	*M*	*M*	-	-	-	-	*L*	-	-	*H*	-	-	-
CLO-3 :	*Understand the business continuity, backup and recovery methods.*	*3*	*75*	*70*	*M*	*M*	*M*	*M*	-	-	-	-	*L*	-	-	*H*	-	-	-
CLO-4 :	*Appreciate the concepts of storage security and information security applied to virtual machine*	*3*	*85*	*80*	*M*	*M*	*L*	*L*	-	-	-	-	*M*	-	-	*H*	-	-	-
CLO-5 :	*Apply the knowledge for storage infrastructure*	*3*	*85*	*75*	*L*	*M*	-	-	-	-	-	-	*M*	-	-	*H*	-	-	-
CLO-6 :	*Acquire the knowledge on structure of cloud computing and its techniques*	*3*	*80*	*70*	*M*	-	-	-	-	-	-	-	*L*	-	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Information Storage Management*	*Virtualization and Cloud Computing : Fiber Channel: Overview*	*Business Continuity And Back Up Recovery Business Continuity: Information Availability.*	*Storage Security And Management :*	*Cloud Computing:Cloud Enabling Technologies*
	SLO-2	*Evolution of Storage Architecture*	*SAN and its Evolution*	*BC Terminology, BC Planning life cycle*	*Information Security Framework*	*Characteristics of Cloud Computing*
S-2	SLO-1	*Data Centre Infrastructure*	*Components of FC SAN, FCConnectivity, FC Architecture*	*Failure Analysis, Business Impact Analysis*	*Risk Triad*	*Benefits of Cloud Computing*
	SLO-2	*Virtualization and Cloud Computing*	*IPSAN-iSCSI components*	*BC Technology Solutions*	*Storage Security Domains*	*Cloud Service Models*
S-3	SLO-1	*Key challenges in managing information.*	*iSCSI Protocol StackiSCSI Names*	*Backup and Archive: Backup Purpose*	*Security Implementations in Storage Networking*	*Cloud Deployment models*
	SLO-2	*Data Center Environment: Application*	*NAS: General Purpose Servers versus NAS Devices*	*Backup Considerations*	*Securing Storage Infrastructure in Virtualized and Cloud Environments*	*Cloud Infrastructure Mechanism: Logical Network Perimeter*
S 4-5	SLO-1	*Database Management System (DBMS)*	*Benefits of NAS- File Systems and Network File Sharing*	*Backup Granularity , Recovery considerations*	*RSA and VMware Security Products*	*Virtual Server , Cloud Storage Device*
	SLO-2					
S-6	SLO-1	*Host : Connectivity, Storage*	*Components of NAS*	*Backup Methods, Backup Architecture*	*Monitoring the Storage Infrastructure*	*Cloud Usage Monitor*
	SLO-2	*Disk Drive Components,Disk Drive Performance*	*NAS I/O Operation*	*Backup and Restore Operations*	*Monitoring Parameters,*	*Resource Replication*
S-7	SLO-1	*Intelligent Storage System*	*NAS Implementations*	*Backup Topologies*	*Components Monitored, Monitoring examples*	*Ready Made environment*
	SLO-2	*Components of an Intelligent Storage System*	*NAS File Sharing Protocols*	*Backup in NAS Environments*	*Storage Infrastructure Management Activities*	*Container*

S-8	SLO-1	*Storage Provisioning*	*Object Based Storage Devices*	*Backup Targets, Data Deduplication for Backup*	*Storage Infrastructure Management Challenges, Storage Management Examples*	*Cloud Challenges*
	SLO-2	*Types of Intelligent Storage Systems*	*Content Addressed Storage*	*Backup in Virtualized Environments*	*Storage Allocation to a New Server/Host,*	*Cloud Adoption Considerations*
S-9	SLO-1 SLO-2	*Creation of Virtual storage machine, Navigation of storage system .*	*Configuration and Tracing of FC scan and iSCSI scan*	*Sharing Files between host and Virtual Machines, Usage of Backup techniques*	*Creation of an Linux Instance in Public Cloud, Generate a private key, Access using SSH client*	*Usage of Cloud services with open source cloud tools (like Eucalyptus, Openstack, Open Nebula and others)*

Learning Resources	1. *EMC Corporation, "Information Storage and Management",2nd edition Wiley India, ISBN13: 978-1118094839* 2. *Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall , 2013,ISBN: 9780133387568*	3. *UifTroppen Rainer Wolfgang Muller,"Storage Networks Explained", India, Wiley, 2010, ISBN13: 978-0470741436*

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100%	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	Dr.V.Masillamani	*1. Dr.B.Amutha SRMIST*
		2. Dr.A.Shanthini, SRMIST

Course Code	18CSE451T	Course Name	WIRELESS SENSOR NETWORKS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand basic sensor network concepts*			
CLR-2 :	*Know physical layer issues, Medium Access Control Protocols*			
CLR-3 :	*Comprehend network and transport layer characteristics and protocols*			
CLR-4 :	*Understand the network management and Middleware services*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Understand the basic ideas about sensor network concepts with Applications and Apply the knowledge for WSN tools*	*2*	*80*	*85*	*H*	*H*	*H*	*H*	*M*	*M*	*M*	*M*	*M*	*H*	*L*	*H*	*H*	*H*	*H*
CLO-2 :	*Acquire the knowledge on wireless transmission technology ,hardware and Medium Access Protocols*	*2*	*75*	*80*	*H*	*H*	*H*	*H*	*M*	*M*	*M*	*M*	*M*	*H*	*L*	*H*	*H*	*H*	*H*
CLO-3 :	*Understand the basic ideas about Wireless Sensor Networks Routing protocols and network - transport layer characteristics*	*2*	*85*	*80*	*H*	*H*	*H*	*H*	*M*	*M*	*M*	*M*	*M*	*H*	*L*	*H*	*H*	*H*	*H*
CLO-4 :	*Apply the knowledge for network management and Middleware services*	*2*	*80*	*75*	*H*	*H*	*H*	*H*	*M*	*M*	*M*	*M*	*M*	*H*	*L*	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to computer and wireless sensor networks*	*Wireless Transmission Technology and systems*	*Overview-Wireless Mac Protocols*	*Design Issues in WSN routing- Data Dissemination and Gathering*	*WSN middleware principles-*
	SLO-2				*Routing Challenges in WSN*	
S-2	SLO-1	*Motivation for a network of Wireless Sensor nodes -*	*Radio Technology Primer*	*Characteristics of MAC protocols in Sensor networks*	*Flooding*	*Middleware architecture*
	SLO-2	*Sensing and sensors*	*Available Wireless Technologies*			*Data related functions, Architecture*
S-3	SLO-1	*Challenges and constraints*	*Hardware- Telosb*	*Contention free MAC Protocols*	*Flat Based Routing – SAR*	*Existing middleware*
	SLO-2				*Directed Diffusion*	*MiLAN, IrisNet*
S-4	SLO-1	*Node architecture*	*Hardware -Micaz motes*	*MAC Protocols -Characteristics*	*MCFA Coherent processing*	*AMF,DSWare*
	SLO-2	*Sensing sub system*		*Traffic Adaptive Medium Access*	*Non-Coherent Processing*	*CLMF*
S-5	SLO-1	*Processor sub system*	*Time Synchronization- Clock*	*Y-MAC*	*Hierarchical Routing- LEACH,TEEN, APTEEN,PEGASIS*	*Operating systems for wireless sensor networks*
	SLO-2	*Communication interfaces-- prototypes*		*Low energy Adaptive Clustering*		
S-6	SLO-1	*Application of Wireless sensors*	*Synchronization Problems*	*Contention based MAC Protocols*	*Query Based Routing*	*Performance and traffic management*
	SLO-2				*Negotiation Based Routing*	
S-7	SLO-1	*WSN Tools- Overview and Limitations*	*Basics of time synchronization*	*Sensor MAC*	*Geographical Based Routing*	*Fundamentals of network security*
	SLO-2		*Time synchronization protocols*	*Timeout MAC and pattern MAC*		
S-8	SLO-1	*Contiki -Introduction*	*Localization*	*MAC protocols in ContikiOS simulator*	*Routing protocol simulation in contiki*	*Network security Challenges*
	SLO-2		*Ranging Techniques*	*Nullmac in Contiki simulator*	*RPL objective function &simulation using DGRM model cooja*	
S-9	SLO-1	*Characteristics of Contiki WSN simulator*	*Range based Localization Range Free*	*CSMA in Contiki simulator*	*RPL(Routing Protocol for Low-Power and*	*Attacks Protocols mechanisms for security*

			Localization		*Lossy Networks) Border Router simulation*	
	SLO-2		*Event driven Localization*		*in Contiki 2.7 OS*	

Learning Resources	1. *Kazem Sohraby, Daniel manoli , "Wireless Sensor networks- Technology, Protocols and Applications", Wiley InterScience Publications 2013.* 2. *Waltenegus Dargie, Christian Poellabauer , "Fundamentals of Wireless Sensor Networks, Theory and Practice", Wiley Series on wireless Communication and Mobile Computing, 2011* 3. *S.Swapna Kumar, "A Guide to Wireless Sensor Networks", kindle Edition, USP publications,2017* 4. *C.S Raghavendra, Krishna M.Sivalingam, Taieb znati , "Wireless Sensor Networks", Springer Science 2010.*	5. *Bhaskar Krishnamachari , " Networking Wireless Sensors", Cambridge University Press, 2005* 6. *https://www.amazon.in/Guide-Wireless-Sensor-Networks-ebook/dp/B072R53JJM* 7. *https://anrg.usc.edu/contiki/index.php/Contiki_tutorials* 8. *file:///C:/Users/Administrator.RD27/Downloads/Fundamentals-of-Wireless-Sensor-Networks-Waltenegus-Dargie.pdf*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mr.Anirban Chowdhry, Director, Frugal Labs	*1. Dr. P.T.V. Bhuvaneshwari, Professor, MIT campus, Anna University*	*1. Dr. Revathi Venkatraman, SRMIST* *2. Dr.N.Snehalatha, SRMIST* *3. Dr.MB.Mukesh krishnan, SRMIST*

Course Code	18CSE452T	Course Name	NETWORK PROTOCOLS AND PROGRAMMING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
CLR-1 :	*Describe the importance of various Internet protocols like ARP, RARP, ICMP, Multicasting and multi routing, SCTP*	1	2	3
CLR-2 :	*Understand the transport layer protocols , application layer protocol and its characteristics*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-3 :	*Learn and Understand IPV6 technologies*			
CLR-4 :	*Work with client server sockets and develop related applications to communicate with each other.*			
CLR-5 :	*Understand the wide area network protocols*			
CLR-6 :	*Learn the basics of MPLS protocol*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Identify the basics of different types of network and transport layer protocols*	*2*	*80*	*85*
CLO-2 :	*Design and implement the socket programming*	*2*	*75*	*80*
CLO-3 :	*Enumerate the types of application layer protocols*	*2*	*85*	*80*
CLO-4 :	*Analyze and compare the IPv4 and IPv6 protocols*	*2*	*80*	*75*
CLO-5 :	*Familiarize with wide area technologies*	*2*	*75*	*85*
CLO-6 :	*Describe the working of MPLS protocol*	*2*	*80*	*85*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*IP header*	*Byte ordering*	*DNS*	*IPV6 Overview*	*DSL*
	SLO-2	*IP fragmentation*	*Byte ordering conversion functions*	*DNS in the Internet,*	*IPV6 Features*	*Other DSL Technology*
S-2	SLO-1	*ARP*	*System calls*	*DNS Resolution*	*IPV6 Addressing Modes*	*DSL Benefits*
	SLO-2	*RARP*	*Sockets*	*DNS Messages*	*IPV6 Address Types*	*Cable Technology*
S-3	SLO-1	*ICMP -introduction*	*System calls used with Sockets*	*TELNET*	*Introduction*	*Compare DSL Vs Cable*
	SLO-2	*ICMP-Messages*	*Iterative and concurrent server*	*SSH*	*Address Space Allocation*	*Frame Relay*
S-4	SLO-1	*Debugging tools*	*Socket Interface*	*FTP*	*Global Unicast Addresses*	*ATM Introduction*
	SLO-2	*ICMP package*	*Structure and Functions of Socket*	*TFTP*	*Autoconfiguration*	*ATM Cell Format*
S-5	SLO-1	*UDP Datagram*	*Remote Procedure Call*	*WWW Architecture*	*Renumbering*	*ATM Layer*
	SLO-2	*UDP characteristics*	*RPC Model, Features*	*WWW Documents*	*IPV6 Routing Protocols*	*AAL Layer*
S-6	SLO-1	*TCP Header*	*TCP Client Server Program*	*HTTP*	*Introduction*	*ATM Application*
	SLO-2	*TCP connection establishment process*	*Input, Output Processing Module*	*HTTP Request and Reply*	*IPV6 Packet Format*	*PPP*
S-7	SLO-1	*TCP Error Control*	*UDP Client Server Program*	*DHCP Operation*	*Comparison between IPV4 and IPV6 Header*	*PPP Services, Components*
	SLO-2	*TCP Congestion Control*	*UDP Control block table & Module*	*DHCP Configuration*	*IPV4 to IPV6 Tunneling*	*PPP frame and byte stuffing*
S-8	SLO-1	*TCP Flow Control*	*UDP Input & Output Module*	*SMTP*	*IPV4 to IPV6 Translation Techniques*	*HDLC*
	SLO-2	*Multicasting*	*SCTP Sockets*	*POP3*	*NAT Protocol Translation*	*HDLC Transfer Modes, Frame*

S-9	SLO-1	*Multicasting and Multicast Routing Protocol*	*SCTP Services and Features, Packet Format*	*IMAP*	*IPV6 Mobility*	*Types of HDLC Frame*
	SLO-2	*Stream Control Transmission Protocol*	*SCTP Client/Server*	*MIME*	*Protocols Changed to Support IPV6*	*MPLS*

Learning Resources	1. *BehrouzA.Forouzan,"TCPIPProtocolSuite"4th edition,2013,McGraw-HillISBN:0073376043* 2. *DouglasE.Comer,InternetworkingwithTCP/IP,Principles,protocols,andarchitecture,Vol15th Edition,2006 ISBN: 0131876716, ISBN:978-0131876712*	3. *Richard Stevens, Unix Network Programming, vol.1, 3rd edition, 2003, McGraw-HillISBN 0-07-246060-1*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.Thamaraiselvam,zoho, thamaraiselvam.s@zohocorp.com	*1.Dr.Ema,Anna University Chennai,umaramesh@auist.net*	*1. Dr. G.Usha,SRMIST,Dr.J.Kalaivani,SRMIST*
2.Mr.Mithun, Cognizant,Mithun.SS@cognizant.com	*2.Dr.KunvarSingh,NITTrichy,kunwar@nitt.edu*	*2. Mr.J.GodwinPon,SRMIST*

Course Code	18CSE453T	Course Name	NETWORK ROUTING ALGORITHMS	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	18CSC302J	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards		Nil	

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Understand how addressing and routing are tied together and different architectural components are related to routing.			
CLR-2 :	Gain knowledge on the need for routers, its functionality and different architectures.			
CLR-3 :	Understand fundamental basis of various algorithms in centralized and distributed point of view.			
CLR-4 :	Apply the knowledge of IP addressing in various routing algorithms.			
CLR-5 :	Understand the various types of key routing protocols used in wireless networks.			
CLR-6 :	Gain knowledge on past experiences and prepare for next generation networks and routing			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Acquire the knowledge of how data transfer happens in conventional networks	2	80	85	H	M	-	-	L	-	-	-	-	M	-	H		-	-
CLO-2 :	Comprehend Router Architectures and IP Address Lookup Algorithms	2	75	80	H	H	M	M	L	-	-	-	-	-	L	H	-	-	-
CLO-3 :	Compare routing techniques and protocols	2	85	80	H	H	L	M	M	-	-	-	M	-	L	H	-	-	-
CLO-4 :	Examine how different dimensions of routing differ for different types of network	2	80	75	H	H	H	H	H	L	-	M	M	-	-	H	-	-	-
CLO-5 :	Apply various routing algorithms in wireless network scenario.	2	75	85	H	H	H	H	M	-	-	-	M	-	-	H	-	-	-
CLO-6 :	Understand various routing paradigms in next generation	2	80	85	H	H	H	M-	M	L	-	-	-	-	-	H	-	-	-

Duration (hour)		8	9	9	9	10
S-1	SLO-1	Network Routing: An Introduction to Routing algorithms	Router Architectures: Basic Forwarding Functions	Bellman-Ford algorithm: Centralized View	Routers, Networks, and Routing Information: Some Basics	Routing in Wireless Networks: Internet based mobile ad-hoc networking
	SLO-2	Functions of Router	Routing table versus forwarding table	Distance Vector Approach: Distributed View	Routing Table, Communication of Routing Information	Classifications of routing protocols
S-2	SLO-1	IP addressing	Types of router	Dijkstra's Algorithm	Routing Information Protocol, Version 1 (RIPv1)	Table-Driven Routing Protocols: Destination Sequenced Distance-Vector Routing Protocol
	SLO-2	On Architecture: Service Architecture	Elements of Router	Comparison of Bellman-Ford and Distance Vector Approach	Routing Information Protocol, Version 2 (RIPv2)	Cluster-Head Gateway Switch Routing Protocol
S-3	SLO-1	Protocol architecture stack	Packet Flow	Shortest Path Computation with Candidate Path Caching	Interior Gateway Routing Protocol (IGRP)	On-Demand Routing Protocols: Dynamic Source Routing Protocol
	SLO-2		Packet Processing	Widest Path Computation with Candidate Path Caching	Enhanced Interior Gateway Routing Protocol (EIGRP), Route Redistribution	Ad Hoc On-Demand Distance-Vector Routing Protocol
S-4	SLO-1	Network Topology Architecture	Shared CPU architecture, Shared forwarding Engine Architecture	Widest Path Algorithm	OSPF: Protocol Features	Hybrid Routing Protocols: Core Extraction Distributed Ad Hoc Routing Protocol
	SLO-2	Network Management Architecture	Shared Nothing Architectures, Clustered Architectures	k-Shortest Paths Algorithm	OSPF Packet Format	Zone Routing Protocol
S-5	SLO-1	Public Switched Telephone Network	Impact of Addressing on lookup	Routing Protocol, Routing Algorithm, and Routing Table	Integrated IS-IS	Routing Protocols With Efficient Flooding Mechanisms : Preferred Link-Based Routing Protocols

			Longest Prefix Matching	*Routing Information Representation and Protocol Messages*	*Similarities and Differences Between IS-IS and OSPF*	*Optimized Link State Routing*
S-6	SLO-1	*Communication Technologies*	*Naïve Algorithms, Binary Tries*	*Distance Vector Routing Protocol*	*IP Traffic Engineering: Traffic, Stochasticity, Delay, and Utilization*	*Hierarchical Routing Protocols*
					Applications' View	*Power-Aware Routing Protocols*
S-7	SLO-1	*Standard Committees – International Telecommunication Union*	*Multi-bit Tries*	*Link State Routing Protocol*	*Traffic Engineering: An Architectural Framework*	*Toward Next Generation Routing: Quality of Service Routing*
	SLO-2	*Internet Engineering Task Force, MFA Forum*	*Compressing multi-bit strides*		*Traffic Engineering: A Four-Node Illustration*	
S-8	SLO-1	*Type Length Value*	*Search By Length Algorithms*	*Path Vector Routing Protocol*	*BGP Operations, configuration, faces of BGP*	*Multiprotocol Label Switching(MPLS)*
	SLO-2	*Network Protocol Analyzer*	*Search By value approaches*		*BGP Decision Process*	*Generalized MPLS*
S-9	SLO-1		*Hardware Algorithms*	*Network Flow Modeling: Single-Commodity Network Flow*	*Internal BGP Scalability*	*Routing and Traffic Engineering with MPLS*
	SLO-2		*Comparing Different Approaches*	*Multicommodity Network Flow: Three-Node Example*	*Protocol Message Format*	
S-10	SLO-1					*PSTN Call Routing Using the Interne*
	SLO-2					

Learning Resources	1. *D.Medhi and K.Ramasamy, Network Routing : Algorithms, Protocols and Architectures, Morgan Kaufmann Publishers, First Edition 2007.* 2. *C.Siva Ram Murthy and B.S.Manoj, Adhoc Wireless Networks, Pearson Education, 2007.* 3. *D.Medhi and K.Ramasamy, Network Routing : Algorithms, Protocols and Architectures, Morgan Kaufmann Publishers, Second Edition 2017.*	4. *Steen Strub M, Routing in Communication networks, Prentice Hall International, 1995.* 5. *Internetworking Technologies Handbook, Inc. Cisco Systems, ILSG Cisco*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. T.Bernald , Senior Consulatant , TCS Chennai. bernald.t@tcs.com (waiting for approval)	*Dr. S.Anbuchelian, Anna University. anbuchelian@annauniv.edu*	1. *Dr.Femilda Josephin J S, SRMIST*
		2. *Mr.Rajesh Babu, SRMIST*
		3. *Mr. J.Godwin, SRMIST*

Course Code	18CSE454T	Course Name	HIGH PERFORMANCE COMPUTING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*To learn about Modern Processors and concepts*			
CLR-2 :	*To understand the basic concepts of optimizations*			
CLR-3 :	*To learn about Parallel Computers and programming*			
CLR-4 :	*To understand the basic concepts of parallelization*			
CLR-5 :	*To Study about Memory Parallel Programming using OpenMP*			
CLR-6 :	*To Study about Memory Parallel Programming using and MPI*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge of Modern processors and concepts*	*2*	*80*	*85*	*H*	*H*		-	-			-	-	*H*	-	-	-	-	-
CLO-2 :	*Understand the basic ideas about Optimizations*	*2*	*75*	*80*	-	*H*	-	-	-	-	-	-	-	-	-	-	-	-	*H*
CLO-3 :	*Acquire the ability to identify parallel computers*	*2*	*85*	*80*	-	-	*H*	-	-	-	-	*M*	-	-	*L*	-	-	-	-
CLO-4 :	*Appreciate the concepts of parallelization*	*2*	*80*	*75*	-	*H*	-	-	*H*	-	-	-	*H*	-	-	*H*		-	-
CLO-5 :	*Apply the knowledge on parallel programming using Open MP*	*2*	*75*	*85*	-	-	-	*H*	-	*L*	*L*	-	-	-	-	-	-	-	-
CLO-6 :	*Acquire the knowledge on parallel programming using MPI*	*2*	*80*	*85*	-	-	-	-	-	-	-	-	-	-	-	-	*H*	*H*	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Stored Program Computer Architecture*	*Scalar profiling- Function- and line-based runtime profiling*	*Taxonomy of parallel computing paradigms*	*Introduction to OpenMP*	*Distributed-memory parallel programming with MPI- Message passing*
	SLO-2	*General-ptupose cache-based microprocessor architecture*	*Hardware performance counters .*	*Shared-memory computers*	*Parallel execution*	*introduction to MPI*
S-2	SLO-1	*Performance based metrics and Benchmarks*	*Manual instrumentation*	*Cache coherence*	*Data scoping*	*Messages and point-to-point Communication, Collective Communication*
	SLO-2	*Transistors galore:*	*Common sense optimizations- Do less work!*	*UMA – ccNUMA*	*OpenMP worksharing for loops*	*Nonblocking point-to-point Communication*
S-3	SLO-1	*Moore's Law*	*Avoid expensive operations!*	*Distributed-memory computers*	*Synchronization*	*Virtual topologies*
	SLO-2	*Pipelining*	*Shrink the working set!*	*Hierarchical (hybrid) systems*	*Reductions*	*Example: MPI parallelization of a Jacobi solver*
S-4	SLO-1	*Superscalarity*	*Simple measures, large impact- Elimination of common subexpressions*	*Networks- Basic performance characteristics of networks*	*Loop scheduling, Tasking*	*MPI implementation*
	SLO-2	*SIMD*	*Avoiding branches*	*Buses, Switched and fat-tree networks*	*Miscellaneous*	*Performance properties, MPI performance tools*
S-5	SLO-1	*Memory hierarchies*	*Using SIMD instruction sets*	*Mesh networks, Hybrids*	*Case study: OpenMP-parallel Jacobi algorithm*	*Communication parameters*
	SLO-2	*Cache*	*The role of compilers*	*Parallelism- Data parallelism*	*Advanced OpenMP: Wavefront*	*Synchronization, serialization, contention*

					parallelization	
S-6	SLO-1	*Cache mapping*	*General optimization options*	*Functional parallelism*	*Efficient OpenMP programming*	*Implicit serialization and synchronization*
	SLO-2	*Prefetch*	*Inlining, Aliasing*	*Parallel scalability*	*Profiling OpenMP programs*	*Contention*
S-7	SLO-1	*Multicore processors*	*Computational accuracy*	*Factors that limit parallel execution*	*Performance pitfalls*	*Reducing Communication overhead*
	SLO-2	*Multithreaded processors*	*Register optimizations, Using compiler logs*	*Scalability metrics, Simple scalability laws*	*Ameliorating the impact of OpenMP worksharing constructs*	*Optimal domain decomposition*
S-8	SLO-1	*Vector processors-*	*C++ optimizations- Temporaries*	*Parallel efficiency, Serial performance versus strong scalability*	*Determining OpenMP overhead for short loops*	*Aggregating messages*
	SLO-2	*Design principles*	*Dynamic memory management*	*Refined performance models*	*Serialization*	*Collective Communication*
S-9	SLO-1	*Maximum performance estimates*	*Loop kernels and iterators*	*Choosing the right scaling baseline*	*False sharing*	*Nonblocking vs. asynchronous Communication,*
	SLO-2	*Programming for vector architectures*	*Storage order- Case study: Jacobi algorithm and Dense matrix transpose.*	*Load imbalance*	*Case study: Parallel sparse matrix-vector multiply*	*Understanding intranode point-to-point Communication*

Learning Resources	1. *GeorgHager, GerhardWellein,"IntroductiontoHighPerformanceComputingforScientistsand Engineers", Chapman&Hall/CRCComputationalScienceseries,2011.* 2. *JohnLevesque,GeneWagenbreth,"HighPerformanceComputing:Programmingand Application"CRC Press,2010*	3. *KaiHwang,Zhiweixu"ScalableParallelComputing:Technology,Architecture,Programming",* 4. *CharlesSeverance,KevinDowd,"HighPerformanceComputing", O'ReillyMedia,2ndEdition,1998.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr.Kesavan, HCL Technologies*	*1. Dr. Surendran Rajendran, AMA International University, Bahrain*	*1. J. Godwin Ponsam, SRMIST*
2. *Mr.R.Celein , Symmantec India Limited*		*2. Mr.SivakumarSRMIST*
		3.. Mr. Jothikumar, SRMIST

Course Code	18CSE455T	Course Name	DATABASE SECURITY AND PRIVACY	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the fundamentals of security relates to information*			
CLR-2 :	*how security is maintained in information systems*			
CLR-3 :	*Understand the concept of security models in database*			
CLR-4 :	*Implementation of virtual private dtabase*			
CLR-5 :	*Learn the procedures of database auditing*			
CLR-6 :	*Implementation of data mining algorithms for PPDM*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*				Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge of information system and information security*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Able to manage the security of information system as well as database*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Able to design and develop the security model in database*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Able to implement VPD in various database*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Able to audit the database activities, users, security*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Apply the security mechanism in PPDM using various algorithms*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Security Architecture: Introduction*	*Administration of Users-Introduction*	*Database Application Security Models: Introduction-*	*Auditing Database Activities-introduction*	*Privacy Preserving Data Mining Techniques: Introduction*
	SLO-2	*Information Systems*	*Authentication*	*Types of Users*	*Oracle Database Activities*	*Data Mining Techniques:*
S-2	SLO-1	*Database Management Systems*	*Creating Users*	*-Security Models*	*Oracle Database Activities*	*Privacy Preserving Data Mining Algorithms*
	SLO-2	*Information Security Architecture*	*SQL Server User*	*Application Types*	*Creating DLL Triggers with Oracle*	*Privacy Preserving Data Mining Algorithms*
S-3	SLO-1	*- Database Security*	*Removing, Modifying Users*	*-Application Security Models*	*Creating DLL Triggers with Oracle*	*General Survey-Data Mining Techniques*
	SLO-2	*Asset Types and value*	*Default users*	*Data Encryption*	*Auditing Database Activities with Oracle*	*Randomization Methods*
S-4	SLO-1	*Security Methods*	*Remote Users*	*Virtual Private Databases: Introduction*	*Auditing Database Activities with Oracle*	*Randomization Methods*
	SLO-2	*Operating System Security Fundamentals: Introduction*	*Database Links*	*-Overview of VPD*	*Auditing Server Activity with SQL Server 2000*	*Group Based Anonymization*
S-5	SLO-1	*Operating System Overview*	*Linked Servers*	*Implementation of VPD using Views*	*Auditing Server Activity with SQL Server 2000*	*Group Based Anonymization*
	SLO-2	*Security Environment*	*Remote Servers*	*Application Context in Oracle*	*Auditing Server Activity with SQL Server 2000*	*Distributed Privacy Preserving Data Mining*
S-6	SLO-1	*Security Components*	*Practices for Administrators and Managers-*	*Implementing Oracle VPD-*	*Auditing Server Activity with Oracle*	*Distributed Privacy Preserving Data Mining*
	SLO-2	*Authentication Methods*	*Profiles, Password Policies, Privileges and Roles: Introduction*	*Implementing Oracle VPD*	*Auditing Server Activity with Oracle*	*Curse of Dimensionality*

S-7	SLO-1	*User Administration*	*Defining and Using Profiles*	*Viewing VPD Policies*	*Security and Auditing*	*Application of Privacy Preserving Data Mining*
	SLO-2	*Password Policies*	*Designing and Implementing Password Policies*	*VPD using views*	*Security and Auditing*	*Application of Privacy Preserving Data Mining*
S-8	SLO-1	*Vulnerabilities*	*Best Practices*	*Application contexts using Data Dictionary*	*Casestudy: projest security and auditing*	*Casestudy: on PPDM*
	SLO-2	*Vulnerabilities*	*Granting and Revoking User Privileges*	*Policy manager implementation*	*Casestudy: projest security and auditing*	*Casestudy: on PPDM*
S-9	SLO-1	*Email Security*	*Creating, Assigning and Revoking UserRoles*	*Policy Manager Implementing Row and Column level Security with SQL Server*	*Casestudy: projest security and auditing*	*Casestudy: on PPDM*
	SLO-2	*Internet security*	*Best practices*	*Policy Manager Implementing Row and Column level Security with SQL Server*	*Casestudy: projest security and auditing*	*Casestudy: on PPDM*

Learning Resources	1. *HassanA.Afyouni,"DatabaseSecurityandAuditing",ThirdEdition,CengageLearning,2009.* 2. *RonBenNatan,"ImplementingDatabaseSecurityandAuditing",ElsevierDigitalPress,2005*	3. *Charu C. Aggarwal, Philip S Yu, "Privacy Preserving Data Mining": Models and Algorithms, Kluwer Academic Publishers, 2008*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr.SomuChockalingam, Founder and President,Doyensys,Chennai*	*Dr.K.Vivekanandan,Professor,Pondicherry Engineering College*	*1. Dr.B.Murugananthan,SRMIST*
		2.. Ms.Thenmozhi,SRMIST
		3.. M.Maheswari,SRMIST

Course Code	18CSE456T	Course Name	SOFTWARE DEFINED NETWORKS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*18CSC302J*	Co-requisite Courses	*Nil*	Progressive Courses	
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*cover topics more advanced than a typical undergraduate networking course*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*prepare students for a market that is going to demand computer scientists and software engineers to deliver the next generation of network switches*			
CLR-3 :	*describe the principles by which large computer networks and applications atop them are designed and maintained*			
CLR-4 :	*Make students understand the state-of-the art networking technologies proposed in literature or used throughout industry in a variety of areas*			
CLR-5 :	*Make students learn to critique research literature through a number of paper reviews and attempt to improve the state-of-the-art through minor and major projects*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will::*	Learning			Program Learning Outcomes (PLO)															
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	*have a knowledge of the technology evolution leading to SDN as well as the Open Source role in SDN and OpenFlow specifications*	*3*	*75*	*80*	*H*	*M*	*H*	*-*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*H*	*H*	*H*	*H*
CLO-2 :	*gain a knowledge of the advantages and disadvantages of SDN, API approaches, Hypervisor overlays, and Data Center SDN, SDN WAN etc*	*3*	*75*	*80*	*H*	*M*	*H*	*-*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*H*	*H*	*H*	*H*
CLO-3 :	*Understand different network virtualization techniques and can deploy SDN/NFV applications*	*3*	*75*	*80*	*H*	*M*	*H*	*-*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*H*	*H*	*H*	*H*
CLO-4 :	*understand the economics of SDN and its impacts in the marketplace*	*3*	*75*	*80*	*H*	*M*	*H*	*-*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction*	*Why SDN? Genesis of SDN*	*Alternative definitions of SDN*	*Emerging SDN Models*	*SDN Ecosystem*
	SLO-2	*How to Read a Paper (S. Keshav)*	*How SDN Works*	*Potential drawbacks of Open SDN*	*Protocol Models: NETCONF, BGP, MPLS*	*White-box switching*
S-2	SLO-1	*Ho to Review a Paper (Timothy Roscoe), How to Disagree (Paul Graham)*	*SDN Evolution, SDN Basics*	*SDN via APIs*	*Controller Models*	*Open Sourcing SDN*
	SLO-2	*Networking Basics: Switching, Addressing, Routing*	*SDN Architecture*	*SDN via Hypervisor-Based Overlays*	*Application Models: Proactive, Declarative, External*	*Open Networking Foundation*
S-3	SLO-1	*Paper Reading: 4D*	*Plane Separation*	*SDN via Opening Up the Device*	*SDN in Datacenters: Multitenancy, Failure Recovery*	*OpenDaylight*
	SLO-2	*Paper Reading: 4D*	*Simple Device and Centralized Control*	*Building our own SDN Switch*	*SDN in Internet eXchange Points (IXPs)*	*The ONOS Project*
S-4	SLO-1	*Paper Reading: ALF*	*Network Automation and Virtualization*	*SDN on Raspberry Pi, Zodiac Fx*	*Tunneling and Path Technologies, Ethernet Fabrics in the Data Center*	*Hypervisors: Background, Types*
	SLO-2	*Paper Reading: ALF*	*Openness, Northbound and Southbound APIs*	*Ryu on Raspberry Pi, Zodiac Fx*	*SDN Use Cases, Open SDN versus Overlays in the Data Center*	*OpenStack Deployment*
S-5	SLO-1	*Switching Architecture: Data, Control, and Management Planes*	*Paper Reading: OpenFlow: Enabling Innovation in Campus*	*Network Function Virtualization (NFV)*	*Real-World Data Center Implementations, SDN in Other Environments*	*OpenStack Orchestration*

			Networks			
	SLO-2	*Hardware Lookup*	*Review 1*	*Review 2*	*Review 3*	*Review 4*
S-6	SLO-1	*Forwarding Rules*	*OpenFlow, Switch-Controller Interaction*	*SDN vs. NFV*	*Wide Area Networks*	*OpenSwitch*
	SLO-2	*Dynamic Forwarding Tables*	*Flow Table, Packet Matching*	*OPNFV*	*Paper Reading: B4: Experience with a Globally-Deployed Software Defined WAN, SIGCOMM, 2013*	*Reactive versus Proactive Applications*
S-7	SLO-1	*Autonomous Switches and Routers*	*Actions and Packet Forwarding*	*Service Creation and Chaining*	*Service Provider and Carrier Networks*	*Analyzing Simple SDN Applications*
	SLO-2	*Internet Architecture*	*Extensions and Limitations*	*NFV Orchestration*	*Campus Networks*	*Other SDN Applications*
S-8	SLO-1	*Control-Data Plane Separation*	*Paper Reading: P4: Programming Protocol-Independent Packet Processors*	*Creating Network Virtualization Tunnels*	*Hospitality Networks, Mobile Networks*	*Future of SDN*
	SLO-2	*Packet Scheduling*	*SDN Controllers: POX, RyuMininet Programming*	*Offloading Flows in the Data Center*	*In-Line Network Functions*	*SDN Security*
S-9	SLO-1	*Paper Reading: The Road to SDN: An Intellectual History of Programmable Networks*	*SDN Controllers: OpenDaylight, Mininet Programming*	*Access Control for the Campus*	*Optical Networks*	*Use Cases*
	SLO-2	*Project Proposal Due*	*SDN Controllers: ONOS, Mininet Programming*	*Traffic Engineering for Service Providers*	*SDN vs. P2P/Overlay Networks*	*Group Project Presentation*

Learning Resources	1. *Software Defined Networks: A Comprehensive Approach, 2nd Edition Morgan Kaufmann, 2016* 2. *SDN: Software Defined Networks, Thomas D. Nadeau, Ken Gray, O'Reilly Media, 2013.*	3. *Network Function Virtualization, Ken Gray, Thomas D. Nadeau, Morgan Kaufmann, 2016*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. *Dr. Femilda*
		2. *Mr. K. Venkatesh*
		3. *Mr. KarthickNanmaran*

Course Code	18CSE457T	Course Name	SEMANTIC WEB	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Learn how the Semantic Web allows new uses of data	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Understand how semantic technologies promote data portability			
CLR-3 :	Become familiar with semantic standards-RDF,OWL			
CLR-4 :	Make use of semantic programming techniques to both enrich web application development			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
CLO-1 :	Apply flexible approach for integrating and future-proofing systems and data	1	80	85
CLO-2 :	Program the Semantic Web provides a standard	3	75	80
CLO-3 :	Incorporate existing data sources into semantically aware applications and publish rich semantic data	3	85	80
CLO-4 :	Make the machines to find, share, and combine data on the Web	3	80	75

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	L	H	-	H	-	-	-	-	-	-	H	H	-	M
H	H	-	-	H	-	-	-	-	-	-	H	H	H	M
H	H	H	-	H	-	-	-	-	-	-	H	-	-	H
H	H	-	-	H	-	-	-	-	-	-	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	The Semantic Web Vision	Querying the Semantic Web	Web Ontology Language	Logic and Inference: Rules	Applications
	SLO-2	Motivation for the Semantic Web	SPARQL Infrastructure	Requirements for Ontology Languages	Logic and Rules	e-commerce
S-2	SLO-1	Semantic Web Technologies	Matching Patterns	OWL Syntax	Rules on the Semantic Web	
	SLO-2	Explicit Metadata		Formal Semantics	Monotonic Rules	Adoption
S-3	SLO-1	Ontologies	Filters	Expressivity	Monotonic Rules: Syntax	Publication
	SLO-2	RDF,OWL			Rules, Facts	News website application
S-4	SLO-1	Logics-Principles of reasoning	Constructs for Dealing with an Open World		Logic Programs	Adoption
	SLO-2	The Semantic Web versus Artificial Intelligence		Reasoning Support	Monotonic Rules: Semantics	Publication
S-5	SLO-1	A Layered Approach	Organizing Result Sets	Compatibility of OWL2 with RDF/RDFS	Predicate Logic Semantics	Constructing Ontologies Manually
	SLO-2			OWL2 Full: RDF-Based Semantics	OWL2 RL	Reusing Existing Ontologies
S-6	SLO-1	RDF: Data Model	Other Forms of SPARQL Queries	OWL2 DL: Direct Semantics		
	SLO-2				Rule Interchange Format: RIF	Semiautomatic Ontology Acquisition
S-7	SLO-1	RDF/XML	Querying Schemas	The OWL2 primitives	RIF-BLD	
	SLO-2	RDFS: Adding Semantics		OWL2 Syntax	Compatibility with RDF and OWL Semantic Web Rules Language (SWRL)	Ontology Mapping
S-8	SLO-1	Classes and Properties	Adding Information with SPARQL Update	OWL2 Property Types		
	SLO-2	Class Hierarchies and Inheritance	Inserting and Loading Triples	OWL2 Property Axioms		
S-9	SLO-1	Property Hierarchies	Deleting Triples	OWL2 Class Axioms	Rules in SPARQL: SPIN	SemanticWeb Application Architecture
	SLO-2	RDF Schema	Case study	Individual Facts	RuleML	

Learning	1. Grigoris Antoniou and Frank Van Harmelen,-A Semantic Web Primer - The MIT Press, Cambridge,	3. John Hebeler , Matthew Fisher, Ryan Blace, Andrew Perez-Lopez , Mike Dean Semantic Web Programming,

Resources	*Massachusetts London, England, Edition 3,2012* 2. *Toby Segaran, Colin Evans, Jamie Taylor, Programming the Semantic Web Build Flexible Applications with Graph Data, O'Reilly Media,2009*	*1st Edition,Wiley, 2009.* 4. *Thomas B. Passin, Explorer's Guide to the Semantic Web, Manning, 2004*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. 1. Dr.Harisekharan,CTO,Sri SeshaaTechnologies Pvt. Ltd., Chennai	*1. Dr.J.Suresh, SSN College of Engineering*	*Dr.G.Vadivu*
	2. Dr. Sharmila Shankar, Crescent Institute of Science and Technology	*Dr.C.N.Subalalitha*
		Ms.S.Veena

Course Code	18CSE458T	Course Name	WIRELESS AND MOBILE COMMUNICATION	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Analyze the fundamental of transmission and cellular systems*			
CLR-2 :	*Apply skills in real time engineering problems and can have capability to evaluate the transmission errors*			
CLR-3 :	*Comprehend the concept of mobile network, transport layer and wireless technologies*			
CLR-4 :	*Differentiate the various types of cellular standard by their unique services.*			
CLR-5 :	*Grasp GSM. GPRS, Handover and Localization techniques*			
CLR-6 :	*Apply skills in various Routing protocols*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Apply Wireless Technology concepts to Engineering problems related to Communication*	*3*	*80*	*70*
CLO-2 :	*Improve their knowledge on Digital and analog Modulation techniques.*	*3*	*85*	*75*
CLO-3 :	*Equip themselves familiar with principle of Mobile Communication*	*3*	*75*	*70*
CLO-4 :	*Familiarize with Digital Cellular Standards*	*3*	*85*	*80*
CLO-5 :	*Acquaint with routing protocols*	*3*	*85*	*75*
CLO-6 :	*Expose to the emerging wireless technologies*	*3*	*80*	*70*

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Apply Wireless Technology concepts to Engineering problems related to Communication*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-2 :	*Improve their knowledge on Digital and analog Modulation techniques.*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-3 :	*Equip themselves familiar with principle of Mobile Communication*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-4 :	*Familiarize with Digital Cellular Standards*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-5 :	*Acquaint with routing protocols*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-6 :	*Expose to the emerging wireless technologies*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to wireless Communication*	*Cellular Concept*	*Introduction to GSM*	*Mobile IP*	*IEEE 802.11*
	SLO-2	*Elements of wireless Communication system*	*Cell area*	*Frequency Bands and Channels*	*IP packet delivery*	*System Architecture*
S-2	SLO-1	*Frequencies for radio Communication*	*Signal strength*	*Frames in GSM*	*Tunneling – Reverse Tunneling*	*Protocol Architecture*
	SLO-2	*Signals, Noise – Types of Noise*	*Cell parameter*	*Planes and layers of GSM*	*IPv6*	*MAC Layer and Management*
S-3	SLO-1	*Introduction to modulation and demodulation*	*Capacity of Cell*	*Protocols*	*DHCP*	*802.11a, 802.11b*
	SLO-2	*Signals in the modulation*	*Co channel interference*	*Localization and calling*	*Tradition TCP*	*HIPERLAN*
S-4	SLO-1	*Introduction to Analog modulation schemes*	*Frequency reuse*	*Handoff – Short messaging system*	*Congestion control*	*Bluetooth Architecture*
	SLO-2	*Amplitude Modulation Frequency modulation*	*Cell splitting Cell sectoring*	*GPRS EDGE*	*Classical TCP Snooping ,*	*IEEE 802.15 IEEE 802.15.4*
S-5	SLO-1	*Phase Modulation Introduction to Analog modulation schemes*	*Multiple Radio access protocols Frequencydivision Multiple Access*	*3G CELLULAR SystemsMMS*	*Mobile TCPFast retransmit / Fast recovery*	*MANET characteristicsROUTING*
	SLO-2	*Amplitude Shift Keying Frequency Shift Keying Phase Shift Keying- BPSK, QPSK*	*Time division Multiple Access Fixed ALOHA , Slotted ALOHA*	*UMTS Release and standards UMTS system architecture UTRAN*	*Transaction oriented TCP TCP over 2.5/3G wireless Networks*	*AODV Routing VANETCommunications in VANET*
S-6	SLO-1	*Multiplexing and multiple access techniques*	*Multiple Access with Collision Avoidance*	*Handover*	*Introduction to WAP WAP Architecture*	*Wireless Sensor Networks*
S-7	SLO-1	*Frequency-division multiplexing*	*Space division Multiple Access Code*	*Satellite System Infrastructure- GEO,*	*Wireless Datagram ProtocolWireless*	*RFID TechnologyTwo tags of RFID*

			division Multiple Access	LEO, MEO	Transaction Protocol	
	SLO-2	Time-division multiplexing	Spread ALOHA multiple Access	Limitations of GPS	Wireless Session Protocol	Wi-Fi Standards
S-8	SLO-1	Code-division multiplexing	OFDM	GPSBeneficiaries of GPS	Wireless Transport Layer Security	WiMax Standards
	SLO-2	Spread spectrum modulation	Variants of OFDM			
S-9	SLO-1	frequency hopping Spread spectrum	Comparison of Multiple Access Technique	4G Cellular systems	Wireless Markup Language	Fem-to-Cell Network
	SL0-2	Direct Sequence Spread spectrum		4G Standards (LTE/WiMax)	Push Architecture	Push-to-talk technology for SMS

Learning Resources	1. Roy Blake, Wireless Communication Technology" CENGAGE learning, Sixth indian reprint 2013. 2. Dharma Prakash Agarwal, Qing-An Zeng , "Introduction to Wireless and Mobile Systems" CENGAGE learning, First edition 2014. 3. Jochen Schiller, "Mobile Communications", Addision Wesley, 2nd edition 2011. 4. Singal TL, "Wireless Communication", Tata McGraw Hill Education Private Limited. 5. G.I.Papadimitriou, A.S.Pomportsis, P.Nicopolitids, M.S.Obaidat, "Wireless Networks", John Wiley and Sons, 2003	6. Gray J.Mullet "Wireless TeleCommunication System and Networks", CENGAGE learning, reprint 2014. 7. Upena Dalal, "Wireless Communication" Oxford University Press, First edition 2009. 8. Kaveh Pahlavan & Prashant Krishnamurthy, "Wireless Networks" PHI 2002. 9. Martyn Mallick, "Mobile and Wireless Design Essentials", Wiley Dreamtech India Pvt.Ltd., 2014.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr.Madan Lakshmanan	Prof. Subra Ganesan	Dr.S.Suresh
Senior Scientist	Professor, Electrical and Computer Engineering	Mrs.Jeya
CEERI, CSIR, Chennai (R&D Industry)	Oakland University, USA	Mr.H.Karthikeyan

Course Code	18CSE459T	Course Name	SERVICE ORIENTED ARCHITECTURE	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Enginering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Learn service oriented analysis techniques*			
CLR-2 :	*Learn technology underlying the service design*			
CLR-3 :	*Learn advanced concepts in building SOA*			
CLR-4 :	*Understand the Java Web services*			
CLR-5 :	*To know about various Web services specification standards*			
CLR-6 :				

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Acquire the knowledge on service oriented design technology*	*2*	*80*	*85*
CLO-2 :	*Acquire the ability to identify web services in SOA*	*2*	*75*	*80*
CLO-3 :	*Understand the basic ideas about building SOA*	*2*	*85*	*80*
CLO-4 :	*Appreciate the concepts of standards and security on SOA*	*2*	*80*	*75*
CLO-5 :	*Apply the knowledge in Java based web servise*	*2*	*75*	*85*
CLO-6 :	*Acquire the knowledge on ASP .NET based web servises.*	*2*	*80*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to SOA , Defining SOA*	*Introduction to Web Services*	*Phases of the SOA delivery lifecycle*	*SOA support in J2EE*	*Introduction to WS-BPEL*
	SLO-2	*Necessity of SOA.*	*Primitive SOA*	*SOA Delivery Strategies Top- down strategy, Bottom-up strategy*	*SOA platform basics and building blocks*	*Basic terms used in the BPEL terminology*
S-2	SLO-1	*SOA timeline from XML to Web services to SOA*	*Web Service Framework with respect to SOA*	*Agile strategy with Pros and cons*	*Overview of Java API for XML-based web services(JAX- WS)*	*WS-Coordination overview*
	SLO-2	*History about XML*	*Logical components of the Web services framework*	*Objectives and service-oriented process steps*	*Java Architecture for XML binding (JAXB)*	*WS-Choreography*
S-3	SLO-1	*Web Services and SOA*	*Service descriptions with WSDL layout*	*Benefits of a business-centric SOA*	*Building web services and client with examples*	*WS-Policy with SOA*
	SLO-2	*Service Oriented Enterprise (SOE)*	*Meta data and service contracts*	*Service- oriented design*	*Introduction to Java API for XML Registries(JAXR)*	*WS Security*
S-4	SLO-1	*Analyze the past architectures*	*Messaging with SOAP protocol and SOAP nodes*	*Introduction to WSDL language basics*	*Java API for XML based RPC (JAX-RPC)*	*Notification and Eventing*
	SLO-2	*Scope Of SOA*	*SOAP message path*	*Define the structure of WSDL*	*Web Services Interoperability*	*Transaction Management*
S-5	SLO-1	*SOA Reference Model*	*Message exchange Patterns and Coordination*	*Implement sample WSDL file*	*SOA support in .NET*	*Case study-SOA in cloud*
	SLO-2	*Key Service characteristics of SOA*	*Web Services a Activity Management,*	*Introduction to SOAP basics*	*NET Platform overview*	*research focus on SOA and issues*

S-6	SLO-1	*Anatomy of SOA*	*Coordination types and protocols*	*SOAP language basics*	*ASP.NET Page Handling*	*Comparative Analysis of SOA and Cloud Computing*
	SLO-2	*SOA architecture*	*ACID properties*	*Structure of SOAP*	*Post back vs Non post back events*	
S-7	SLO-1	*Components in SOA interrelate*	*Analyze atomic transaction with SOA*	*Implement SOAP style web services in Java.*	*ASP.NET web services*	*Case Study On Vehicle management system- create a service for identify the vehicle by entering the vehicle number.*
	SLO-2	*SOA component and specific behaviors*	*Business activities and protocols*	*SOA Composition*	*Creating a Web Site Using Visual Studio IDE*	
S-8	SLO-1	*Relationships among these components*	*Orchestration*	*service layers and standards*	*ASP.NET Programming Basics*	*Case Study on Online Healthcare System- Design an API to help healthcare providers collect, store, retrieve and exchange patient healthcare information more efficiently and enable better patient care.*
	SLO-2	*Technical Benefits of SOA*	*Choreography*	*Entity-centric business service design: List the step-by-step process*	*Creating a Web Site Using Visual Studio IDE*	
S-9	SLO-1	*Business Benefits of SOA*	*Service layer configuration scenarios*	*Application service design: process steps*	*Case Studies: Implement the Small Business Customer Management application as a web applications using ASP.NET*	*Case study on Simple Library Management System using API to get, post, edits and update book data from server.*
	SLO-2	*Principles of service orientation*	*Application Service Layer*	*Task centric business service design process steps*	*Web Services Enhancements (WSE)*	

Learning Resources	1. *ThomasErl,"Service-Oriented Architecture: Concepts, Technology, and Design", Pearson Education, 2009.* 2. *EricNewcomer,Lomow,"UnderstandingSOAwithWebServices",PearsonEducation,2005* 3. *JamesMcGovern,SameerT yagi, Michael EStevens, Sunil Mathew, Java WebServices Architecture",Elsevier,2003.* 4. *AchievingService-Oriented Architecture: Applying an Enterprise Architecture Approach, Rick Sweeney, 2010* 5. *Shankar Kambhampaly, "Service –Oriented Architecture for Enterprise Applications", Wiley India Pvt Ltd, 2008 3.Newcomer, Lomow, "Understanding SOA with Web Services", Pearson Education, 2005 4.Sandeep Chatterjee, James Webber, "Developing Enterprise Web Services, An Architect's Guide", Pearson Education,2005.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts

Course Code	18CSE460T	Course Name	NETWORK DESIGN AND MANAGEMENT	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	*Understand the various type of Networks and the Network Management basics*
CLR-2 :	*Understand the Network Management Standards*
CLR-3 :	*Understand the working of Simple Network Management Protocol and its various versions*
CLR-4 :	*Understand the working of Remote Monitoring*
CLR-5 :	*Understand the Network Management Applications*
CLR-6 :	*To Understand Network Designing and Planning*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Acquire knowledge on networks and network management*	*1*	*70*	*75*
CLO-2 :	*Gain knowledge of the various standards*	*1*	*75*	*80*
CLO-3 :	*Gain knowledge on the working of SNMP protocol and its various applications*	*1*	*85*	*80*
CLO-4 :	*To apply the network management tools and gather information from the network*	*2*	*75*	*70*
CLO-5 :	*To Familiarize with the working of various management applications*	*2*	*75*	*80*
CLO-6 :	*Apply the knowledge to create an efficient network*	*3*	*70*	*75*

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	*M*	-	-	-	*M*	-	-	-	-	-	-
H	-	-	-	*M*	-	-	-	*M*	-	-	-	-	-	-
H	-	-	-	-	-	-	-		-	-	-	-	-	-
H	*H*	*H*	*H*	*H*	-	-	-	*H*	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Telephone Network Management*	*Introduction to SNMP*	*Remote Monitoring*	*Network Management Applications*	*Network Design and Planning*
	SLO-2	*Distributed Computing Environment*	*SNMP v1 model*	*RMON SMI and MIB*	*Fault Management -Architecture*	*Network Design for Enterprise Network*
S-2	SLO-1	*TCP/IP Based Networks*	*Organization Model*	*RMON1*	*Fault location ,Fault isolation*	*Network Design Process*
	SLO-2	*Communication Protocols and Standards*	*System overview*	*RMON2*	*Algorithm*	*Data Collection*
S-3	SLO-1	*Protocol Layer and Services*	*SNMP v1 Information model*	*System Utilities for Management*	*Self-healing*	*Data Generation*
	SLO-2	*Challenges of IT Managers*	*Structure of Management Information*	*Tools*	*Avoiding failures*	*Traffic Generators*
S-4	SLO-1	*Network Management*	*Managed Objects*	*Network Statistics Measurement Systems*	*Configuration setting,*	*Cost Generators*
	SLO-2	*Network and System Management*	*MIB-Object Group*	*Traffic Load*	*Configuration discovery and Change Control*	*Topology*
S-5	SLO-1	*Network Management System Platform*	*System Group, Interfaces Group, Address Translation group*	*Protocol Statistics*	*Configuration Management Applications*	*Architecture*
	SLO-2	*Current status and future of Network Management*	*IP Group, ICMP Group, TCP Group, UDP Group*	*Data and Error Statistics*	*Patch Management*	*Graph*
S-6	SLO-1	*Network Management Standards*	*SNMP v1Communication model*	*Network Management System*	*Approaches for Performance Management*	*Link*
	SLO-2	*Network Management Model - Organizational model*	*Functional model*	*Components, Requirements*	*Performance Monitoring and Reporting*	*Algorithms*
S-7	SLO-1	*Information Model*	*SNMPv2*	*System Management*	*Performance trouble shooting,*	*Network Design Techniques*
	SLO-2	*Management Information Trees*	*System Architecture, MIB, Protocol*	*Network Management Applications*	*Capacity Planning*	*Performance Analysis*

S-8	SLO-1	*Communication Model*	*SNMPv3*	*Configuration Management*	*Account Management*	*Queuing Essentials*
	SLO-2	*ASN.1*	*Architecture, Applications, MIB*	*Inventory Management*	*Report Management-System and User Reports*	*Loss and Delay*
S-9	SLO-1	*Terminology, Symbols and Conventions*	*User Based Security Model*	*Performance Management*	*Policy Management*	*Reliability*
	SLO-2	*Functional Model*	*Access Control*	*Tools*	*Service Level Management*	*Network Cost*

Learning Resources	1. *Mani Subramanian "Network Management Principles and Practice", Second Edition, Pearson Publication, 2012.* 2. *DineshChandraVerma,"PrinciplesofComputerSystemsandNetworkManagement",Springer,2009.*	3. *Greg Tomsho, Ed Tittel, David Johnson, "Guide to Network Essentials", Fifth Edition, Cengage Learning, 2010 4.Teresa C.Piliouras ," Network Design Management and Technical Perspectives", Second Edition ,2004*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*40 %*	-	*20 %*	-	*30 %*	-	*40%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*20 %*	-	*40 %*	-	*30 %*	-	*20%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.Vivekanandan ,Nokia Technology Specialist, anandanviv1@gmail.com	*1.*	*1. Dr.B.Amutha, SRMIST*
2.Mr.SanthoshKumar.S,Associate Consultant,TCS, santhosh.sansoft@gmail.com	*2.*	*2.Dr.N.Snehalatha, SRMIST*

Course Code	18CSE387T	Course Name	GENETIC ALGORITHM AND ITS APPLICATIONS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Evolutionary Computation and Genetic Algorithms*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Terminologies and operators of GA and*			
CLR-3 :	*Advanced Operators and Techniques in GA and Classification of Genetic Algorithms*			
CLR-4 :	*Genetic Programming and Genetic Algorithm Optimization problems*			
CLR-5 :	*Applications of Genetic Algorithms*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Provides a introduction to genetic algorithm including fundamentals of genetic concepts*	*3*	*80*	*75*
CLO-2 :	*To have a clear view of genetic operators*	*3*	*85*	*75*
CLO-3 :	*To explore Genetic Algorithm optimization problems*	*3*	*80*	*75*
CLO-4 :	*Discuss applications of Genetic Algorithms for various optimization problems.*	*3*	*85*	*80*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*L*	*H*	-	*H*	*L*	-	-	-	*L*	*L*	-	*H*	-	-	-
CLO-2 :	*M*	*H*	*L*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-3 :	*M*	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-4 :	*M*	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*The Historical Development of Evolutionary Computing. Genetic Algorithms and Genetic Programming*	*Terminologies and operators of GA.Key elements, Individuals,*	*Diploidy, Dominance etc. Inversion and Reordering. Order Crossover and Cycle crossover.*	*Genetic programming (GP). Comparison of GP and other algorithms. Genetic operators. Tree based GP, Representation of GP.*	*Specific Applications of Genetic Algorithms. GA in network synthesis, Control systems engineering and Fuzzy based speed control of Brushless DC motor.*
	SLO-2		*Genes, Fitness, Populations. Data Structures.*			
S-2	SLO-1	*Features of Evolutionary Computation Advantages of Evolutionary computation.*	*Breeding, Selection, Crossover, Mutation and Replacement.*	*Micro operators: Segregation and translocation, Duplications and Deletion, Sexual determination.*	*Attributes in GP. Steps of GP, Characteristics of GP. What are Human Competitive, High-Return, Routine, and Machine Intelligence?*	*Feature selection in machine learning using GA. Designing texture filters with GA.*
	SLO-2					
S-3	SLO-1	*Genetic algorithms-Biological background. Cell, Chromosomes, Genetics, Reproduction and Natural selection.*	*Search Termination or Convergence criteria.*	*Non-binary representation, Multi-objective optimization, combined optimization and Knowledge based techniques.*	*Applications of Genetic Programming*	*GA based knowledge acquisition in Image Processing. Object localization in image using GA.*
	SLO-2					
S-4	SLO-1	*Search space, GA world, Evolution and optimization*	*Best individual, Worst individual, Sum of fitness and Medium fitness.*	*Classification of GAs. Simple Genetic algorithms (SGA). Parallel and distributed GAs.*	*GA Optimization problems: Fuzzy optimization problems, Multi objective Reliability Design Problem. Network and bicriteria reliability problems.*	*Data mining applications such as feature selection in data mining, GA in intrusion detection, etc.*
	SLO-2					
S-5	SLO-1	*Evolution and genetic algorithms. Conventional optimization and search techniques.*	*Why do genetic algorithms work? Building block hypothesis*	*Master-slave, Fine-grained parallel GAs. Multiple-Deme Parallel GAs.*	*Combinatorial Optimization problems. Linear integer model,*	*Applications in wireless networks for topology planning. GA application in ATM network.*
	SLO-2					

S-6	SLO-1	*Gradient based, Random search, Stochastic Hill climbing*	*A Macro mutation hypothesis. An adaptive mutation hypothesis.*	*Hierarchical Parallel algorithms. Hierarchical Genetic Algorithms: Crossover, Initialization heuristics. Remove sharp algorithms.*	*Applications of combinatorial optimization methods.*	*VLSI design applications Genetic layout optimization using GA.*
	SLO-2					
S-7	SLO-1	*Simulated Annealing, Symbolic AI. A simple Genetic Algorithm.*	*The schema theorem*	*Adaptive GA., Initialization, Evaluation function, Selection operators, Crossover operators, and mutation operators.*	*Network design and Routing problems*	*Introduction to Particle Swam Optimization [PSO] and Ant Colony Optimization [ACO].*
	SLO-2		*Optimal allocation of Trials. Implicit Parallelism*			
S-8	SLO-1	*Comparison of GA with other optimization techniques.*	*Advanced operators and techniques in GA,*	*Independent sampling GA and Breeding Phase.*	*Planning of passive optical networks, Packet switched networks,*	*Examples on PSO and ACO.*
S-9		*Limitations of GA.*	*Convergence problems in GA*	*Niched pareto genetic algorithm*	*Optimal topological design of all terminal networks.*	*Comparison of GA with PSO and ACO*

Learning Resources	1. *S.N. Sivanandam and S.N. Deepa , "Introduction to Genetic Algorithms", Springer, 2nd edition (2008)* 2. *Mitsuo Gen and Runwei Cheng, "Genetic Algorithms and Engineering Optimization", John Wiley, Fourth edition (2010)*	3. *Michael Negnevitsky, "Artificial Intelligence, A Guide to Intelligent Systems", Second edition ((2005))*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. K. Selvaraj, Caterpillar, Bangalore	*Dr. A.P. Shanthi, CSE, Anna University, Chennai*	*1.Dr. V. Ganapathy SRMIST*
	Dr. A. Kannan, CSE, VIT, Vellore.	*2.Dr. D. Rajeswari SRMIST*
		3.S. Saranya SRMIST

Course Code	18CSE388T	Course Name	ARTIFICIAL NEURAL NETWORKS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Connect Biology with Computers*
CLR-2 :	*Understand components of artificial neural networks*
CLR-3 :	*Understand supervised learning networkparadigms*
CLR-4 :	*Understand unsupervised learning networkparadigms*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Know the purpose of Artificial Neural Networks*	*1*	*80*	*85*	*H*	*L*	-	-	*H-*	-	-	-	-	-	-	*H*	*L*	*L*	-
CLO-2 :	*Apply the concepts of activation, propogation functions*	*2*	*75*	*80*	*H*	*H*	-	-	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*H*
CLO-3 :	*Work with supervised learning network paradigm*	*3*	*85*	*80*	*H*	*H*	*H*	-	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*H*
CLO-4 :	*Work with unsupervised learning network paradigm*	*3*	*80*	*75*	*H*	*H*	-	-	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Why neural network?*	*Components of artificial neural networks*	*Learning and training samples*	*Radial basis functions*	*Unsupervised learning networkparadigms*
	SLO-2	*Basics of Artificial Neural Networks*	*The concept of time in neural networks*	*Paradigms of Learning*	*Information processing of an RBF network*	*Structure of a self-organizing map(SOM)*
S-2	SLO-1	*A brief history of neural networks Biological neural networks*	*Connections*	*Using training samples*	*Training of RBF networks*	*Functionality*
	SLO-2		*Propagation function*	*Gradient Optimization Procedure*	*Growing of RBF networks*	*Training*
S-3	SLO-1	*Biological neural networks*	*Activation*	*Hebbian learning rule*		*Topology function*
	SLO-2	*The vertebrate nervous system*	*Threshold value, Activation function*	*Supervised learning networkparadigms*	*Compare multilayer perceptrons and RBF*	*Decreasing Learning Rate*
S-4	SLO-1	*peripheral nervous system*	*Common activation functions*	*The perceptron, back propagation and its variants*	*Recurrent perceptron-like networks*	*Variations of SOMs*
	SLO-2	*Cerebrum, cerebellum, diencephalon,brainstem*	*Output function, Learning strategies*	*Singlelayer perceptron*	*Jordan networks*	*Neural gas*
S-5	SLO-1		*Network topologies*	*Linear Separability*	*Elman networks*	*Multi-SOM*
	SLO-2	*The Neuron*	*Feedforward networks*	*Multilayer perceptron*	*Training recurrent networks*	*Multi-neural gas*
S-6	SLO-1	*Components*	*Recurrentnetworks*	*Backpropagation of error*		*Growing neural gas*
	SLO-2	*Electrochemical processes*	*Completely linked networks*	*Selecting learning rate*	*Unfolding in time*	*Adaptive resonance theory(ART)*
S-7	SLO-1	*Receptor cells- Various types*	*Bias neuron*	*Resilient Backpropagation*	*Teacher forcing*	*Task and structure of an ART network*
	SLO-2	*Information processing within nervous system*	*Representing Neurons*	*Adaption of Weights*	*Recurrent backpropagation*	*Resonance*
S-8	SLO-1	*Light Sensing organs*	*Orders of Activation*	*Variations in Backpropagation*		
	SLO-2	*Neurons in living organisms*	*Synchronous activation*			
S-9	SLO-1	*Transition to technical neurons*	*Asynchronous activation*	*Multilayer perceptron*	*Evolutionary algorithms*	*Learning process of an ART network*
	SLO-2		input and outputof data			

Learning Resources	1. *David Kriesel, A BriefIntroduction to Neural Networks, dkriesel.com, 2005* 2. *GunjanGoswami, Introduction to Artificial Neural Networks, S.K. Kataria& Sons, 2012*	3. *Raul Rojas, Neural Networks: A Systematic Introduction, 1996.* 4. *S. Sivanandam, Introduction to Artificial Neural Networks, 2003*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.Harisekharan,CTO,Sri SeshaaTechnologies Pvt. Ltd., Chennai	*1. Dr.J.Suresh, SSN College of Engineering*	*Dr.G.Vadivu*
	2. Dr. Sharmila Shankar, Crescent Institute of Science and Technology	*Dr. D.Rajeswari*
		Dr.M.S.Abirami

Course Code	18CSE389T	Course Name	FUZZY LOGIC AND ITS APPLICATIONS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science & Engg*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the Fuzzy Logic Basics*			
CLR-2 :	*Gain knowledge on the Machine learning concepts*			
CLR-3 :	*Gain knowledge on Fuzzy based clustering concepts*			
CLR-4 :	*Acquire knowledge on Fuzzy Integrated classification*			
CLR-5 :	*Understanding Neuro-Fuzzy Modeling concepts*			
CLR-5 :	*Acquiring better understanding on Fuzzy logic usage*			
CLR-6	*Understanding the fuzzylogics in Machine learning*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Acquire the knowledge on Basics of Fuzzy Logic*	*2*	*80*	*85*
CLO-2 :	*Understand the basic concepts in Machine learning*	*2*	*75*	*80*
CLO-3 :	*Apply the knowledge of Clustering in Fuzzy logics*	*2*	*85*	*80*
CLO-4 :	*Apply the concept of Classification in Fuzzy Logics*	*2*	*80*	*75*
CLO-5 :	*Acquire the knowledge on Neuro-Fuzzy resoning*	*2*	*75*	*85*
CLO-6 :	*Acquire the insight of Neuro-Fuzzy Modeling*	*2*	*75*	*85*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*H*	*M*	-	*H*	-	-	-	-	-	-	-	*H*	*L*	*H*	*M*
CLO-2 :	*H*	*H*	-	*H*	-	-	-	-	-	-	-	*H*	*L*	*H*	*M*
CLO-3 :	*H*	-	-	*H*	-	-	-	-	-	-	-	*H*	*L*	*H*	*M*
CLO-4 :	*H*	*H*	-	*H*	-	-	-	-	-	-	-	*H*	*L*	*H*	*M*
CLO-5 :	*H*	-	-	*H*	-	-	-	-	-	-	-	*H*	*L*	*H*	*M*
CLO-6 :	*H*	-	*H*	*H*	*H*	-	-	-	-	-	-	*H*	*L*	*H*	*M*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Fuzzy Logic Introduction : Comparison of traditional logic and fuzzy logic*	*Machine learning : Importance of ML*	*Fuzzy Clustering Basics: Cluster analysis Objective function-based cluster analysis, Fuzzy analysis of data*	*Fuzzy Integral Classification: Introduction and Notation , Reduction vs. Ordering*	*Neuro Fuzzy Modeling : ANFIS – Adaptive Neuro Fuzzy Inference system*
	SLO-2	*Basic History of Fuzzy Logic*	*Types of MachineLearning : SupervisedLearning-Unsupervised Learning, reinforcement Learning*	*Special objective functions, A principal clustering algorithm*	*The Borda Count*	*ANFIS - architecture*
S-2	SLO-1	*The case of Imprecision, A Historical perspective*	*TheCurse of dimensionality Overfitting and linear regression*	*Classical Fuzzy Clustering Algorithms : The fuzzy c-means algorithm*	*The Average Rule , The Median Alternative*	*Hybrid learning algorithm*
	SLO-2	*The Utility of Fuzzy systems, Limitations of Fuzzy systems*		*The Gustafson-Kessel algorithm*	*The Product Rule, The MaxMax and MaxMin Rules*	*Coactive Neuro fuzzy modeling : Towards generalized ANFIS*
S-3	SLO-1	*Fuzzy sets and membership*	*Bias andVariance LearningCurve*		*The Intersection Method , The Union Rule*	*Framework*
	SLO-2	*Chance Vs Fuzziness*		*The Gath-Geva algorithm*	*Logistic Regression : The Logit Transform and Maximum Likelihood Estimation*	*Neuron functions for adaptive netwoks*
S-4	SLO-1	*Classical sets and Fuzzy sets : Operations on classical sets, properties of classical sets*	*Classification*	*Computational effort*	*Separate Weight Sets*	*Fuzzy membership functions Vs Receptive field units*
	SLO-2	*Operations on fuzzy sets, properties of*	*Error and noise*	*Linear and Ellipsoidal Prototypes : The fuzzy*	*Model Selection by Local Accuracy*	*Non-linear rule*

		fuzzy sets		*c-varieties algorithm*		
S-5	SLO-1	*Classical relations : Cartesian product, crisp relations*	*Measuring(dis)similarity-Evaluating the output of clusteringmethod*	*The adaptive fuzzy clustering algorithm*	*Maximizing the Fuzzy Integral : What Does This Have to Do with Classifier Combination?*	*Neuro-fuzzy spectrum*
	SLO-2	*Fuzzy relations: cardinality of fuzzy relations, operations on fuzzy relations*	*Hierarchical clustering, Agglomerativeclustering - Divisiveclustering*	*Algorithms by Gustafson/Kessel and Gath/Geva*	*Pairwise Coupling - Pairwise Threshold Optimization*	*Analysis of Adaptive learning capability : Convergence based on the steepest descend method alone*
S-6	SLO-1	*Properties of fuzzy relations*	*K-Meansclustering*		*Comparing the Combination Methods :Small Training Set, Three Models*	*Interpretability spectrum*
	SLO-2	*Tolerance and Equivalence relations: crisp tolerance*		*Cluster Estimation Models :AO membership functions*	*Large Training Set, Three Models*	*Evolution of antecedents*
S-7	SLO-1	*Fuzzy Tolerance*	*Perceptrons*	*ACE membership functions*	*Small Training Set, Three Good Models , One Worthless*	*Evolution of consequence*
	SLO-2	*Properties of Membership functions, Fuzzification and defuzzification – Features of the memberfunction*	*Feedforwardnetworks.*	*Hyperconic clustering (dancing cones)*	*Large Training Set, Three Good Models, One Worthless*	*Evolving partitions*
S-8	SLO-1	*Various forms*	*MultilayerNetworks and Back PropagationAlgorithms*	*Cluster Validity : Global validity measures*	*Small Training Set, Worthless and Noisy Models Included*	*Neuro Fuzzy Control : Feedback control systems and Neuro fuzzy control*
	SLO-2	*Defuzzification of crisp sets*	*Linear Models – Linear regression,Logistic regression*	*Solid clustering validity measures, Shell clustering validity measures*	*Large Training Set, Worthless and Noisy Models Included*	*Expert control*
S-9	SLO-1	*Lamda cuts of fuzzy relations, Defuzzification to scalars*	*Tree learning : Decision trees*	*Local validity measures : The compatible cluster merging algorithm, The unsupervised FCSS algorithm*	*Fuzzy Association rules*	*Inverse learning, specialized learning*
	SLO-2	*Conclusion : Benefits of Fuzzy in comparison with crisp*	*Conclusion : Summary of ML concepts*	*Conclusion : Fuzzy based clustering merits*	*Conclusion : Fuzzy based classifier benefits*	*Conclusion : Summary / benefits of Neuro-fuzzy systems*

Learning Resources	1. *Vojislav Kecman, Learning and soft computing: Support vector Machines, Neural networks and Fuzzy logic models, A Bradford Book, The MIT Press., 2001, ISBN : 0-262-11255-8* 2. *Timothy J. Ross,University of New Mexico, USA., Fuzzy Logic with Engineering Applications, 3rd Edition, Wiley, 2010. ISBN 978-0-470-74376-8* 3. *Frank Höppner, Frank Klawonn, Rudolf Kruse and Thomas Runkler: Fuzzy Cluster Analysis, Wiley (1999)ISBN 0-471-98864-2*	4. *Timothy Masters, Assessing andImproving Predictionand ClassificationTheory and Algorithms in C++, ISBN-13 (pbk): 978-1-4842-3335-1 ISBN-13 (electronic): 978-1-4842-3336-8 ,https://doi.org/10.1007/978-1-4842-3336-8,2018.* 5. *Jyh-Shing, Roger Jang, Chuen-Tsai sun, Eiji Mizutani., Neuro fuzzy and softcomputing – A computational approach to learning and machine intelligence, Prentice Hall (1997) , ISBN : 0-13-2610663* 6. *Kevin P. Murphy,"MachineLearning: AProbabilistic Perspective",MIT Press, 2012* 7. *EthemAlpaydin,"Introduction to MachineLearning",Prentice Hall ofIndia, 2005* 8. *TomMitchell,"MachineLearning",McGraw-Hill, 1997.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-

	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr.R.Gokulakrishnan, Additional Director(EXIM), Software Technology Parks of India , r.gokul@stpi.in* 2. *Dr.Prabhu, Coherant , US., prabu.balu@coherant.com*	*Dr.Subrat Kumar Nayak, Associate professor, Institute of Technical education and Research, subratnayak@soa.ac.in*	*Dr.G.Maragatham , Dr. Manas Ranjan ,Ms.A.Saranya*

Course Code	18CSE390T	Course Name	COMPUTER VISION	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Recognize and describe both the theoretical and practical aspects of computing with images. Connect issues from Computer Vision to Human Vision*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Describe the foundation of image formation and image analysis. Understand the basics of 2D and 3D Computer Vision.*			
CLR-3 :	*Become familiar with the major technical approaches involved in computer vision. Describe various methods used for registration, alignment, and matching in images.*			
CLR-4 :	*Get an exposure to advanced concepts leading to object and scene categorization from images.*			
CLR-5 :	*Build computer vision applications.*			
CLR-5 :	*Recognize and describe both the theoretical and practical aspects of computing with images. Connect issues from Computer Vision to Human Vision*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
CLO-1 :	*Provide an introduction to computer vision including fundamentals of image formation*	*3*	*80*	*75*
CLO-2 :	*Provide a clear view of image formation*	*3*	*85*	*75*
CLO-3 :	*Provide a clear view of image processing*	*3*	*80*	*75*
CLO-4 :	*Provide knowledge about Computational photography*	*3*	*85*	*80*
CLO-5 :	*Provide knowledge about Image rendering*	*3*	*80*	*75*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
L	*H*	-	*H*	*L*	-	-	-	*L*	*L*	-	*H*	-	-	-
M	*H*	*L*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
M	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
M	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
H	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Computer Vision*	*Points and patches-An Introduction*	*Active contours*	*Triangulation*	*Motion models*
	SLO-2	*Image formation*	*Feature detectors*	*Snakes*	*Two-frame structure from motion*	*Planar perspective motion*
S-2	SLO-1	*Geometric primitives*	*Feature descriptors*	*Dynamic snakes and CONDENSATION*	*Projective reconstruction*	*Rotational panoramas*
	SLO-2	*2D,3D Transformations*			*Self-calibration*	
S-3	SLO-1	*3D to 2D Projection*	*Feature matching*	*Scissors*	*Perspective and projective factorization*	*Gap closing*
	SLO-2	*Lighting,Reflectance and shading*		*Level Sets*	*Bundle adjustment*	
S-4	SLO-1	*Sampling and aliasing*	*Feature tracking*	*Split and merge*	*Exploiting sparsity*	*Cylindrical and spherical coordinates*
	SLO-2	*Image processing Point operators*				
S-5	SLO-1	*Pixel transforms*	*Edge detection*	*Mean shift and mode finding*	*Constrained structure and motion*	*Bundle adjustment*
	SLO-2	*Color transforms*				
S-6	SLO-1	*Histogram equalization*	*Edge linking*	*Normalized cuts*	*Hierarchical motion estimation*	*Parallax removal*
	SLO-2					
S-7	SLO-1	*Linear filtering*	*Successive approximation*	*Graph cuts and energy-based methods*	*Fourier-based alignment*	*Recognizing panoramas*
	SLO-2	*Non Linear filtering*	*Hough transforms*			
S-8	SLO-1	*Fourier transforms*	*Hough transforms*	*2D and 3D feature-based alignment*	*Incremental refinement*	*Compositing*
S-9	SLO-1	*Two-dimensional Fourier transforms, Wiener filtering*	*Vanishing points*	*Pose estimation*	*Case Study*	*Case Study*

Learning Resources	1. *RichardSzeliski,"Computer Vision:Algorithms and Applications",Springer,2010.* 2. *Forsyth/Ponce,"ComputerVision:AModernApproach",PearsonEducationIndia;2edition(2015)*	3. *S.Nagabhushana,"ComputerVisionandImageProcessing",NewAgeInternationalPvtLtd;First edition(2005)* 4. *Rafael C. GonzaLez'"Digital Image Processing",Pearson Education; Fourth edition (2018)*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	Dr. A.P.Shanthi , CEG Campus Anna University	*1.Dr.V.Ganapathy,SRMIST*
		2.T.Senthil Kumar,SRMIST

Course Code	18CSE479T	Course Name	STATISTICAL MACHINE LEARNING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the Fuzzy Logic Basics*			
CLR-2 :	*Gain knowledge on the Machine learning concepts*			
CLR-3 :	*Gain knowledge on Fuzzy based clustering concepts*			
CLR-4 :	*Acquire knowledge on Fuzzy Integrated classification*			
CLR-5 :	*Understanding Neuro-Fuzzy Modeling concepts*			
CLR-5 :	*Acquiring better understanding on Fuzzy logic usage*			
CLR-6	*Understanding the fuzzylogics in Machine learning*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Acquire the knowledge on statistical machine learning techniques.*	*1*	*80*	*85*
CLO-2 :	*Acquire the ability to build model based on logistic regression and random forest techniques*	*1*	*75*	*80*
CLO-3 :	*Understand the basic ideas of probability and work on probabilistic approaches like Naïve Bayes, Bayes Theorem*	*1*	*85*	*80*
CLO-4 :	*Apply the knowledge of Kernel functions in practical applications*	*3*	*80*	*75*
CLO-5 :	*Apply the knowledge of K-means clustering on real world examples*	*3*	*75*	*85*
CLO-6 :	*Acquire the knowledge on using PCA and SVD with Scikit-learn*	*2*	*80*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	*H*	*H*	-	-
H	*H*	-	-	-	-	-	-	-	-	-	*H*	*H*	-	-
H	-	-	-	-	-	-	-	-	-	-	*H*	*H*	-	-
H	*H*	*H*	*H*	-	-	-	-	-	-	-	*H*	*H*	*M*	*H*
H	-	*H*	*H*	-	-	-	-	-	-	-	*H*	*H*	*M*	*H*
H	-	*H*	*H*	-	-	-	-	-	-	-	*H*	*H*	*M*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Statistical terminology for model building and validation-Machine Learning,Major differences between statistical modeling andmachine learning*	*Comparison between regression and machinelearning models*	*K-nearest neighbors-KNN voter example*	*Support Vector Machines and Neural Networks-Support vector machines working principles-Maximum margin classifier*	*K-means clustering-K-means working methodology from first principles*
	SLO-2		*Compensating factors in machine learning models*	*Curse of dimensionality-Curse of dimensionality with 1D, 2D, and 3D example*		
S-2	SLO-1	*Steps in machine learning model developmentand deployment*	*Assumptions of linear regression Steps applied in linearregression modeling*	*Curse of dimensionality with 3D example*	*Support vector classifier*	*Optimal number of clusters and cluster evaluation*
	SLO-2					
S-3	SLO-1	*Statistical fundamentals and terminology for model building and validation*	*Example of simple linear regression from first principles*	*KNN classifier with breast cancer Wisconsin data example*	*Support vector machines*	*The elbow method*
	SLO-2					
S-4	SLO-1	*Bias versus variance trade-off,Train and test data*	*Machine learning models - ridge and lasso regression-Example of ridge regression machine learning,Example of lasso regression machine learning model*	*Naive Bayes*	*Kernel functions*	*K-means clustering with the iris data example*
	SLO-2					
S-5	SLO-1	*Linear regression versus gradient descent Machine learning losses*	*Logistic Regression Versus Random Forest-Maximum likelihood estimation*	*Probability fundamentals-Joint probability*	*Artificial neural networks - ANN*	*Principal component analysis - PCA-PCA working methodology from first principles*
	SLO-2					

S-6	SLO-1	*When to stop tuning machine learning models*	*Terminology involved in logistic regression*	*Understanding Bayes theorem with conditional probability*	*Forward propagation and backpropagation*	*PCA applied on handwritten digitsusing scikit-learn*
	SLO-2		*Applying steps in logistic regression modeling*			
S-7	SLO-1	*Train, validation, and test data Cross-validation*	*Random forest-Example of random forest using German credit data*	*Naive Bayes classification*	*Optimization of neural networks-Stochastic gradient descent - SGD*	*Singular value decomposition - SVD*
	SLO-2		*Grid search on random forest*			
S-8	SLO-1	*Grid Search*	*Variable importance plot*	*Laplace estimator*	*Introduction to deep learning-Solving methodology*	*SVD applied on handwritten digitsusing scikit-learn*
	SLO-2					
S-9	SLO-1	*Machine learning model overview*	*Comparison of logistic regression with random forest*	*Naive Bayes SMS spam classification example*	*Deep learning software*	*SVD applied on handwritten digitsusing scikit-learn*
	SLO-2					

Learning Resources	1. *Pratap Dangeti,"Statistics for Machine Learning":,Packt Publishing Ltd,,2017.* 2. *Masashi Sugiyama,"Introduction to Statistical Machine Learning",Elsevier,2016*	3. *Gareth James,Daniela Witten,Trevor Hastie and Robert Tibshirani, An Introduction to Statistical Learning with Applications in R, Springer,2015* 4. *Hastie Trevor, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, Springer-Verlag New York Inc, February2009*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.Harisekharan,CTO,Sri SeshaaTechnologies Pvt. Ltd., Chennai	*1. Dr.Bagavandas, Cetre for Statistics, SRMIST*	*1. Dr.G.Vadivu*
2. Mr. S. Sudarsun – Chief Scientist, Co-Founder, Buddhealth	*2. Dr. Sampath, Professor, Department of Statistics, Madras University*	*2. Dr.C.Lakshmi*
		3.Dr.G.Manju

Course Code	18CSE480T	Course Name	NATURE INSPIRED COMPUTING TECHNIQUES	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*To Understand the basics of Natural systems*
CLR-2 :	*To appreciate the concepts of Natural systems and its applications*
CLR-3 :	*To understand newBasic Natural systems functions(operations)*
CLR-4 :	*To understand the fundamentals of nature inspired techniques which influence computing*
CLR-5 :	*To understand an Integration of Hardware and software in Natural applications.*
CLR-6:	*To Understand practical implementation of Natural design considerations.*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning 1: Level of Thinking (Bloom)	Learning 2: Expected Proficiency (%)	Learning 3: Expected Attainment (%)	PLO 1: Engineering Knowledge	PLO 2: Problem Analysis	PLO 3: Design & Development	PLO 4: Analysis, Design, Research	PLO 5: Modern Tool Usage	PLO 6: Society & Culture	PLO 7: Environment & Sustainability	PLO 8: Ethics	PLO 9: Individual & Team Work	PLO 10: Communication	PLO 11: Project Mgt. & Finance	PLO 12: Life Long Learning	PLO 13: PSO - 1	PLO 14: PSO - 2	PLO 15: PSO – 3
CLO-1 :	*Illustrate the basic concepts of Swarm Intelligenceprocesses*	3	80	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-2 :	*Examine the principle of Immuno computing techniques*	3	85	75	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-3 :	*Skills for planning, estimating, and resourcing for Natural design considerations*	3	75	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-4 :	*Manage the scope changes of nature inspired techniques which influence computing*	3	85	80	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-5 :	*Ability to identify optimization Techniques as a means to provide functionality and value to apply context in specific case studies*	3	85	75	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L
CLO-6 :	*Ability to understand the needs and familiarize the DNA Computing*	3	80	70	L	H	L	H	L	L	M	L	L	L	M	L	L	L	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction*	*Evolutionary Computing*	*Swarm Intelligence*	*Introduction to Immune System*	*DNA Computing*
	SLO-2	*Overview of Philosophy*		*Introduction*		
S-2	SLO-1	*Nature to Nature Computing*	*Hill Climbing*	*Ant Colony Optimization*	*Physiology and main components*	*DNA Molecule*
	SLO-2			*Ant Foraging Behavior*		
S-3	SLO-1	*A Brief Overview of Three Branches*	*Simulated Annealing*	*Ant Colony Optimization*	*Pattern Recognition and Binding*	*Adleman's experiment*
	SLO-2	*Individuals, Entities and agents*		*SACO algorithm*		
S-4	SLO-1	*Parallelism and Distributivity Interactivity*	*Simulated Annealing*	*Ant Colony Algorithm (ACA)*	*Immune Network Theory*	*PAM Model*
	SLO-2				*Danger Theory*	
S-5	SLO-1	*Adaptation- Feedback*	*Genetics Principles*	*scope of ACO algorithms*	*Immune Algorithms*	*Splicing Systems*
	SLO-2					
S-6	SLO-1	*Self-Organization*	*Standard Evolutionary Algorithm*	*Swarm Robotics*	*Genetic algorithms*	*From Classical to DNA Computing*
	SLO-2	*Complexity, Emergence*	*Genetic Algorithms*			
S-7	SLO-1	*Bottom-up Vs Top-Down Approach*	*Reproduction*	*Social Adaptation of Knowledge*	*Bone Marrow Models*	*Universal DNA Computers*
	SLO-2		*Crossover Mutation*			
S-8	SLO-1	*Determination*	*Evolutionary Programming*	*Particle Swarm Optimization*	*Forest's Algorithm*	*Scope of DNA Computing*
	SLO-2					

S-9	SLO-1	*Chaos and Fractals*	*Genetic Programming*	*Particle Swarm Optimization*	*Artificial Immune Networks*	*Lipton's Solution to SAT Problem*
	SLO-2					

Learning Resources	1. *LeandroNunesdeCastro,"FundamentalsofNaturalComputing,BasicConcepts,Algorithms andApplications",Chapman&Hall/CRC,TaylorandFrancisGroup,2007.* 2. *FloreanoD.andMattiussiC.,"Bio-InspiredArtificialIntelligence:Theories,Methods,and Technologies", MIT Press, Cambridge, MA,2008.*	3. *AlbertY.Zomaya,"HandbookofNature-InspiredandInnovativeComputing",Springer,2006* 4. *Marco Dorrigo,Thomas Stutzle," Ant Colony Optimization", PHI,2005.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mr.Lokesh Peta,Head Developer,OEConnection,Newbury-UK;Mail:peta.lokesh@gmail.com	*Prof. A. Amuthan, Professor, Pondicherry Engineering College, amuthan@pec.edu*	*Dr.G.Maragatham / Mr. C. SanthanaKrishnan Dr.C.Lakshmi*

Course Code	18CSE481T	Course Name	APPLIED MACHINE LEARNING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*18CSE392T*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Analyze the text data using Machine Learning*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Analyze the audio data using Machine Learning*			
CLR-3 :	*Analyze Time series and Sequential data using Machine Learning*			
CLR-4 :	*Analyze the Image Content using Machine Learning*			
CLR-5 :	*Visualize the data*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Identifying patterns in text using topic modeling*	*3*	*75*	*80*
CLO-2 :	*Building a speech recognizer*	*3*	*75*	*80*
CLO-3 :	*Extracting statistics from time series data, Building Conditional Random Fields for sequential text data*	*3*	*75*	*80*
CLO-4 :	*Building an object recognizer*	*3*	*75*	*80*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	*M*	*H*	-	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*H*
H	*M*	*H*	-	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*H*
H	*M*	*H*	-	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*H*
H	*M*	*H*	-	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Text Feature Engineering Introduction*	*Speech Recognition Introduction*	*Dissecting Time Series and Sequential Data*	*Image Content Analysis*	*Biometric Face Recognition*
	SLO-2	*Cleaning text data*	*Reading audio data*	*Introduction*	*Computer Vision*	*Face detection from the image and video*
S-2	SLO-1	*Preprocessing data using tokenization*	*Plotting audio data*	*Transforming data into the time series format Pandas and Numpy to convert Time Series data*	*Operating on images using OpenCV- Python*	*Capturing and processing video from a webcam Resizing and Scaling*
	SLO-2	*Tagging and categorising words*	*Transforming audio signals into the frequency domain*	*Plotting time series data*	*Learn to extract and load the image*	*Building a face detector using Haar cascades*
S-3	SLO-1	*Sequential tagging, Backoff tagging*	*Apply Fourier transform signal and plot*	*Slicing time series data Operating on time series data*	*Detecting edges Histogram equalization*	*determine the location of a face in the video frames captured from the webcam*
	SLO-2	*Creating features from text data-Stemming,*	*Generating audio signals with custom parameters*	*Plotting sliced time series data*	*Sobel filter, Laplacian edge detector, Canny edge detector*	*Face detector on the grayscale image*
S-4	SLO-1	*Lemmatising*	*Generate the time axis*	*Operating on time series data*	*Histogram equalization*	*Building eye and nose detectors*
	SLO-2	*Bagging using random forests*	*Synthesizing music*	*Extracting statistics from time series data*	*Visualize gray scale image*	*Face cascade classifier*
S-5	SLO-1	*Implementing bag of words*	*Construct the audio sample -amplitude and frequency*	*Correlation coefficients*	*Detecting corners*	*Visualize eye and nose detector*
	SLO-2	*Testing prepared data*	*synthesizer function*	*Plotting and understanding correlations*	*Understand the output corner detection image*	*Performing Principal Components Analysis*

S-6	SLO-1	*Analyze the results*	*Extracting frequency domain features*	*Building Hidden Markov Models for sequential data*	*Detecting SIFT feature points*	*PCA in face recognition systems*
	SLO-2	*Building a text classifier*	*MFCC and filter bank features*	*Prepare the Time Series data*	*SIFT feature detection*	*Convert the dataset from a five-dimensional set to a two-dimensional set*
S-7	SLO-1	*Analyzing the sentiment of a sentence*	*Building Hidden Markov Models*	*Train Gaussian HMM*	*Visualize the feature detected image*	*Kernel Principal Components Analysis*
	SLO-2	*Implement the sentiment analysis of a sentence*	*HMM training and prediction*	*Visualizing the model*	*Building a Star feature detector*	*Perform Kernel PCA*
S-8	SLO-1	*Identifying patterns in text using topic modeling*	*Building a speech recognizer*	*Building Conditional Random Fields for sequential text data*	*Detect features using the Star feature detector*	*Plot the PCA-transformed data*
	SLO-2	*Implement identifying patterns in text using topic modeling*	*MFCC features*	*CRF Model*	*Visualize keypoints on the input image*	*Plot Kernel PCA-transformed data*
S-9	SLO-1	*Case study- Twitter Data*	*Case study*	*Analyzing stock market data using Hidden Markov Models*	*Creating features using visual codebook and vector quantization*	*Performing blind source separation*
	SLO-2	*Case study- Twitter Data*	*Case study*	*Train the HMM and visualize*	*Method to quantize the data points*	*Independent Components Analysis*

Learning Resources	1. *Prateek Joshiandco,Python:RealWorldMachineLearning,PacktPublishing,2016* 2. *Sebastian Raschka,Python Machine Learning,PacktPublishing,2013.*	3. *Richert Coelho,Building Machine Learning Systems with Python,PacktPublishing,2016* 4. *Michael Bowles,Machine Learning in Python,Wiley&Sons,2015*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr.Harisekharan,CTO,Sri SeshaaTechnologies Pvt. Ltd., Chennai	*Dr.J.Suresh, SSN College of Engineering*	*1. Dr.G.Vadivu*
Mr. S. Sudarsun – Chief Scientist, Co-Founder, Buddhealth	*Dr. Sharmila Shankar, Crescent Institute of Science and Technology*	*2. Mr.Karthik Nanmaran*
		3. Dr.Renukadevi

Course Code	18CSE482T	Course Name	COMPUTATIONAL NEUROSCIENCE	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science & Engg*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand to knowWhat happens in your brain when you make a decision*			
CLR-2 :	*Gain knowledge mathematical and computational models that are used in the field of theoretical neuroscience*			
CLR-3 :	*Basics of adaptively and learning,*			
CLR-4 :	*Acquire knowledge on Basic models of cognitive processing.*			
CLR-5 :	*Acquire knowledge on implementation model for neuro models*			
CLR-6 :	*Acquire knowledge on various computational algorithm*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*To Design Models of single neurons , and small networks*	*3*	*80*	*70*
CLO-2 :	*Implementation of all simple as well as more complex numerical computations with few neurons.*	*3*	*85*	*75*
CLO-3 :	*Analyse connected networks in the mean-field limit*	*3*	*75*	*70*
CLO-4 :	*Formalize biological facts into mathematical models*	*3*	*85*	*80*
CLO-5 :	*Understand a simple mathematical model of memory formation in the brain*	*3*	*85*	*75*
CLO-6 :	*Understand a simple mathematical model of decision processes*	*3*	*80*	*70*

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*To Design Models of single neurons , and small networks*	*L*	*H*	*L*	*H*	*H*	-	-	-	*L*	*L*	-	*H*	*L*	*H*	*H*
CLO-2 :	*Implementation of all simple as well as more complex numerical computations with few neurons.*	*H*	*H*	*L*	*M*	*L*	-	-	-	*M*	*L*	-	*H*	*L*	*H*	*H*
CLO-3 :	*Analyse connected networks in the mean-field limit*	*H*	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	*L*	*H*	*H*
CLO-4 :	*Formalize biological facts into mathematical models*	*M*	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	*L*	*H*	*H*
CLO-5 :	*Understand a simple mathematical model of memory formation in the brain*	*H*	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	*L*	*H*	*H*
CLO-6 :	*Understand a simple mathematical model of decision processes*	*L*	*H*	-	*H*	*L*	-	-	-	*L*	*L*	-	*H*	*L*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*History of Computational Neuroscience*	*Four components of Neural Signaling*	*From artificial neural network to realistic neural networks - Introduction*	*Memory Classification Scheme – Declarative, Non-declarative*	*Hebbian Learning-Hebbian versus Perceptron Learning-*
	SLO-2	*Models in Computational Neuroscience*	*Four components of Neural Signaling*	*Modelling the ventral stream*	*Auto-associative network and hippo campus - Learning and retrieval phase*	*Learning by Error Minimization*
S-2	SLO-1	*Computational Theory of the Brain*	*Neurotransmission*	*Modelling the dorsa and auditory stream*	*Point-attractor neural networks - Network dynamics and training*	*Gradient Descent Learning*
	SLO-2	*Biological Background*	*Population dynamics*	*Mechanical behavior of ceramics-flexural strength -The Perceptron .*	*Signal-to-noise analysis - Noisy weights and dilued attractor networks*	*Stabilizing Hebbian Learning*
S-3	SLO-1	*Basic synaptic mechanisms and dendritic processing*	*Modeling the average behavior of neurons*	*Mapping function*	*Sparse attractor neural networks and correlated patterns-Sparse patterns and expansion recoding*	*Principal Component Analysis (PCA)-Eigenvectors-Eigenvalues-Covariance matrix*
	SLO-2	*The generation of action potentials*	*Hodgkin*	*Multi-layer Perceptron*	*Control of sparseness in attractor networks*	*Singular Value Decomposition*
S-4	SLO-1	*Stimulation and rising phase*	*Modeling the average behavior of neurons*	*Back-propagation – Initution , Derivation*	*Chaotic networks-Attractors*	*Limits and Extensions of PCA*
	SLO-2	*Peak and falling phase*	*Huxley Model*	*Back-propagation –Loss Function*	*Lyapunov functions - The Cohen-Grossberg theorem*	*Variations of Hebbian Learning*
S-5	SLO-1	*After hyperpolarization and Refractory Period*	*Spiking neuron models - Single*	*Back-propagation – Limitation*	*Asymmetrical networks*	*Nonlinear Hebbian learning*
	SLO-2	*Hodgkin and Huxley equations - Intro*	*Spiking neuron models - Detailed*	*Support Vector Machines - Introduction*	*Non-monotonic networks*	*Linsker's Model of the Visual System*
S-6	SLO-1	*Neuron - axons,dendritesetc, thefour components ofNeural Signaling*	*Spiking neuron models – 2D Model*	*Support Vector Machines - Classification*	*Complementary memory systems*	*Application of Lateral Inhibition*

	SLO-2	*Neurotransmission:neurotrasmitter,receptor, ionchannel, channelgating*	*Integrate and firing model -Leaky integrate-and-fire model*	*Support Vector Machines - Regression*	*Distributed model of working memory-Limited capacity of working memory*	*Lateral Geniculate Nucleus*
S-7	SLO-1	*Electrophysiology -Nernst potential,resting potential,Goldman-Hodgkin-Katz voltageequation, outline ofthe Hodgkin-Huxley model.*	*Integrate and firing model -Nonlinear integrate-and-fire model*	*Support Vector Machines – Kernel Function*	*The spurious synchronization hypothesis*	*Striate Cortex*
	SLO-2	*Modeling ion1 channel kinetics,activation andinactivation gates*	*Integrate and firing model -Stimulation by synaptic currents*	*Self-organizing Maps - Introduction*	*The interacting-reverberating-memory hypothesis*	*Linsker's model for orientation columns*
S-8	SLO-1	*Completeformulation ofHodgkin-Huxleymodel. Relationbetween outputfiring and constant input current.Discussion ofregimes. Softwaredemo.*	*noise in spikingneuron model – part I*	*Self-organizing Maps - Variable*	*Motor Learning and Control*	*Reinforcement Learning -Elements of Reinforcement Learning*
	SLO-2	*Compartmental models: Cable theory*	*noise in spikingneuron model – part II*	*Self-organizing Maps - Algorithm*	*Feedback controller*	*Markov decision process-Dynamic programming algorithms for solving MDPs*
S-9	SLO-1	*Compartmental models: Cable theory – Cable Equation*	*compartmental modeling - I*	*Self-organizing Maps – SOM Initialization*	*Forward and inverse model controller*	*Algorithms for large state spaces*
	SLO-2	*Physical Shape of Neurons and Neuron Simulators*	*compartmental modeling -II*	*Self-organizing Maps – Kohonen Algorithm*	*The cerebellum and motor control*	*Gradient temporal difference learning*

Learning Resources	1. *Thomas Trappenberg, "Fundamentals of Computational Neuroscience", Oxford University Press, January2010* 2. *Peter Dayan & LF Abbot, "Theoretical Neuroscience: Computational and Mathematical Modeling of Neural Systems", MIT Pres,2005*	3. *Richard S. Sutton and Andrew G. Barto, "Reinforcement Learning-An Introduction",2nd Edition,The MIT Press,2018*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr.Venkatesan venkatesan.g@tcs.com* 2. *Ganesan, Associate Consultant Tata Consultancy Services Australia*	*Dr.Sarulatha.K , Pondicherry Engg college, charuladha@pec.edu.in / Prof. Godfrey Winster, Saveetha Engineering College, godfreywinster@saveetha.ac.in*	*1. Dr. G.Maragatham / Dr. C.Vijayakumaran*

Course Code	18CSE483T	Course Name	INTELLIGENT MACHINING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the fundamentals of Artificial Intelligence*			
CLR-2 :	*Learn basics of Intelligent machining, sensors and machining process*			
CLR-3 :	*Understand the design of Intelligent Systems - RTOS*			
CLR-4 :	*Understand the computational methods, optimization and reasoning about physical system*			
CLR-5 :	*Understand implications of Artificial Intelligence in various real time applications*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Acquire the knowledge on the fundamentals of Artificial intelligence and its problem solving approaches*	2	80	85
CLO-2 :	*Acquire the knowledge on fundamentals of Intelligent Machining and machining process*	2	75	80
CLO-3 :	*Acquire knowledge on the design of Intelligent Systemsand RTOS*	2	85	80
CLO-4 :	*Acquire knowledge on computational methods and optimization*	2	80	75
CLO-5 :	*Apply the knowledge on Real time applications*	2	75	85

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*H*	*H*	*H*	*H*	*H*	*H*	-	-	-	-	-	*H*	-	-	-
CLO-3 :	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	-	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-5 :	-	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Artificial Intelligence and it's techniques*	*Introduction Intelligent Machining, Basics*	*Representation of Intelligent systems*	*Computational methods and optimization*	*Case Study - Autonomous Vehicle (Driver Less Car)*
	SLO-2	*Problem Solving with Artificial Intelligence*	*Open Architecture Machine Control*	*Control for the Evolution of VLSI Designs*		
S-2	SLO-1	*AI Models, Data acquisition and learning aspects of AI*	*Manufacturing Automation Protocol*	*An Object-Oriented Approach*	*Neural Network Modelling*	*Case Study - Defect Prediction , Wear and Tear Prediction in Mechanical devices*
	SLO-2	*Problem Solving - Problem Solving Process, Formulating Problems*	*The Evolution of Intelligent Machining*			
S-3	SLO-1	*Problem types and Characteristics*	*MOSAIC - NGC*	*Tools and Techniques for Conceptual Design*	*Fuzzy set theory*	*Case Study - Flying Drones*
	SLO-2	*Problem Space and Search*	*OSACA - SERCOS*	*Design Compilers*		
S-4	SLO-1	*Intelligent Agent*	*Components of Intelligent Machining*	*Labelled Interval Calculus*	*Machining Optimization*	*Case Study -Cogito*
	SLO-2	*Rationality and Rational agent with performance measures*	*Introduction sensors - Machining Process*	*Knowledge Representations for Design Improvisation*		
S-5	SLO-1	*Flexibility and Intelligent Agents*	*Sensing and Monitoring*	*A knowledge-based Framework for Design*	*Objective Functions and Constraints*	*Case Study - Alexa , SIRI*
	SLO-2	*Task Environment and its Properties*	*Signal Processing*		*Optimization Techniques*	
S-6	SLO-1	*Types of Agents*	*Transforming Data into Information*	*Introduction to RTOS - Hardware*	*Reasoning about physical system*	*Case Study - Smarter Home robots*

			Examples	*Components*		
	SLO-2	*Other aspects of agents*	*Machining Process Control*			
S-7	SLO-1	*Constraint satisfaction problem (CSP)*	*Practical Uses of Machine Learning*	*Design Principles of RTOS - Interupt Processing - task Management*	*Temporal Qualitative Analysis*	*Case Study -Application of AI in CAD/CAM*
	SLO-2	Crypto Arithmetic puzzles	Machine Learning Process Control Strategies			
S-8	SLO-1	*CSP as a search problem-constraints and representation*	*Programmable Logic Controllers (PLC)*	*Task Scheduling -Synchronization tools*	*Reasoning about Geometry*	*Case Study - Streamlining Drug Discovery*
	SLO-2	*CSP- backtracking and Role of heuristic*	*Closed Loop Process Control Systems*	*Task Communication - Memory Management*		
S-9	SLO-1	*CSP - Froward Checking and constraint propogation*	*Introduction to Adaptive Control*	*File System*	*Study of Heuristic knowledge for automatic configuration Generation and Innovation*	*Case Study - Betterment (Financial Advisor)*
	SLO-2	*CSP-Intelligent backtracking*	*Commercially Available Software*	*Tracing and Debugging*		

Learning Resources	1. *Farid Meziane, Sunil Vadera, Khiary Kobbacy and Nathan Proudlove, "Intelligent Systems in Manufacturing: Current Developments and Future Prospects", (unit 1)* 2. *How Netflix Uses Analytics To Select Movies, Create Content, and Make Multimillion Dollar Decisions Author: Zach Bulygo(unit 1)* 3. *Digital Signal Processing: A Practical Guide for Engineers and Scientists, Steven Smith (unti 2)* 4. *4. Artifical Intelligent in Engineering Design: Volume 1 , Gerard Meurant, Springer (Chapter 2,3,5,6,9 - unit3)*	5. *K.C.Wang, " Embedded and Real-Time Operating Systems (Chapter 10.6- Unit 3)* 6. *Sam Siewert, John Pratt," Real-Time Embedded Components and Systems with Linux and RTOS", David Pallai Publisher, 2016. (Chapter 8- Unit 3)* 7. *Machining: Fundamentals and Recent Advances, J. Paulo Davim, Springer. (Chapter 12-unit 4)* 8. *8.Artifical Intelligent in Engineering Design: Volume 2 , Gerard Meurant, Springer (Chapter 10-14 - unit 5)*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr, Mariappan, Engineering Leader, Amazon, India	*Khanna Nehemiah H, Professor, Ramanujam Computing Center, Anna University*	*1.Dr.C.Lakshmi, SRMIST*
		2. Dr.S Prabakaran, SRMIST
		3. Dr. M. Thenmozhi, SRMIST

Course Code	18CSE484T	Course Name	DEEP LEARNING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the concepts of Neural Networks and Deep Learning*
CLR-2 :	*Understand Deep neural network and layered learning approach*
CLR-3 :	*Study and understand CNN and RNN for deep learning*
CLR-4 :	*Learn and understand Auto Encoders and its applications*
CLR-5 :	*Understand concept of transfer learning and its applications with keras*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Apply basic mathematical concepts in Deep Learning*	*2*	*80*	*85*
CLO-2 :	*Work with powerful framework for supervised learning*	*3*	*75*	*80*
CLO-3 :	*Deal with Convolution Neural Networks*	*2*	*85*	*80*
CLO-4 :	*Analyze various types efficient data encoders*	*2*	*80*	*75*
CLO-5 :	*Apply various network models in deep learning*	*3*	*75*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	*L*	-	-	*H-*	-	-	-	-	-	-	*H*	*H*	-	-
H	*H*	-	-	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*M*
H	*H*	*H*	-	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*H*
H	*H*	-	-	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*H*
H	*H*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Historical trends in deep learning – Machine Learning basics*	*Introduction to Simple DNN*	*Convolution Neural Networks Introduction*	*Encoder*	*Deep Architectures in Vision*
	SLO-2	*Learning algorithms – Supervised and Unsupervised Training*	*Platform for Deep Learning*	*Convolution Operation*	*Decoder*	*AlexNet to ResNet*
S-2	SLO-1	*Linear Algebra for machine learning*	*Deep Learning Software Libraries*	*Motivation*	*Auto Encoders Introduction*	*Transfer Learning*
	SLO-2	*Testing - Cross Validation*	*Deep Feed Forward Networks Introduction*	*Pooling*	*Auto Encoders*	
S-3	SLO-1	*Dimensionality Reduction*	*Learning XOR*	*Normalization*	*Under Complete Auto Encoder*	*Siamese Networks*
	SLO-2	*Over fitting /Under Fitting*	*Gradient-Based Learning*	*Applications in Computer Vision - ImageNet*	*Regularized Auto Encoder*	
S-4	SLO-1	*Hyper parameters and validation sets*	*Various Activation Functions, ReLU, Sigmoid – Error Functions*	*Sequence Modelling –VGGNet, LeNet*	*Stochastic Auto Encoder*	*Metric Learning*
	SLO-2	*Estimators – Bias - Variance*	*Architecture Design*	*Recurrent Neural Networks*	*Denoising Auto Encoder*	*Ranking / Triplet Loss*
S-5	SLO-1	*Loss Function-- Regularization*	*Differentiation Algorithms*	*RNN topologies- Difficulty in Training RNN*	*Contractive Auto Encoder*	*RCNNs with keras*
	SLO-2	*Biological Neuron – Idea of Computational units*	*Regularization methods for Deep Learning*		*Auto Encoder Applications*	
S-6	SLO-1	*McCulloch-Pitts units and Thresholding logic*	*Early Stopping*	*Long Short Term Memory*	*Dimensionality Reduction and Classification using Auto encoders*	*CNN-RNN*

	SLO-2	*Linear Perceptron*	*Drop Out*		*Recommendation*	
S-7	SLO-1	*Perceptron Learning Algorithm*	*Difficulty of training deep neural networks*	*Bidirectional LSTMs*	*Optimization for Deep Learning-Optimizers–RMS prop for RNNs*	*Applications in captioning and Video tasks*
	SLO-2	*Convergence theorem for Perceptron Learning Algorithm*				
S-8	SLO-1	*Linear Separability*	*Greedy layer wise training*	*Bidirectional RNNs*	*SGD for CNNs*	*3D CNNs*
	SLO-2	*Multilayer perceptron –The first example of network with Keras code*				
S-9	SLO-1	*Backprobagation*	*Optimization methods for Neural Networks-Adagrad, Adam*	*Application case study -Handwritten digits recognition using deep learning, LSTM with Keras – sentiment Analysis*	*Application case study – Image dimensionality reduction using encoders LSTM with Keras – sentiment Analysis*	*Application case study – Image recognition using RCNN and transfer learning*
	SLO-2					

Learning Resources	1. *IanGoodfellow,YoshuaBengio,AaronCourville,"DeepLearning",MITPress,2016.* 2. *KevinP.Murphy,"MachineLearning:AProbabilisticPerspective",MITPress,2012.*	3. *Neural Networks: A Systematic Introduction, RaulRojas, 1996.* 4. *ChristopherandM.Bishop,"PatternRecognitionandMachineLearning",SpringerScienceBusinessMedia, 2006.* 5. *JasonBrownlee,"DeepLearningwithPython",ebook,2016.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.	*1.*	*1. Dr.E.Poovammal*
2.	*2.*	*2. Dr.G.Vadivu*
		3. Mr.Joseph James

Course Code	18CSE485T	Course Name	ROBOTICS: COMPUTATIONAL MOTION PLANNING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Acquire knowledge of Bug algorithms and configuration Space*			
CLR-2 :	*Acquire knowledge of Potential functions and Navigations*			
CLR-3 :	*Acquire knowledge of Sampling Algorithms*			
CLR-4 :	*Gain knowledge of filtering techniques*			
CLR-5 :	*Gain knowledge about Trajectory and Motion Planning*			
CLR-6 :	*Design motion plan for Robot in the path specified*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Apply knowledge of Bug algorithms and configuration Space*	*3*	*80*	*70*
CLO-2 :	*Apply knowledge of Potential functions and Navigations*	*3*	*85*	*75*
CLO-3 :	*Apply knowledge of Sampling Algorithms*	*3*	*75*	*70*
CLO-4 :	*Gain knowledge of filtering techniques*	*3*	*85*	*80*
CLO-5 :	*Gain knowledge about Trajectory and Motion Planning*	*3*	*85*	*75*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
M	*H*	-	*H*	*L*	-	-	-	*L*	*L*	-	*H*	-	-	-
M	*H*	*L*	*M*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
M	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
M	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
H	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Over view of Motion Planning*	*Potential Function: Addictive Attractive/Repulsive Potential*	*Sampling - Based Algorithms- Probabilistic Road Maps: Basic PRM*	*Linear Kalman Filtering*	*Trajectory Planning : Preliminaries*
	SLO-2	*Bug1 And Bug 2*	*Gradient Descent*	*Implementation of basic PRM*		
S-2	SLO-1	*Tangent Bug*	*Computing Distance From Implementation In The Plane*	*PRM sampling Strategies*	*Kalman Filter : Example*	*Decoupled Trajectory Planning*
	SLO-2	*Implementation: The Tangent Line*		*PRM connection Strategies*		
S-3	SLO-1	*Distance On Gradient*	*Local Minima Problem*	*Single-Query Sampling Based Planners: Expensive Spaces Trees*	*Bayesian Methods : Localization*	*Direct Trajectory Planning: Optimal Control*
	SLO-2	*Continuation Method*	*Wave-Front Planner*	*Rapidly Exploring Random Trees*	*Basic Idea Probabilistic Localization*	*Nonlinear Ptimization*
S-4	SLO-1	*Robot Configuration Specification*	*Navigation Potential Function: Sphere- Space*	*Connection Strategies and SBL Planner*	*Probabilistic Localization As Recursive Bayesian Filtering*	*Grid-Based Search*
	SLO-2		*Star-Space*			
S-5	SLO-1	*Circular Mobile Robot*	*Potential Functions for Rigid-Body Robots*	*Integration Of Planners Sampling Based Roadmap*	*Derivation Of Probabilistic Localization*	*Nonholonomic And Underactuated Systems : preliminaries*
	SLO-2	*Two joint planer arm*	*Path Planning for Articulated Bodies*			*Control Systems*
S-6	SLO-1	*Dimension Of The Configuration Space*	*Visibility Graph*	*Analysis Of PRM*	*Representation Of Posterior*	*Controllability*
	SLO-2					
S-7	SLO-1	*Topology of configuration space: Homeomorphisms and Diffeomorphisms*	*Deformation Retracts : Generalized Voronoi Diagram*	*Control based Planning*	*Sensor Model*	*Motion Planning: Optimal Control*
	SLO-2			*Multiple Robots*		

S-8	SLO-1	*Differentiable Manifolds*	*Retract -Like Structure: Generalized Voronoi Graph*	*Manipulation Planning*	*Mapping:: Mapping with known locations*	*Steering Chained -Form Systems Using Sinusoids*
	SLO-2					
S-9	SLO-1	*Examples*	*Piecewise Retracts: The Rod Hierarchical Generalized Voronoi GraphSilhouette Methods*	*Assembly Planning*	*Bayesian Simultaneous Localization and Mapping*	*Nonlinear Optimization*
	SLO-2					

Learning Resources	*1. HowieM.Choset,Seth Hutchinson, Kevin M.Lynch, George Kantor, Wolf ram Burgard, LydiaE. Kavraki, Sebastian Thrun, "Principles of Robot Motion: Theory, Algorithms, and Implementation"* *2. Jean-ClaudeLatombe,"RobotMotionPlanning",SpringerScience&BusinessMedia,2012*	*3. http://robotics.stanford.edu/~latombe/cs326/2009/schedule.htm*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Dr.R.Annie Uthra
		Dr.P. Supraja

Course Code	18CSE486T	Course Name	ADVANCED ALGORITHMS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*18CS201J*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand different asymptotic notations to analyze an algorithms*			
CLR-2 :	*Utilize various data structures in developing applications*			
CLR-3 :	*Utilize stack and queues in processing data for real-time applications*			
CLR-4 :	*Understand various data structures to handle graph theory related real-time applications*			
CLR-5 :	*Understand various probabilistic algorithms and randomized algorithms for real-time programming applications*			
CLR-6 :	*Understand various Complexity classes like P-Type, NP-Type, NP-Complete, NP-Hard problems*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Understand complexity of various algorithms*	*3*	*80*	*70*
CLO-2 :	*How efficiently a problem can be solved with respect to time and space*	*3*	*85*	*75*
CLO-3 :	*To find the appropriateness of Data structure for real time applications*	*3*	*75*	*70*
CLO-4 :	*Representation and Solving Graph algorithms*	*3*	*85*	*80*
CLO-5 :	*Understand approximation methods to solve very difficult problems*	*3*	*85*	*75*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
L	*H*	-	*H*	*L*	-	-	-	*L*	*L*	-	*H*	-	-	-
M	*H*	*L*	*M*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
M	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
M	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
H	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction-Basic Terminology*	*Elementary data structures-Array*	*Graph algorithms-Representation of graphs*	*Approximation algorithms*	*Complexity classes-Introduction*
	SLO-2	*Complexity of algorithms- Space and time complexity issues- Growth of functions*	*Operations on Arrays – Insertion and Deletion*	*BFS-DFS*	*The vertex-cover problem*	*Various definitions*
S-2	SLO-1	*Introduction of various asymptotic notations like Θ,ω,O, Ω*	*Stack-Various ADT operations- Uses of stack-Various examples*	*Strongly connected components*	*The traveling-salesman problem*	*NP-Completeness and the classes of P and NP*
	SLO-2	*Designing algorithm-Analysis of Insertion sort-Best case, worst case, average case analysis*	*Queue ADT- Insertion-deletion and various operations on Queue*	*Minimum Spanning tree-Introduction Prim's algorithm*	*Example*	*Continued*
S-3	SLO-1	*Various Problem solving techniques*	*Linked List- Deletion and Search-Doubly linked list-Various operations on linked list*	*Kruskal algorithm*	*The set-covering problem –With an example*	*A Formal language framework-Polynomial time verification*
	SLO-2	*Divide and Conquer paradigm*	*Polynomial Arithmetic*	*Single source Shortest path problem*	*The subset-sum problem*	*Continued*
S 4-5	SLO-1	*Recurrence relations-Construction of recurrence relation for various examples- Towers of Hanoi Problem, Fibannacci series*	*Hashing-Hash functions Open addressing- Perfect Hashing*	*The Bellman-Ford algorithm - Single-source shortest paths in directed acyclic graphs -Dijkstra's algorithm*	*String Matching- The naive string-matching algorithm*	*p-type and NP-type problems NP-Completeness-Various examples*
	SLO-2					
S-6	SLO-1	*Solution by Substitution method*	*Various hashing methods*	*Shortest paths and matrix multiplication*	*Example*	*NP-Completeness-reducibility*
	SLO-2	*Recursion Tree Method*	*Collision in hashing-Avoiding Collision –*	*The Floyd-Warshall algorithm*	*The Rabin-Karp algorithm*	*Continued*

			Various methods			
S-7	SLO-1	*Mater Theorem-Proof*	*Binary search tree*	*An example*	*Continued*	*NP-Completeness-reducibility*
	SLO-2	*Simple examples*	*Insertion-Deletion-Finding max,min*	*Johnson's algorithm for sparse graphs*	*The Knuth-Morris-Pratt algorithm*	*Continued*
S-8	SLO-1	*Probabilistic analysis of an algorithm*	*Red Black tree*	*Example*	*An example*	*NP-completeness proofs Continued-Satisfiability of boolean formulas is NP-complete.*
	SLO-2	*Hiring assistant problem*	*Insertion-Deletion*	*Flow network-example*	*Computational Geometry- Finding Convex hull- Finding the closest pair of points*	*3-CNF satisfiability problem-NP Complete*
S-9	SLO-1	*Probabilistic analysis Quick sort with illustration*	*Properties of RBT*	*Continued*	*Continued*	*NP-Hard problem-Definition and various examples-continued*
	SLO-2					

Learning Resources	1. *Cormen,ThomasH.;Leiserson,CharlesE.;Rivest,RonaldL.;Stein,Clifford(2009) Introduction to Algorithms (3rd ed.). MIT Press and McGraw-Hill* 2. *Ananyleviton, Introduction to the Design and Analysis of Algorithms, Kindleedition 2017.*	3. *Harowitz,SahaniandSangudevarRajasekaran,Fundamentalsofcomputeralgorithm, Universities Press; Second edition2008* 4. *Mark Allen Weiz, Data structures and algorithm analysis, Pearson Education India 2012*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	*100 %*		*100 %*		*100 %*		*100 %*		*100 %*	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	1. Dr.Masila Mani.V IIITDM, Kancheepuram,noor@iiitdm.ac.in	*1. K..Senthil Kumar, SRMIST*
		2. Dr.Thenmozhi , SRMIST

Course Code	18CSE355T	Course Name	DATA MINING AND ANALYTICS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	*Understand the concepts of Data Mining*																		
CLR-2 :	*Familiarize with Association rule mining*																		
CLR-3 :	*Familiarize with various Classification algortihms*																		
CLR-4 :	*Understand the concepts of Cluster Analysis*																		
CLR-5 :	*Familiarize with Outlier analysis techniques*																		
CLR-6 :	*Familiarize with applications of Data mining in different domains*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Gain knowledge about the concepts of Data Mining*	*2*	*80*	*85*															
CLO-2 :	*Understand and Apply Association rule mining techniques*	*2*	*75*	*80*															
CLO-3 :	*Understand and Apply various Classification algortihms*	*2*	*85*	*80*															
CLO-4 :	*Gain knowledge on the concepts of Cluster Analysis*	*2*	*80*	*75*															
CLO-5 :	*Gain knowledge on Outlier analysis techniques*	*2*	*75*	*85*															
CLO-6 :	*Understand the importance of applying Data mining concepts in different domains*	*2*	*80*	*85*															

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Why Data mining? What is Data mining ?*	*Mining frequent patterns: Basic concepts*	*Classification: Basic concepts*	*Cluster Analysis: Introduction*	*Outliers: Introduction*
	SLO-2	*Kinds of data meant for mining*	*Market Basket Analysis*	*General approach to Classification*	*Requirements and overview of different categories*	*Challenges of outlier detection*
S-2	SLO-1	*Kinds of patterns that can be mined*	*Frequent itemsets, Closed itemsets*	*Decision tree induction*	*Partitioning method: Introduction*	*Outlier detection methods: Introduction*
	SLO-2	*Applications suitable for data mining*	*Association rules-Introduction*	*Algorithm for Decision tree induction*	*k-means*	*Supervized and Semi-supervized methods*
S-3	SLO-1	*Issues in Data mining*	*Apriori algorithm-theoritical approach*	*Numerical example for Decision tree induction*	*k-medoids*	*Unsupervized methods*
	SLO-2	*Data objects and Attribute types*	*Apply Apriori algorithm on dataset-1*	*Attribute selection measure*	*Hierarchical method: Introduction*	
S-4	SLO-1	*Statistical descriptions of data*	*Apply Apriori algorithm on dataset-2*	*Tree pruning*	*Agglomerative vs. Divisive method*	*Statistical and Proximity based methods*
	SLO-2		*Generating Association rules from frequent itemsets*	*Scalability and Decision tree induction*	*Distance measures in algorithmic methods*	
S-5	SLO-1	*Need for data preprocessing and data quality*	*Improving efficiency of Apriori*	*Bayes' Theorem*	*BIRCH technique*	*Statistical approaches*
	SLO-2			*Naïve Bayesian Classification*		
S-6	SLO-1	*Data cleaning*	*Pattern growth approach*	*IF-THEN rules for classification*	*DBSCAN technique*	*Statistical data mining*
	SLO-2	*Data integration*		*Rule extraction from a decision tree*		
S-7	SLO-1	*Data reduction*	*Mining frequest itemsets using Vertical data format*	*Metrics for evaluating classifier performance*	*STING technique*	*Data mining and recommender systems*
	SLO-2		*Strong rules vs. weak rules*	*Cross validation*		

S-8	SLO-1	*Data transformation*	*Association analysis to Correlation analysis*	*Bootstrap*	*CLIQUE technique*	*Data mining for financial data analysis*
	SLO-2			*Ensemble methods-Introduction*		
S-9	SLO-1	*Data cube and its usage*	*Comparison of pattern evaluation measures*	*Bagging and Boosting*	*Evaluation of clustering techniques*	*Data mining for Intrusion detection*
	SLO-2			*Random Forests: Introduction*		

Learning Resources	1. *Jiawei Han and Micheline Kamber, " Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kauffman Publishers, 2011.*	

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.V.Selvakumar, Hexaware Technologies, selvakumarv@hexaware.com	*1. Dr.Latha Parthiba, Pondicherry University, lathaparthiban@yahoo.com*	*1. Mr.L.N.B.Srinivas, SRMIST*
2.	*2.*	*2. Mr.S.Karthick, SRMIST*
		3. Dr.V.V.Ramalingam, SRMIST

Course Code	18CSE391T	Course Name	BIG DATA TOOLS AND TECHNIQUES	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Gain knowledge about the various tools and techniques used in big data analytics*			
CLR-2 :	*Learn the fundamentals of Hadoop and the related technologies*			
CLR-3 :	*Understand the basics of development of applications using MapReduce, HDFS, YARN*			
CLR-4 :	*Learn the basics of Pig, Hive and Sqoop*			
CLR-5 :	*Learn the basics of Apache Spark, Flink and understand the importance of NoSQL databases*			
CLR-6 :	*Learn about Enterprise Data Science and data visualization tools*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Use the various tools and techniques in big data analytics*	*2*	*80*	*85*	*L*	-	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Apply Hadoop and related technologies to big data analytics*	*2*	*75*	*80*	*L*	*H*	*H*	*M*	*H*	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Apply MapReduce, HDFS and YARN develop big data applications*	*2*	*85*	*80*	*L*	-	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Develop applications using Pig, Hive and Sqoop*	*2*	*80*	*75*	*L*	*H*	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Apply Apache Spark and Flink to applications and understand the importance of NoSQL databases*	*2*	*75*	*85*	*L*	-	*H*	*M*	*H*	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Understand the applications of Enterprise Data Science and data visualization tools*	*2*	*80*	*85*	*L*	-	*H*	-	*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Overview of Big Data Analytics*	*MapReduce*	*Setting up a Hadoop cluster*	*Introducing Oozie*	*Enterprise Data Science Overview*
	SLO-2	*Introduction to data analytics and big data*	*Analyzing data with Unix tools and Hadoop*	*Cluster specification and setup*		
S-2	SLO-1	*Big data mining*	*Scaling Out – Data Flow, Combiner Functions*	*Hadoop configuration*	*Apache Spark*	*Data Science Solutions in the enterprise*
	SLO-2	*Technical elements of the Big Data platform*	*Hadoop Streaming*	*YARN configuration*		
S-3	SLO-1	*Analytics Toolkit, Components of the analytics toolkit*	*HDFS*	*Introduction to Pig*	*Limitations of Hadoop and overcoming the limitations*	*Enterprise data science – Machine Learning and AI*
	SLO-2	*Distributed and Parallel Computing for Big Data*		*Installing and running pig*	*Core components and architecture of Spark*	*Enterprise Infrastructure solutions*
S-4	SLO-1	*Cloud computing and Big Data*	*Hadoop filesystems*	*Basics of Pig Latin*	*Introduction to Apache Flink*	*Visualizing Big Data*
	SLO-2		*Java Interface to Hadoop*		*Installing Flink*	
S-5	SLO-1	*In-Memory Computing Technology for Big Data*	*YARN*	*Introduction to Hive*	*Batch analytics using Flink*	*Using Python and R for visualization*
	SLO-2		*Job Scheduling*	*Installing and running Hive*		*Big Data Visualization Tools*
S-6	SLO-1	*Fundamentals of Hadoop*	*Hadoop I/O*	*Introduction to HiveQL*	*Big Data Mining with NoSQL*	*Data Visualization with Tableau*
	SLO-2	*Hadoop Ecosystem*				
S-7	SLO-1	*The core modules of Hadoop*	*Data Integrity*	*Introduction to Zookeeper*	*Why NoSQL?*	*Case Studies: Hadoop*

	SLO-2		*Compression*	*Installing and running Zookeeper*	*NoSQL databases*	
S-8	SLO-1	*Introduction to Hadoop MapReduce*	*Serialization*	*The Zookeeper Service*	*Introduction to HBase*	*Case Studies: Spark*
	SLO-2		*File based Data Structures*	*Flume Architecture*		
S-9	SLO-1	*Introduction to Hadoop YARN*	*Developing a MapReduce Application*	*Introduction to Sqoop*	*Introduction to MongoDB, Cassandra*	*Case Studies: NoSQL*
	SLO-2					

Learning Resources	1. *TomWhite,Hadoop:The Definitive Guide,3rdEdition,O'Reilly,2012.* 2. *Sridhar Alla,Big Data Analytics with Hadoop3,Packt,2018.*	3. *NatarajDasgupta,Practical Big Data Analytics,Packt,2018.* 4. *DTEditorialServices,Big Data:Black Book,2016.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts

Course Code	18CSE392T	Course Name	MACHINE LEARNING - I	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*To provide basic concepts of machine learning*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*To provide deeper understanding of various tools and techniques for Machine learning Algorithms and outputs*			
CLR-3 :	*Understand and Implement the major classification techniques*			
CLR-4 :	*Understand and Implement the various Clustering Methods*			
CLR-5 :	*Learn and Understand the Tree based machine Learning Algorithms*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Understand the concepts of machine learning*	2	80	85	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Learn and understand machine tools and libraries of machine learning*	2	75	80	H	H	H	-	H	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Learn and understand the linear learning models and classification in machine learning*	2	85	80	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Understand the clustering techniques and their utilization in machine learning*	2	80	75	H	H	-	-	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Study the tree based machine learning techniques and to appreciate their capability*	2	75	85	H	H	-	H	H	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Machine Learning: What and Why?*	*Platform for machine learning*	*Ridge Regression*	*Measuring (dis)similarity*	*Decision tree representation*
	SLO-2	*Types of Machine Learning*	*Machine learning python libraries*		*Evaluating output of clustering methods*	
S-2	SLO-1	*Supervised Learning*	*Scikit-learn*	*Maximum likeliwood estimation (least squares)*	*Spectral clustering*	*Basic decision tree learning algorithm*
	SLO-2	*Unsupervised Learning*	*training data – testing data – validation data*		*Hierarchical clustering*	
S-3	SLO-1	*Reinforcement learning*	*k-fold cross validation*	*principal component analysis*	*Agglomerative clustering*	*Inductive bias in decision tree*
	SLO-2	*The Curse of dimensionality*	*Features*		*Divisive clustering*	
S-4	SLO-1	*Over fitting and under fitting*	*Performance metrics*	*Bayesian classifier*	*Choosing the number of clusters*	*Decision tree construction*
	SLO-2	*linear regression*	*MSE, accuracy, confusion matrix, precision*		*Clustering datapoints and features*	
S-5	SLO-1	*Bias and Variance tradeoff*	*recall, F- score*	*Support vector machine*	*Bi-clustering*	*Issues in decision tree*
	SLO-2	*Testing – cross validation*				
S-6	SLO-1	*Regularization*	*Linear Regression with multiple variables*	*Support vector machine + kernels*	*Multi-view clustering*	*Classification and regression trees (CART)*
	SLO-2	*Learning Curve*				
S-7	SLO-1	*Classification*	*Logistic Regression*	*Multi class classification*	*K-Means clustering*	*Random Forest*
	SLO-2	*Error and noise*				*Random Forest with scikit-learn*
S-8	SLO-1	*Parametric vs. non-parametric models*	*spam filtering with logistic regression*	*K nearest neighbour classification*	*K-meloids clustering*	*Multivariate adaptive regression trees (MART)*
	SLO-2					*Introduction to Artificial Neural Networks*
S-9	SLO-1	*Linear Algebra for machine learning*	*Naive Bayes with scikit-learn*	*Application: face recognition with PCA*	*Application: image segmentation using K-means clustering*	*Perceptron learning*
	SLO-2					

Learning Resources	1. *Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.* 2. *Ethem Alpaydin, "Introduction to Machine Learning", Prentice Hall of India, 2005* 3. *Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.*	4. *Sebastian Raschka, Vahid Mirjilili,"Python Machine Learning and deep learning", 2nd edition, kindle book, 2018* 5. *Carol Quadros,"Machine Learning with python, scikit-learn and Tensorflow", Packet Publishing, 2018.* 6. *Gavin Hackeling," Machine Learning with scikit-learn", Packet publishing, O'Reily, 2018.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Dr.G.Vadivu *Dr. UshaKiruthika* *Mr.S.Joseph James*

Course Code	18CSE393T	Course Name	TEXT MINING	Course Category		*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the fundamentals of text mining*
CLR-2 :	*Utilize text for prediction techniques*
CLR-3 :	*Understand the relevance between information retrieval and text mining*
CLR-4 :	*Understand the goals of information extraction*
CLR-5 :	*Analyze different case studies related to text mining*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire knowledge on fundamentals of text mining*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Perform prediction from text and evaluate it*	*2*	*80*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Perform document matching*	*2*	*80*	*75*	*H*	*M*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Identify patterns and entities from text*	*2*	*75*	*85*	*H*	-	*M*	-	*M*	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Understand how text mining is implemented*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	*L*	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Overview of text mining*	*Labels for the Right Answers*	*Linear scoring Methods*	*Clustering Documents by similarity*	*Ideal Model of Data*
	SLO-2	*Special about Text Mining*	*Feature selection by attribute ranking*	*Evaluation of Performance*	*Similarity of composite documents*	*Practical Data Sourcing*
S-2	SLO-1	*Structured Data*	*Sentence Boundary Determination*	*Estimating current and future performance*	*K-means Clustering*	*Prototypical Examples*
	SLO-2	*Unstructured Data*	*Part of speech Tagging*	*Getting the most from a Learning Method*	*Hierarchical Clustering*	*Hybrid Example*
S-3	SLO-1	*Is text different from numbers*	*Word Sense Disambiguation*	*Errors and Pitfalls in Big data Evaluation*	*The EM Algorithm*	*Mixed Data in Standard Table Format*
	SLO-2	*Types of Problem can be solved.*	*Phrase Recognition*	*Graph models for social Networks*	*Goals for Information Extraction*	*Case study: Market Intelligence from the web*
S-4	SLO-1	*Document Classification*	*Named Entity Recognition*	*Information Retrieval and Text Mining*	*Finding Patterns and Entities from Test*	*Case Study: Lightweight Document Matching for Digital Libraries*
	SLO-2	*Informational Retrieval*	*Parsing*	*Keyword search*	*Entity Extraction as Sequential Tagging*	*Generating Model cases for Help desk Application: case study*
S-5	SLO-1	*Prediction and Evaluation*	*Feature Generation*	*Nearest- Neighbor Methods*	*Tag Prediction as Classification*	*Assigning topics to news articles: Case study*
	SLO-2	*From Textual Information to Numerical Vectors*	*Using text for prediction*	*Measuring Similarity*	*The maximum Entropy method*	*E-mail Filtering: Case study*
S-6	SLO-1	*Collecting Documents*	*Recognizing that document Fit a pattern*	*Shared Word Count*	*Linguistic Features and Encoding*	*SearchEngines : case study*
	SLO-2	*Document Standardization*	*Document Classification*	*Word count and Bonus*	*Local Sequence Prediction Models*	*Extracting Named Entities from Documents*
S-7	SLO-1	*Tokenization*	*Learning to Predict from Text*	*Cosine Similarity*	*Global sequence Prediction Models*	*Mining Social Media*

	SLO-2	*Lemmatization*	*Similarity and Nearest-Neighbor Method*	*Web based Document Search*	*Coreference and relationship Extraction*	*Customized Newspapers*
S-8	SLO-1	*Inflectional Stemming*	*Document Similarity*	*Link Analysis*	*Template Filling And Database Construction*	*Emerging Directions*
	SLO-2	*Stemming to a Root*	*Decision Rules*	*Document Matching*	*Commercial Extraction System: Application*	*Different ways of collecting samples*
S-9	SLO-1	*Vector Generation for Prediction*	*Decision trees*	*Inverted List*	*Criminal Justice : Application*	*Learning to Unlabeled data*
	SLO-2	*Multiword Features*	*Scoring by Probabilities*	*Evaluation of Performance*	*Intelligence Applicaton*	*Distributed Text Mining*

Learning Resources	1. *By Sholom M. Weiss, Nitin Indurkhya, Tong Zhang.,Fundamentals of Predictive Text Mining*	

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Dr.E.Poovammal, SRMIST
		Mr.L.N.B.Srinivas, SRMIST
		Mr.D.Vivek, SRMIST

Course Code	18CSE394T	Course Name	BUSINESS INTELLIGENCE AND ANALYTICS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Familiarize with Business Intelligence, Analytics and Decision Support*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Understand the technologies for Decision making*			
CLR-3 :	*Familiarize with predictive modeling techniques*			
CLR-4 :	*Familiarize with sentiment analysis techniques*			
CLR-5 :	*Understand about Multi-criterai Decision making systems*			
CLR-6 :	*Familiarize with Automated decision systems*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Gain knowledge on Business Intelligence, Analytics and Decision Support*	*2*	*80*	*85*
CLO-2 :	*Understand the technologies for Decision making*	*2*	*75*	*80*
CLO-3 :	*Apply predictive modeling techniques*	*2*	*85*	*80*
CLO-4 :	*Apply sentiment analysis techniques*	*2*	*80*	*75*
CLO-5 :	*Gain knowledge on Multi-criterai Decision making systems*	*2*	*75*	*85*
CLO-6 :	*Gain knowledge on Automated decision systems*	*2*	*80*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Information Systems Support for Decision Making*	*Decision Making:*	*Basic Concepts of Neural Networks*	*Decision Support Systems modeling*	*Automated Decision Systems*
	SLO-2		*Introduction and Definitions*	*Developing Neural Network*	*Structure of mathematical models for decision support*	*The Artificial Intelligence field*
S-2	SLO-1	*An Early Framework for Computerized Decision Support*	*Phases of the Decision*	*Based Systems*	*Decision making under certainty*	*Basic concepts of Expert Sysytems*
	SLO-2		*Making Process*	*Illuminating the Black Box of ANN with Sensitivity*	*Uncertainty and Risk*	
S-3	SLO-1	*The Concept of Decision Support Systems*	*The Intelligence Phase*	*Support Vector Machines*	*Decision modeling with spreadsheets*	*Applications of Expert Sysytems*
	SLO-2			*A Process*		
S-4	SLO-1	*A Framework for Business Intelligence*	*Design Phase*	*Based Approach to the Use of SVM*	*Mathematical programming optimization*	*Structure of Expert Sysytems*
	SLO-2			*Nearest Neighbor Method for Prediction*		
S-5	SLO-1	*Business Analytics Overview*	*Choice Phase*	*Sentiment Analysis Overview*	*Decision analysis-introduction*	*Knowledge Engineering*
	SLO-2					
S-6	SLO-1	*Brief Introduction to Big Data Analytics*	*Implementation Phase*	*Sentiment Analysis Applications*	*Decision tables*	*Development of Expert Sysytems*
	SLO-2					
S-7	SLO-1	*Clickstream Analysis*	*Decision Support SystemsCapabilities*	*Sentiment Analysis Process*	*Decision Trees*	*Location based Analytics*
	SLO-2	*Metrics*				

S-8	SLO-1	*Clickstream Analysis*	*Decision Support SystemsClassification*	*Sentiment Analysis*	*Multi-criteria decision making*	*Cloud Computing*
	SLO-2	*Practical Solutions*				
S-9	SLO-1	*Competitive Intelligence Analysis*	*Decision Support SystemsComponents*	*Speech Analytics*	*Pairwise comparisons*	*Business Intelligence*
	SLO-2					

Learning Resources	1. *Ramesh Sharda, Dursun Delen, EfraimTurban, J.E.Aronson,Ting-Peng Liang, David King, "Business Intelligence and Analytics: System for Decision Support", 10th Edition, Pearson Global Edition, 2013.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.V.Selvakumar,Hexaware Technologies, selvakumarv@hexaware.com	*1.*	*1. Mr.L.N.B.Srinivas, SRMIST*
2.	*2.*	*2. Ms.S.Nagadevi, SRMIST*

Course Code	18CSE395T	Course Name	WEB INTELLIGENCE	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the topics of Web Intelligence*
CLR-2 :	*Study models of information retrieval, semantic webs, search engines, and web mining.*
CLR-3 :	*Gain knowledge on the algorithmic aspect of Web Intelligent systems*
CLR-4 :	*Acquire knowledge on Data mining techniques*
CLR-5 :	*Understand the impact of Social Network Design for Web Intelligence*
CLR-6 :	*Gain Knowledge on different approaches required for studying the impact of social network for Web Intelligence*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge on topics and benefits of Web Intelligence*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	*H*	*H*	*H*	-
CLO-2 :	*Acquire the ability to build models of information retrieval, semantic webs, search engines, and web mining.*	*2*	*75*	*80*	*H*	*H*	*H*	-	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*M*
CLO-3 :	*Understand the basic ideas of Multimedia Information Retrieval*	*2*	*85*	*80*	*H*	-	-	-	-	*H*	-	-	-	-	-	*H*	*H*	*H*	*H*
CLO-4 :	*Acquire knowledge to use web crawlers and fetch relevant information*	*2*	*80*	*75*	*H*	*H*	*H*	*M*	*M*	-	-	-	-	-	-	*H*	*H*	*H*	*H*
CLO-5 :	*Acquire knowledge to refine the social network design approached used for developing intelligent web*	*2*	*75*	*85*	*H*	-	-	*H*	*H*	-	-	-	-	-	-	*H*	*H*	*H*	*H*
CLO-6 :	*Apply the knowledge of different web intelligence based algorithms in practical applications*	*2*	*80*	*85*	*H*	-	*H*	-	-	*H*	-	-	-	-	-	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Web Intelligence What is Web Intelligence? Benefits of Intelligent Web:What applications can benefit from web intelligence*	*Information Retrieval- Introduction, Document Representation*	*Data Mining Techniques-Classification*	*Web Content Mining-Web Crawlers*	*Social Network Design for Web Intelligence:Introduction: Social Network Design for Web Intelligence*
	SLO-2					
S-2	SLO-1	*Wisdom Web*	*Retrieval Models*	*Data Mining Techniques-Clustering and Association*	*Web Crawlers*	*Overview of Social Intelligence Design: Groups and Communities, Issues of Social Intelligence Design, Applications of Social Intelligence Design*
	SLO-2					
S-3	SLO-1	*Ingredients of Intelligent Web*	*Retrieval Models*	*Data Mining Techniques- Association*	*Search Engines*	*The Travelling Conversation Model*
	SLO-2					
S-4	SLO-1	*Topics of Web Intelligence*	*Evaluation of Retrieval Performance*	*Web Usage Mining- Web-Log processing*	*Personalization of Web Content*	*A Broadcast-Based Approach*
	SLO-2					
S-5	SLO-1	*How can I build intelligence in my own application?*	*Semantic Web-Introduction, The Layered-Language Model*	*Web Usage Mining -Analyzing Web Logs*	*Multimedia Information Retrieval*	*A Conversational Agent-Based Approach*
	SLO-2					
S-6	SLO-1	*Examples of intelligent web applications*	*Metadata and Ontologies*	*Applications of Web Usage Mining Clustering of Web Users*	*Web Structure Mining- Modeling Web Topology*	*Smart Environment based approach*
	SLO-2					
S-7	SLO-1	*Fallacies of Intelligent applications*	*Ontology Languages for the Web*	*Applications of Web Usage Mining-Classification Modeling of Web Users*	*PageRank Algorithm*	*Psychological Evaluation, Technical Issues*
	SLO-2					
S-8	SLO-1	*Related Technologies*	*Tool Environment for the Ontology RDFferret-*	*Applications of Web Usage Mining-*	*Hyperlink-Induced Topic Search*	*Case Study-Putting it all together : an*

	SLO-2		*Full Text Search and RDF Querying.Onto Share-Community support Onto Edit-Ontology Development*	*Association Mining of Web Usages*	*(HITS)*	*intelligent news portal*
S-9	SLO-1	*Related Technologies*	*OntoView-Change Management for Ontologies Sesame-Repositories for Ontologies and Data CORPORIUM-Information Extraction*	*Sequence-Pattern Analysis of Web Logs*	*Random Walks on the Web*	*Case Study-Applying Web Intelligence for Business Intelligence*
	SLO-2					

Learning Resources	1. *Akerkar, R. & Lingras, P. (2008). Building an Intelligent Web: Theory and practice. Jones and Bartlett Publishers, Sudbury, Massachusetts. ISBN-13: 978-0- 7637-4137-2* 2. *Marmanis & Babenko: Algorithms of the Intelligent Web, Manning Publications, 2009, ISBN:978-1933988665* 3. *Witten, Ian H. & Frank, E. (2005). Data Mining: Practical Machine Learning Tools and Techniques. 2nd Edition, Morgan Kaufman. ISBN 0120884070, 9780120884070*	4. *Bing Liu: Web Data Mining, Springer, 2nd ed. 2011 (view online or download fromSpringerlink)* 5. *Manning, Raghavan and Schuetze: Introduction to Information Retrieval, CambridgeUniversityPress,2008(bookavailableonline)* *N. Zhong, J.M. Liu, Y.Y. Yao, Web Intelligence (Springer, 2003)*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.B.Sathiya, Data Scientist,SPi Global - Analytics & AI,Adyar, Chennai	*1. Dr.S.RenugaDevi, Assistant Professor(Sl.Gr.),College of Engineering,Guindy,AnnaUniversity,Chennai*	*1. Dr.G.Manju*
		2.Mr.K.Vijayakumar
		3.Mr.LNB.Srinivas

Course Code	18CSE396T	Course Name	DATA SCIENCE	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Able to apply fundamental algorithmic ideas to process data*			
CLR-2 :	*Understand the Data Analytics lifecycle*			
CLR-3 :	*Able to construct predictive models to classify new data set*			
CLR-4 :	*Learn to apply hypotheses and data into actionable predictions*			
CLR-5 :	*Document and communicate the results effectively to different stakeholders*			
CLR-6 :	*Effectively communicate the findings using visualization techniques*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Able to comprehend basic methods of processing data from real world problems*	*2*	*85*	*80*
CLO-2 :	*Able to convert data into actionable insights*	*2*	*80*	*75*
CLO-3 :	*Build clustering and classification models using R environment*	*3*	*85*	*80*
CLO-4 :	*Apply statistical techniques for evaluation*	*3*	*75*	*70*
CLO-5 :	*Analyze and validate the models using appropriate performance metrics*	*4*	*80*	*75*
CLO-6 :	*Present the results using effective visualization techniques*	*4*	*85*	*80*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*L*	*M*	*L*	*L*	*H*	*L*	*L*	*L*	*L*	*L*	*M*	*M*	*H*	*M*	*L*
CLO-2 :	*M*	*H*	*L*	*M*	*M*	*L*	*L*	*M*	*M*	*M*	*M*	*H*	*M*	*M*	*M*
CLO-3 :	*H*	*M*	*H*	*H*	*H*	*L*	*L*	*M*	*H*	*M*	*H*	*M*	*M*	*H*	*M*
CLO-4 :	*M*	*H*	*H*	*H*	*H*	*L*	*M*	*M*	*H*	*H*	*H*	*H*	*M*	*H*	*H*
CLO-5 :	*H*	*H*	*M*	*H*	*M*	*L*	*M*	*M*	*H*	*M*	*H*	*H*	*M*	*H*	*H*
CLO-6 :	*M*	*M*	*M*	*H*	*H*	*M*	*L*	*H*	*H*	*H*	*H*	*H*	*M*	*M*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Data science process*	*Approaching Analytics Problems*	*Introduction to R*	*Choosing and evaluating models*	*Documentation*
	SLO-2	*The roles in a data science project*	*Key roles for successful Analytics project*	*R Graphical user interfaces*	*Schematic model construction and evaluation*	*Knitr package*
S-2	SLO-1	*Stages in data science project*	*Discovery*	*Data Import and Export*	*Mapping problems to machine learning*	*Deploying models*
	SLO-2	*Define, Collect, Build, Evaluate, Present and Deploy*	*Business domain, Resources, Problem framing, Key stakeholders, Analytics sponsors, Initial hypotheses, Data sources*	*Attributes and Data Types*	*Solving classification problems, working without known targets*	*Deploying R HTTP services and exporting*
S-3	SLO-1	*Working with data from files*	*Data Preparation*	*Vectors*	*Evaluating classification models*	*Presenting your results to the project sponsor*
	SLO-2	*Structured data, other data formats and Transforming data in R*	*Learning about the data, conditioning*	*Arrays and Matrices*	*Accuracy, precision, Recall, sensitivity and specificity*	*Summarizing the project goals and stating the results*
S-4	SLO-1	*Working with relational databases and NoSQL databases*	*Model Planning*	*Data Frames*	*Evaluating clustering models*	*Presenting your model to end user*
	SLO-2	*Staging and Curating the data*	*Data exploration, Model selection*	*Lists*	*Intracluster distance, cross cluster distance*	*Presenting your work to other data scientist*
S-5	SLO-1	*Exploring data*	*Model Building*	*Factors*	*Validating models*	*Introduction to data analysis*
	SLO-2	*Using summary statistics to spot*	*Common tools for model building*	*Contingency Tables*	*Overfitting, Quantifying model*	*Visualization before Analysis*

		problems			*soundness, Ensuring model quality*	
S-6	SLO-1	*Managing data*	*Communicate Results*	*Descriptive statistics*	*Memorization methods*	*Dirty data*
	SLO-2	*Cleaning data*	*Analysis over the different models*	*Model building, Evaluation and Deployment*	*Using single variable and multi variable*	*Visualizing a single variable*
S-7	SLO-1	*Sampling for modeling and validation*	*Operationalize*	*Hypotheses Testing*	*Linear regression*	*Examining multiple variables*
	SLO-2	*Training and test set split, Sample group column, Record grouping, Data provenance*	*Moving the model to deployment environment*	*Null hypotheses and Alternative hypotheses*	*Building a linear regression model and predicting*	*Dotchart and Barplot*
S-8	SLO-1	*Data Structures*	*Analytics Plan*	*Difference of means*	*Logistic regression*	*Box and Whisker plot*
	SLO-2	*Structured, Semi-structured, Quasi-structured and Unstructured data*		*Student t-test, Welch's t-test*	*Building a logistic regression model and predicting*	*Hexbinplot for large datasets*
S-9	SLO-1	*Drivers of big data*	*Key deliverables of analytics project*	*Wilcoxon Rank-Sum test*	*Unsupervised methods*	*Scatterplot matrix*
	SLO-2	*Devices – Mobile, smart devices*	*Presentation: Project sponsors, Analysts, Code, Technical specifications*	*Type I and II errors*	*Cluster analysis*	*Analyzing a variable over time*

Learning Resources	1. *David Dietrich, Barry Heller, Beibei Yang, "Data Science and Big Data Analytics" , EMC Education Services,2015* 2. *NinaZumel,JohnMount,"PracticalDataSciencewithR",ManningPublications,2014* 3. *JureLeskovec,AnandRajaraman,JeffreyD.Ullman,"MiningofMassiveDatasets",Cambridge University Press,2014* 4. *MarkGardener,"BeginningR-TheStatisticalProgrammingLanguage",JohnWiley&Sons,Inc,2012* 5. *W.N.Venables,D.M.SmithandtheRCoreTeam,"AnIntroductiontoR",2013* 6. *Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd.,2014*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply / Analyze	*30 %*	-	*40 %*	-	*30 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate / Create	*30 %*	-	*30 %*	-	*40 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Pethuru Raj, Reliance Jio Infocomm Ltd, peterindia@gmail.com	*1. Prof. P.Marikkannu, IT HOD, Anna University Regional centre, Coimbatore, pmarikkannu@gmail.com*	*1. Dr. G. Vadivu, SRMIST*
	2. Prof. E.Ilavarasan, Pondicherry University, eilavarasan@pec.edu	*2. Dr.B.Baranidharan, SRMIST*
		3. Mr.D.Vivek, SRMIST

Course Code	18CSE487T	Course Name	DATA WAREHOUSING AND ITS APPLICATIONS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the basic idea of data warehouse*
CLR-2 :	*To learn step by step approach to design a data warehouse*
CLR-3 :	*Understand ETL Process*
CLR-4 :	*To learn building process of data warehouse and implementation of data mart*
CLR-5 :	*Identify the Data mining concepts with various domains*
CLR-6 :	*To learn case studies to bring out practical aspects of data warehouse*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge, Architecture and schema and OLAP Tool concepts.*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Acquire knowledge to design a data warehouse.*	*2*	*75*	*80*	*H*		-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Implement ETL Process in various data warehouse applications.*	*2*	*85*	*80*	*H*		-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Acquire knowledge to implement a data warehouse.*	*2*	*80*	*75*	*H*		-		-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Implement the various concepts and applications of data mining rules and technology.*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*To Implement the data warehouse concepts in various organizations.*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to dataware housing*	*Data Warehouse Schema- Introduction*	*Building a data warehouse - Introduction*	*DATA MINING-introduction – Data – Types of Data – Data Mining Functionalities*	*Data Warehouse in Tamil Nadu government*
	SLO-2	*Introduction to data ware housing*	*Dimensional Modeling*	*Critical success factor*	*Integrating Data Mining with Data Warehouse*	*Data warehouse for ministry of commerce*
S-2	SLO-1	*Data warehousing Components*	*The Star Schema*	*Requirement Analysis*	*Data Mining Task Primitives*	*Data warehouse for the government of Andhra Pradesh*
	SLO-2	*Need for Data warehousing*	*The Snowflake Schema*	*Planning for the data warehouse*	*Data Preprocessing*	*Data warehouse for the government of Andhra Pradesh*
S-3	SLO-1	*Benefits and application of data warehouse*	*Aggregate Tables*	*Data warehouse design stage*	*Association rule mining and classification*	*Data warehouse in Hewlett Packard*
	SLO-2	*Data Warehouse Architecture Goals*	*DBMS Schemas for Decision Support*	*Building and implementing data marts*	*Frequent pattern Mining*	*Data warehouse in Hewlett Packard*
S-4	SLO-1	*Data Warehouse Architecture and Characteristics*	*Data Extraction*	*Building data warehouse*	*Apriori algorithm*	*Data warehouse in Levi Strauss*
	SLO-2	*Data Warehouse Architecture and Characteristics*	*Data transformation: Basic tasks*	*Backup and Recovery*	*Frequent pattern Mining without candidate generation*	*Data warehouse in Levi Strauss*
S-5	SLO-1	*Data Mart*	*Major transformation types*	*Establish the data recovery quality framework*	*Mining Multilevel Association Rules*	*Data warehouse in World Bank*
	SLO-2	*Data Mart*	*OLAP definition,*	*Operating the warehouse*	*Mining Multidimensional Association Rule, Correlation Analysis Rule*	*Data warehouse in World Bank*

S-6	SLO-1	*Classification of data mart, Implementation*	*Dimensional Analysis*	*Recipe for a successful data warehouse*	*Classification: Decision Tree*	*HARBOR-A highly available data warehouse*
	SLO-2	*Classification of data mart, Implementation*	*Hypercube*	*Data warehouse pitfalls*	*Bayesian Classification-Naïve Bayes Classification*	*HARBOR-A highly available data warehouse*
S-7	SLO-1	*Gathering the business requirement*	*OLAP operations*	*Meta Data – Introduction*	*SVM Linear and Non linear data*	*A Typical Business Data Warehouse for a trading company*
	SLO-2	Planning and project management-Project principles	Drill down	Meta Data – Data Management	Text Mining Temporal Data Mining and Spatial Data mining	A Typical Business Data Warehouse for a trading company
S-8	SLO-1	Data ware house readiness assessment, project team	Roll up	Meta Data – Query Generation	Cluster Analysis-Introduction	Customer Data warehouse of world's first and largest online bank in united kingdom
	SLO-2	Selecting the operating system	Slice	Meta Data – Query Generation	K-means– Partitioning Methods	Customer Data warehouse of world's first and largest online bank in united kingdom
S-9	SLO-1	Selecting the database software	OLAP models	Meta Data and Tools	Hierarchical Methods	A German supermarket Edeka's Data warehouse
	SLO-2	Selecting the tools	MOLAP	Meta Data and Tools	Data Mining Applications	A German supermarket Edeka's Data warehouse

Learning Resources	1. *PaulrajPonniah,—DataWarehousing:FundamentalsforITProfessionals,WileyIndia.,2001.* 2. *Reema Theraja "Data Warehousing" by Oxford UniversityPress-2011.* 3. *DataMiningandDataWarehousingbyMs.KhushbooSaxena,Mr.Sandeepsaxena,Dr.AkashSaxenafirst edition 2015,BPBpublication,India*	4. *Prabhu CSR ,Data Warehousing Concepts, Technique, Product and application, PHI Learning private Ltd, Third Edition,2013.* 5. *SamAnahory,DennisMurray,DataWarehousingintheRealWorld,Pearsonpublication-2009*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
K Selvanayagam, System Analyst, project Lead, Preludesys, Siruseri, Kancheepuram Dist.	*V.Masillamani, Asst Prof,IIITDM, Kancheepuram ,chennai*	*1.A.M.J Muthu Kumaran*
		2. S.A Saranya

Course Code	18CSE488T	Course Name	FUNCTIONAL PROGRAMMING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the basic building blocks of stream processing*			
CLR-2 :	*Explore the data ingestion options into stream processing engines*			
CLR-3 :	*Process streaming data in real time*			
CLR-4 :	*Utilize NOSQL storage options to store real time data*			
CLR-5 :	*Deliver stream processing results to end users*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Comprehend the usage of basic constructs of a functional programming language*	*3*	*80*	*70*	*L*	*H*	*H*	*H*	*H*	-	-	-	*L*	*L*	-	*H*	-	-	-
CLO-2 :	*Create the different types of functions and evaluate its operations*	*3*	*85*	*75*	*M*	*H*	*L*	*M*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-3 :	*Create patterns and match the same with traits and case classes*	*3*	*75*	*70*	*M*	*H*	*M*	*H*	*H*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-4 :	*Create lists and collections, evaluate its operations*	*3*	*85*	*80*	*M*	*H*	*M*	*H*	*H*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-5 :	*Construct functional design for real world applications using common structures*	*3*	*85*	*75*	*H*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Programming Paradigms*	*Modules, Objects and Namespaces*	*Traits – Purpose and Syntax*	*Lists – Java vs Scala Lists*	*Functors - Purpose and Use*
	SLO-2	*Different types of programming paradigms, Functional vs OOP*	*Demo - Modules, Objects and Namespaces*	*Define a trait*	*Lists definitions and usage demo*	*Writing a simple functor*
S-2	SLO-1	*Scala Language Basics - Variables,*	*Anonymous Functions*	*Interface types*	*Working with Lists*	*Functor Laws*
	SLO-2	*Expressions*	*Polymorphic Functions, Nested Functions*	*Interface types examples*	*Constructing Lists*	*Applicatives – Concepts and use*
S-3	SLO-1	*Functions*	*Demo – Anonymous , Polymorphic and Nested Functions*	*Thick Interfaces*	*Basic operations on lists*	*Defining an applicative*
	SLO-2	*Recursion*	*Closures*	*Thin Interfaces*	*head, tail, isEmpty demo, List Patterns*	*Demo of Applicatives*
S-4	SLO-1	*Call By Name*	*Demo - Closures*	*Comparison - Thick vs Thin Interfaces*	*Lists - First Order methods*	*Traversable functors*
	SLO-2	*Call By Value*	*Repeated Parameters*	*Ordered trait*	*Examples of First Order Methods*	*Example – Traversable Functors*
S-5	SLO-1	*Conditionals*	*Tail Recursion*	*Demo – Ordered trait, Trait Comparisons*	*Lists - Higher Order methods*	*Monads*
	SLO-2	*Looping – for each and for*	*Demo – Tail Recursion*	*Traits for modifying interfaces*	*Examples of Higher Order Methods*	*Defining Monads*
S-6	SLO-1	*Significance of vals*	*Define a tail recursive function*	*Stacking modifications*	*Sequences – Overview and operations*	*Monad Laws*
	SLO-2	*Classes*	*Tracing tail-recursive functions*	*Recap – Traits and operations*	*Demo - Sequences*	*Demo – Monads and Monad Laws*
S-7	SLO-1	*Types*	*Demo – Tracing tail-recursive functions*	*Mixin – Purpose & Composition*	*Tuples - Overview and operations*	*Monoid – Concept, Purpose and Use*
	SLO-2	*Fields*	*Limits of tail-recursive functions*	*Mixin Example*	*Demo - Tuples*	*Examples of Monoid*
S-8	SLO-1	*Methods*	*Curried Functions*	*Case Classes – Use, Definition*	*Sets and Maps – Overview and operations*	*Recap with more examples -Monads and Functors*
	SLO-2	*Variable scope*	*Demo - Curried Functions*	*Pattern Matching, Example*	*Demo – Sets and Maps*	*Recap with more examples -Applicatives*
S-9	SLO-1	*Objects*	*Higher Order Functions - Definition and Uses*	*Sealed Classes, Option Type*	*Recap – Lists and Collections*	*Applications – Functors, Monads*

	SLO-2	*Singleton object, Variables of objects*	*Higher Order Functions Example*	*Applications – Sealed Classes and Option Type*	*Examples – Lists and Collections*	*Applciations - Monads*

Learning Resources	1. *Chiusano.P,BjarnasonR,FunctionalProgramminginScala,ManningPublications,2015* 2. *OderskeyM,SpoonL,VennersB,"ProgramminginScala",Thirdedition.*	3. *Hortsmann, C., Scala for the Impatient, 2nd ed., Addison-Wesley,2016.* 4. *Raychaudhuri R, Scala in Action, 1st ed. Manning Publications,2013.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Ms. K.Sornalakshmi
		Mr.R.Rajkumar

Course Code	18CSE489T	Course Name	STREAMING ANALYTICS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the basic building blocks of stream processing*
CLR-2 :	*Explore the data ingestion options into stream processing engines*
CLR-3 :	*Process streaming data in real time*
CLR-4 :	*Utilize NOSQL storage options to store real time data*
CLR-5 :	*Deliver stream processing results to end users*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Comprehend the concepts and terminologies in stream processing*	*3*	*80*	*70*
CLO-2 :	*Create the data ingestion pipeline for a stream processing application*	*3*	*85*	*75*
CLO-3 :	*Create stream processing applications using Apache Storm and Spark Streaming*	*3*	*75*	*70*
CLO-4 :	*Store real time data using NoSQL databases*	*3*	*85*	*80*
CLO-5 :	*Construct stream data visualizations for users*	*3*	*85*	*75*
		3	*80*	*70*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*L*	*H*	*H*	*H*	*H*	-	-	-	*L*	*L*	-	*H*	-	-	-
CLO-2 :	*M*	*H*	*L*	*M*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-3 :	*M*	*H*	*M*	*H*	*H*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-4 :	*M*	*H*	*M*	*H*	*H*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-5 :	*H*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-
	L	*H*	*H*	*H*	*H*	-	-	-	*L*	*L*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Stream Processing*	*Getting Started with Kafka*	*Apache Storm – Introduction*	*Apache Spark Streaming Introduction*	*NoSQL Data Bases*
	SLO-2	*Batch vs Stream Processing, Examples of stream processing*	*Why Kafka ? Publish Subscribe messaging model*	*Features of Storm*	*Spark's Memory Usage*	*Introduction to MongoDB*
S-2	SLO-1	*Map Reduce, Scalability and Fault Tolerance*	*Kafka Architecture*	*Storm Components*	*Understanding Resilience and Fault Tolerance in a Distributed System*	*MongoDB's Key Feature*
	SLO-2	*Applications of stream processing*	*Messages and Batches, Schemas*	*Nimbus, Supervisor Nodes*	*Spark's cluster manager*	*Data Model, Adhoc queries*
S-3	SLO-1	*Stateful Stream Processing*	*Topics and Partitions,*	*Zookeeper cluster*	*Data Delivery Semantics in Spark*	*Indexes, Querying*
	SLO-2	*Stream Processing Model*	*Producers and consumers*	*Storm Data Model*	*Data Delivery Semantics in Spark Applications*	*Replication, Speed and Durability*
S-4	SLO-1	*Data Sources, Stream processing pipelines, Sinks*	*Brokers and Clusters*	*Definition of a Storm topology, Operation modes in Storm*	*Microbatching*	*Scaling, MongoDB Change Streams*
	SLO-2	*Transformations and Aggregation*	*Multiple Clusters, Data Ecosystem*	*Storm – Prerequisites and Setting up a storm cluster, Developing a hello world example*	*Dynamic Batch Interval*	*Real-time data changes with Change Streams*
S-5	SLO-1	*Window Aggregations*	*Sending messages with producers*	*Storm topology options, Demo of Hello world in Storm*	*Structured Stream processing model*	*Visualizing Streaming data – Events, Logs, Records*
	SLO-2	*Stateless and stateful processing*	*Steps & Example - Sending messages with producers*	*Introduction to Storm UI*	*Spark Streaming Resilience Model*	*Dashboards*

S-6	SLO-1	*Effect of time in stream processing*	*Receiving messages with consumers*	*Cluster, Nimbus, Supervisor, Topology Summary. Nimbus Configuration*	*Data Structures in Spark – RDDs and DStreams*	*Visual Elements and Properties*
	SLO-2	*Lambda Architecture*	*Steps & Example - Receiving messages with consumers*	*Storm Scheduler*	*Spark Fault Tolerance Guarantees*	*Data Density*
S-7	SLO-1	*Kappa Architecture*	*Developing Kafka Streams Application*	*Types of schedulers*	*First Steps in Structured Streaming*	*Dividing time, Time to Live, Context*
	SLO-2	*Examples – Lambda & Kappa Architectures*	*Phases in a Kafka Streams Applciation Development*	*Applications of schedulers*	*Streaming Analytics Phases*	*Examples of Streaming Data Visualization*
S-8	SLO-1	*Streaming vs Batch Algorithms*	*Constructing a topology*	*Storm Cluster Monitoring*	*Acquiring streaming data*	*Visual Distractions and Visual Deception*
	SLO-2	*Applications – Streaming and Batch Algorithms*	*Streams and State – Applying stateful operations*	*Integration of Storm with Kafka*	*Transforming streaming data*	*Example – Stream processing visualization dashboards*
S-9	SLO-1	*Use of a Batch-Processing Component in a Streaming Application*	*Example application development with Kafka Streams*	*Integration of Storm with Kafka example*	*Output the resulting data*	*Streaming Visualization Techniques*
	SLO-2	*Recap – Stream Processing Fundamentals*	*Demo – Kafka Streams*	*Recap – Storm in Stream Processing*	*Demo – Stream Processing with Spark Streaming*	*Demo – Stream Processing visualizaton*

Learning Resource s	1. *Ellis B, Real-Time Analytics – Techniques to analyze and visualize streaming data, 1st ed., John Wiley & Sons Inc,2014* 2. *Andrade.H.C, Gedik B, Turaga D.S, "Fundamentals of Stream Processing: Application Design, Systems, and Analytics", 1st ed., Cambridge University Press,2014.* 3. *Narkhede N, Shapira .G, and Palino T., Kafka: The Definitive Guide - Real-Time Data and Stream Processing at Scale, 1st ed., O'Reilly Media, Inc.,2017.*	4. *Jain.A, Mastering Apache Storm, 1st ed., Packt Publishing,2017.* 5. *Garillot F and Mass. G.,, Stream Processing with Apache Spark, 1st ed., O'Reilly Media, Inc.,2019.* 6. *https://docs.mongodb.com/manual/changeStreams/* 7. *Banker K., Bakkum P., Verch S., Garret D., Hawkins T., MongoDb in Action, ", 1st ed., Manning Publications, 2016* 8. *Arageus A, Visualizing Streaming Data, 1st ed., O'Reilly Media, Inc.,2018.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Ms.K.Sornalakshmi
		Ms.A.Saranya, Dr.Manju

Course Code	18CSE490T	Course Name	BIG DATA VISUALIZATION	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the key techniques used in visualization which includes data models, graphical perception and techniques specifically for visual encoding and interaction*			
CLR-2 :	*Obtain an exposure to common data domains and the corresponding analysis tasks which includes multivariate data and text*			
CLR-3 :	*Get hands-on experience in building and evaluating visualization systems*			
CLR-4 :	*Gain knowledge in data visualization aides*			
CLR-5 :	*Understand the significance of data by placing it in a visual context*			
CLR-6 :	*Utilize the knowledge by reading and discussing research papers from the visualization literature*			
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Design and exploring the result with data visualizations*	*3*	*75*	*70*
CLO-2 :	*Conducting exploratory data analysis using visualization techniques and tools.*	*3*	*75*	*70*
CLO-3 :	*Visual presentations of data for effective Communication.*	*3*	*80*	*75*
CLO-4 :	*Designing and evaluating color palettes for visualization based on principles of perception.*	*3*	*85*	*80*
CLO-5 :	*Using the knowledge of perception and cognition to evaluate visualization design alternatives*	*3*	*85*	*80*
CLO-6 :	*Identifying opportunities for the application of data visualization in various domains.*	*3*	*85*	*80*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
L	*M*	*M*	*M*	*L*	-	-	-	*M*	*L*	*M*	*M*			
M	*H*	*M*	*M*	*M*	-	-	-	*M*	*L*	*M*	*M*			
M	*M*	*H*	*H*	*M*	*M*	-	-	*M*	*M*	*H*	*H*			
M	*M*	*M*	*H*	*H*	-	-	-	*M*	*M*	*H*	*H*			
M	*H*	*M*	*H*	*H*	-	-	-	*M*	*M*	*H*	*H*			
M	*H*	*H*	*H*	*H*	-	-	-	*M*	*M*	*H*	*H*			

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Big Data Visualization*	*Definitions and explanations of visualization categories*	*An Introduction to Visualization tools*	*Introduction to D3*	*Case Studies: 1: Color considerations with a dark background*
	SLO-2	*Challenges of Big Data Visualization*	*Exploring R In big data*	*Visualization tools and big data*	*D3 and big data*	
S-2	SLO-1	*Categorization*	*Example with Patient Medical History*	*Example 1 – Sales transactions*	*Basic Examples*	*2: Leveraging animation in thevisuals you present*
	SLO-2	*Visualization Philosophies*	*Digging in with R*	*Adding more context*	*Getting started with D3*	
S-3	SLO-1	*Approaches to Big Data Visualization*	*No looping*	*Wrangling the data*	*D3 visualization sample templates*	*3: Logic in order*
	SLO-2	*Quality of Visualization*	*Comparisons and Contrasts*	*Trifacta Script panel*	*Big data visualization using D3*	
S-4	SLO-1	*Infographics versus Data Visualization*	*Tendencies*	*A visualization dashboard*	*Displaying Results Using D3*	*4: Strategies for avoiding thespaghetti graph*
	SLO-2	*Exploration versus Explanation*	*Dispersion*	*Experimenting with the data and build the visualization*	*Create a summary file for visualization*	
S-5	SLO-1	*Informative versus Persuasive versus Visual Art*	*Data quality categorized*	*Data pane_core details*	*Visualization using HTML document*	*5: Alternatives to pies*
	SLO-2	*Ingredients of Successful Visualizations*	*Data Manager*	*Constructing Dashboards*	*Data visualization showing the stacked view*	
S-6	SLO-1	*Choose Appropriate Visual Encodings-Natural Ordering, Distinct Values*	*Data Manager and big data*	*Saving and Presenting the work*	*Visual transitions*	*Final Thought*
	SLO-2	*Redundant Encoding ,Defaults versus*	*Example-Reformatting-A little Setup*	*Visualization re-coloring, resizing, adding or*		

		Innovative Formats ,Readers' Context		*changing labels*		
S-7	SLO-1	*Compatibility with Reality ,Patterns and Consistency*	*Adding Script Code*	*Filters and Measure Names*	*Multiple donuts*	*Where to go from here*
	SLO-2	*Selecting Structure*	*Executing the scene*	*Example-Promotion Spend Effect on Sales*	*Another twist on bar chart visualizations with examples*	
S-8	SLO-1	*Position: Layout and Axes*	*Status and relevance*	*Sales and spend*		*Building storytelling with data competency in yourteam or organization*
	SLO-2	*The Meaning of Placement and Proximity*	*Naming the nodes*	*Sales v Spend and Spend as % of Sales Trend*	*D3 Stacked Area via Nest template*	
S-9	SLO-1	*Patterns of Organization-Specific Graphs, Layouts, and Axis Styles*	*Consistency ,Reliability ,Appropriateness*	*ables and indicators*	*Adopting the sample*	
	SLO-2	*Appropriate Use of Circles and Circular Layouts*	*Accessibility and Other Output nodes*		*Visualization changes format*	

Learning Resources	1. *Big Data Visualization,James D. Miller,Copyright © 2017 Packt Publishing* 2. *Designing Data Visualizations,by Noah Iliinsky and Julie Steele,Copyright © 2011 Julie Steele and Noah Iliinsky. All rights reserved.Printed in the United States of America*	3. *Storytelling with data - a data visualization guide for business professionals by cole nussbaumer knaflic, Wiley publications* 4. *Tableau Your Data! by Daniel G. Murray and the InterWorks BI Team, Wiley publications*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Valiyullasha, Bugtreat Technologies, UK, ceo@bugtreat.com	*Prof.Shiv ram Dubey, IIIT Sricity, srdubey@iiits.in*	*Dr.Mangalraj,SRMIST,*
Saravanakarthick,Hewlett-Packard, India, saravanakarthick.chinniah@dxc.com	*Prof. Bhawana Rudra, NITK suratkal,bhawanarudra@nitk.edu.in*	*Dr.K.P.Vijayakumar,SRMIST*

Course Code	18CSE491T	Course Name	MACHINE LEARNING - II	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*18CSE392T*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the Fundamentals of machine Learning Experiments*			
CLR-2 :	*Design and implement Ensemble learning methods*			
CLR-3 :	*To provide deeper understanding of Reinforcement Learning and its Elements*			
CLR-4 :	*Understand and Implement Neural Network Algorithms*			
CLR-5 :	*Understand the concepts of Deep Learning Algorithms*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Design and Analyze Machine Learning Experiments*	*2*	*80*	*85*
CLO-2 :	*Learn and Understand Graphical Model Learning and ensemble learning*	*2*	*75*	*80*
CLO-3 :	*Understand the concept of Reinforcement learning*	*2*	*85*	*80*
CLO-4 :	*Study the neural network systems for machine learning*	*2*	*80*	*75*
CLO-5 :	*Learn and Implement Deep Learning algorithms*	*2*	*75*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-
H	*H*	-	*H*	*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to machine learning*	*Graphical Models*	*Reinforcement Learning*	*Neural Networks representations*	*Feature selection*
	SLO-2	*Basic probability theory*	*Bayesian belief networks*	*K-Armed Bandit*	*McCulloch-Pitts units*	*Feature extraction*
S-2	SLO-1	*linear algebra*	*Markov random fields*	*Elements of reinforcement learning*	*Thresholding logic*	*Deep Learning*
	SLO-2			*Model based learning*	*Perceptron*	*Deep learning python libraries*
S-3	SLO-1	*Factors*		*Value iteration*	*Feed forward networks*	*Simple DNN*
	SLO-2	*Response and strategy of Experimentation*	*Naïve Bayes classifiers*	*policy iteration*	*Multi-layer perceptron*	*Activation functions*
S-4	SLO-1	*Randomization, Replication and Blocking*	*Markov models*	*Temporal difference learning*	*Back propagation algorithms*	*Regularization methods*
	SLO-2	*Guidelines for machine learning Experiments*	*Hidden Markov models*	*Exploration strategies*		
S-5	SLO-1	*Cross validation and resampling methods*	*Ensemble learning methods*	*Deterministic and Non-deterministic rewards and actions*	*Convergence and Hidden layer representation in back propagation*	*Convolutional Neural Networks*
	SLO-2	*Measuring classifier performance*	*Voting, Boosting, Adaboost*		*Optimization Algorithms*	
S-6	SLO-1	*Interval estimation*	*Gradient Boosting*	*Semi-supervised learning*	*Gradient Decent*	*Recurrent Neural Networks*
	SLO-2	*Hypothesis testing*	*Bagging*		*Stochastic gradient*	
S-7	SLO-1	*Assessing a Classification Algorithm's performance*	*Random Forest*	*Computational learning theory*	*Adam, Adagrad*	*LSTM*
	SLO-2	*Comparing two classification Algorithms*			*RMSProp*	*Sentiment analysis with LSTM keras code*

S-8	SLO-1	*Comparing multiple Algorithms*	*Fine Tuning Ensemble*	*VC dimension*	*Drop out*	*Auto encoders*
	SLO-2		*Cascading*		*Batch Normalization*	
S-9	SLO-1	*Comparison over multiple Datasets*	*Application Face recognition using Ensemble techniques*	*PAC learning*	*Application Face recognition using Neural Networks*	*Dimensionality reduction using Auto Encoders*
	SLO-2					

Learning Resources	1. *KevinP.Murphy,"MachineLearning:AProbabilisticPerspective",MITPress,2012.* 2. *EthemAlpaydin,"IntroductiontoMachineLearning",PrenticeHallofIndia,2005* 3. *Tom Mitchell, "Machine Learning", McGraw-Hill,1997.*	4. *Sebastian Raschka, VahidMirjilili,"Python Machine Learning and deep learning", 2nd edition, kindle book,2018* 5. *IanGoodfellow,Yoshua Bengio ,Aaron Courville,"DeepLearning",MITPress,2016.* 6. *JasonBrownlee,"DeepLearningwithPython",ebook,2016.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. Dr.G.Vadivu
		2. DrUshaKrithika *3. Mr. S. JosephJames*

Course Code	18CSE341T	Course Name	COMMUNICATION SYSTEMS ENGINEERING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the principles of Communication systems engineering*			
CLR-2 :	*Gain knowledge on the basics of Communication system components*			
CLR-3 :	*Acquire knowledge on encoding, decoding techniques*			
CLR-4 :	*Understand the fundamentals of Fiber Optic Communication*			
CLR-5 :	*Understand the basics of Satellite Communication*			
CLR-6 :				

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Understand the basic ideas about Communication and its types*	*1*	*80*	*85*
CLO-2 :	*Acquire the knowledge on applications of Communication systems*	*2*	*75*	*80*
CLO-3 :	*Gain knowledge on information sources and source coding algorithms*	*2*	*85*	*80*
CLO-4 :	*Understand the concepts of coding for reliable Communication*	*2*	*80*	*75*
CLO-5 :	*Ability to apply/appreciate the skills learnt during the design and integration of the fibre optic mode of Communication in any system under development*	*2*	*75*	*85*
CLO-6 :	*Ability to apply/appreciate the skills learnt during the design and integration of the satellite mode of Communication in any system under development*	*2*	*80*	*85*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	6	9	9	9
S-1	SLO-1	Significance of human Communication, Communication systems, transmitter	Introduction to information sources and source coding	Coding for reliable Communication	Fibre Optic Communication: Introduction Through Optical Fiber	Satellite Communication: Introduction
	SLO-2	Communication channel, Receivers, Transceivers	Modeling of information sources	Tight bound on error probability of orthogonal signals	Electromagnetic Spectrum	Basic Satellite Transponder Kepler's Laws Kepler's First Law Kepler's Second Law Kepler's Third Law
S-2	SLO-1	Attenuation, Noise	Measure of Information	The promise of coding	Types of Optical Fibres	Satellite Orbits: Low Earth Orbit Satellite Medium Earth Orbit Satellite
	SLO-2	Types of electronic Communication, simplex	Joint and Conditional Entropy	Linear block codes	Propagation of Light	Satellite Orbital Patterns Inclined Orbits Equatorial Orbit, Polar Orbits
S-3	SLO-1	Full duplex, half duplex	Source coding theorem	Theorem on Linear code	Single Mode Fibre	Geostationary Satellites
	SLO-2	Analog signals, Digital signals	Source coding algorithms	Hamming Codes	Multimode Fibre	Geosynchronous Satellite—Advantages and Disadvantages
S-4	SLO-1	Modulation and multiplexing, Baseband transmission	The Huffman source coding algorithm	Decoding and performance of linear block codes	Losses Within an Optical Fibre: Attenuation Loss	Power Systems
	SLO-2	Broadband transmission	Huffman Encoding Algorithm	Soft decision decoding	Absorption Loss	Altitude Control: Spin Stabilized

S-5	SLO-1	Multiplexing	Examples on Huffman Encoding Algorithm	Hard decision decoding	Radiation Loss	Spun/de-spun Stabilization Method
	SLO-2	Electromagnetic spectrum	The Lempel-Ziv source coding algorithm	Error detection and Error correction	Dispersion Loss	Three-axis Stabilized Method
S-6	SLO-1	Frequency and wavelength	Rate distortion theory	Burst error correcting codes	Rayleigh Scattering Loss	Altitude Control Components: Sensors, Actuators
	SLO-2	Optical spectrum	Mutual information	Cyclic codes, The structure of cyclic codes	Modal Dispersion Loss	Satellite System Parameters
S-7	SLO-1	Bandwidth	Differential Entropy	The generator matrix, Encoding of cyclic codes	Coupling Losses	Equivalent Noise
	SLO-2	Channel bandwidth	Rate distortion function	BCH Codes, Reed-Solomon Codes	Fibre Optic Transmission System: Fibre Optic Cable Light Sources	Temperature Carrier-to-Noise Density Ratio
S-8	SLO-1	Spectrum management	Examples on Rate distortion function	Convolutional Codes	Types of Fibre Optic Transmitters, Optical Detectors, Optical Repeater	Energy of Bit-to-Noise Density Ratio
	SLO-2	Standards	Digital audio transmission and digital audio recording	Basic properties of convolutional codes, Encoding, The transfer function	Optical Point-to-point Communication System:	Satellite System Link Models
S-9	SLO-1	Communication applications survey - Simplex	Digital audio in telephone transmission systems	Catastrophic codes	Single Channel System Amplified Single Channel System	Satellite System Link Equation 636 Uplink Power Budget Calculation
	SLO-2	Communication applications survey - Duplex	Digital audio recording	Optimum decoding of convolutional codes - The Viterbi algorithm	Wavelength Division Multiplexing (WDM) Systems	Satellite Radio Navigation

Learning Resources	1. *Louis E. Frenzel, Principles of Electronic Communication Systems, 4th Edition, Tata McGraw Hill Education, 2019. (Unit -I)* 2. *John G. Proakis, Masoud Salehi , Communication Systems Engineering, 2nd edition, Pearson Education International, 2015. (Unit - II & Unit -III)*	3. *Communication Systems , V. Chandra Sekar, Oxford University Press, 2015(Unit - IV &Unit-V)*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Ramesh Somasundaram,Director & Head, IT Sourcing Management & Supplier Governance, Energica, Chennai	*Dr.M.P Chitra, HOD/ECE, Panimalar Institute of Science and Technology*	*Dr.Annapurani.K, Dr.M.Prakash*
Mr. Umakanthan Velayutham, Senior Partner & Head, Transform Advisory Services, Energica, Chennai	*Dr.Dhalia Sweetlin, Asst.Prof(Sr.G), IT Dept, MIT,Chennai*	*Mrs.Kayalvizhi Jeyavel*

Course Code	18CSE342T	Course Name	DIGITAL COMMUNICATION SYSTEMS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the model of digital Communication system.*			
CLR-2 :	*Gain the knowledge about digital coding, signal compression and its application*			
CLR-3 :	*Gain knowledge on digital modulation , baseband and band-pass modulation*			
CLR-4 :	*To know the fundamentals of error control coding*			
CLR-5 :	*To learn the importance of Multiplexing and Multiple Access*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge on digital Communication, signals and systems*	*1*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Acquire the knowledge on sampling, Quantization, encoding and Signal Compression*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Understand the various digital modulation techniques*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*To understand the error Detection and Correction codes*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Understand the behavior of various multiplexing techniques*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :		*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction Digital Communication System, advantages of Digital Communication*	*Introduction to digital coding*	*Introduction to Digital Modulation*	*Introduction-Types and Measure of Error- Shannon-Hartley Capacity Theorem*	*Introduction to Multiplexing-Types*
	SLO-2	*Regeneration of Digital Signals, Power Efficiency of Digital Modulators*	*Digitizing Analog Signals*	*Baseband Modulation*	*Methods of Error Control-Classification of Error Correcting Codes*	*Frequency Division Multiplexing*
S-2	SLO-1	*Bandwidth Compression, Multimedia: Unification of Signals*	*Sampling*	*Pulse Modulation Systems*	*Linear Block Codes-Hamming Distance, Weight, Error Detection, Correction*	*Time Division Multiplexing*
	SLO-2	*Performance, Technology*	*Quantization*	*Baseband Signaling*	*Linear Block Codes-Generator Matrix, Systematic codes, Parity Check Matrix*	*Frame Synchronization*
S-3	SLO-1	*Time and Frequency Representation*	*Encoding*	*Correlative Coding: Duo-Binary Coding*	*Standard Array - Implementing the decoder*	*Primary Multiplexing in Digital Telephony*
	SLO-2	*Fourier Series, Fourier Transform*	*Signal Compression,*	*Modified Duo-Binary Coding*	*Cyclic Codes-Generator Polynomial for cyclic code*	*Higher Order Multiplexing*
S-4	SLO-1	*Discrete-time Fourier Transform*	*Signal Statistics and Redundancy*	*Digital Phase Modulation(Phase Shift Keying): Bi-phase shift keying modulation*	*Systematic Cyclic code*	*Multiple Access-Frequency Division Multiple Access*
	SLO-2	*Discrete Fourier Transform*	*Companded PCM*	*Differential coding in Bi-phase shift keying*	*Polynomial Multiplication and division*	*Time Division Multiple Access*
S-5	SLO-1	*Convolution*	*Predictive Coding*	*Scarmbling*	*Importance of Block Codes-Hamming Codes*	*Code Division Multiple Access*
	SLO-2	*Correlation*	*Transform Coding*	*Bi-phase shift keying modulator, Quadrature*	*Problem solving session*	*Random Access*

				and Offset Quadrature phase shift keying		
S-6	SLO-1	*Hilbert Transform*	*Parametric Coding*	*Digital Frequency Modulation(Frequency Shift Keying)*	*Golay-Reed Solomon Codes*	*Carrier Sense Multiple access/Collision Detection*
	SLO-2	*Problem solving session*	*Perceptual Coding*	*Minimum Shift Keying*	*Convolutional codes, Convolutional Encoder*	*Fixed Assignment Multiple Access*
S-7	SLO-1	*Low-pass and Band-pass Representations,*	*Application of Digital Coding-Digital*	*Minimum Shift Keying Modulator, Gaussian*	*Convolutional Decoding, Maximum*	*Demand Assignment Multiple Access*
		Band-pass Signals and Systems	*Speech*	*Minimum Shift Keying, Continuous Phase Modulation*	*like hood Decoding*	
	SLO-2	*Analytic Signals*	*Adaptive Delta Modulation Codec*	*Power Spectral Density of Baseband Signals*	*Viterbi algorithm*	*Introduction to Pseudo-Noise Sequence*
S-8	SLO-1	*Low-pass Equivalent Signals*	*Pulse Code modulation Codec*	*Power Spectral Density of Band-pass Signals*	*Sequential Decoding and Fano Algorithm*	*Properties of PN Sequences*
	SLO-2	*Problem solving session*	*Digital Audio: MP3 Coding*	*Problem solving session*	*Practical Applications of Error Correcting codes*	*Direct Sequence Spread Spectrum Transmitter and Receiver, Interface Rejection*
S-9	SLO-1	*Signal Space Representations: Vector Space*	*Digital Video: Run Length Coding, variable Length Coding*	*Comparison of Basic Modulations*	*Deep Space Communication*	*Frequency hopping Spread Spectrum, Frequency hopping Spread Spectrum Transmitter and receiver*
	SLO-2	*Problem solving session*	*MPEG1*	*Orthogonal Frequency Division Multiplexing*	*Satellite Communication*	*Spread Spectrum Applications*

Learning Resources	1. *R.N. Mutagi, Digital Communication – Theory, Techniques and Applications, 2nd Edition, Oxford University Press,2014.* 2. *John R. Barry, Edward A. Lee, David G. Messerschmitt, Digital Communication, 3rd Edition, Springer International Edition, Springer,2011*	3. *JohnG.Proakis,MasoudSalehi,DigitalCommunications,5thEdition,McGrawHillEducation,2015*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Ramesh Somasundaram,Director & Head, IT Sourcing Management & Supplier Governance, Energica, Chennai	*Dr.M.P Chitra, HOD/ECE, Panimalar Institute of Science and Technology*	*Dr.Annapurani.K, Dr.M.Prakash*
Mr. Umakanthan Velayutham, Senior Partner & Head, Transform Advisory Services, Energica, Chennai	*Dr.Dhalia Sweetlin, Asst.Prof(Sr.G), IT Dept, MIT,Chennai*	*Mrs. M. Safa, Mrs. D. Anitha*

Course Code	18CSE378T	Course Name	PRINCIPLES OF CLOUD COMPUTING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	*Understand the fundamental ideas behind Cloud Computing, the evolution of the paradigm, its applicability; benefits, as well as current and future challenges*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Learn cloud enabling technologies and get exposure to advanced clouds*			
CLR-3 :	*Explore cloud storage technologies and relevant distributed file systems, NoSQL databases and object storage;*			
CLR-4 :	*Understand the cloud security threats and protective mechanism for cloud computing*			
CLR-5 :	*Participate in team-based peer reviews to analyze the security development life cycle and mitigate risks and vulnerabilities*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Explain terms used in secured software development and life cycle process*	*3*	*80*	*70*	*H*	*H*	*H*	*H*	*H*	*-*	*-*	*-*	*L*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-2 :	*Apply fundamental concepts in cloud infrastructures to understand the cloud system, network and virtualization and outline their role in enabling the cloud computing system model.*	*3*	*85*	*75*	*M*	*H*	*L*	*M*	*H*	*M*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-3 :	*Illustrate the fundamental concepts of cloud storage and demonstrate their use in storage systems such as Amazon S3 and HDFS*	*3*	*75*	*70*	*M*	*H*	*M*	*M*	*H*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-4 :	*Evaluate the security issues related to cloud computing and handle the security threats and construct different cloud delivery design models.*	*3*	*85*	*80*	*M*	*H*	*L*	*H*	*M*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-5 :	*Analyze various cloud programming models and apply them to solve problems on the cloud.*	*3*	*85*	*75*	*H*	*H*	*M*	*H*	*H*	*M*	*-*	*-*	*M*	*M*	*-*	*H*	*-*	*-*	*-*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Cloud Computing Evolution of cloud computing*	*Cloud enabling technologies- Broadband networks and Internet architecture*	*Introduction to Cloud Data Storage, The evaluation of storage technology*	*Fundamental Cloud Security*	*Cloud Application Development and Architectural Styles*
	SLO-2				*Basic Terms and Concepts*	
S-2	SLO-1	*Network-Centric Computing*	*Data Center Technology*	*Storage Models*	*Threat Agents, Cloud Security Threats*	*MapReduce Programming Model*
	SLO-2	*Network-Centric Content*				
S-3	SLO-1	*Origin of Cloud Computing, Basic Concepts and Terminology*	*Web Technology*	*File Systems and databases*	*Cloud Security Mechanisms*	*Case Study: the GrepTheWeb Application*
	SLO-2		*Multitenant Technology*			
S-4	SLO-1	*Goals and Benefits*	*Service Technology Virtualization Technology*	*Distributed File Systems Google File System*	*Encryption Hashing*	*Hadoop: Yarn and Tez*
	SLO-2	*Risks and Challenges, Roles and Boundaries, Cloud Characteristics*				
S-5	SLO-1	*Cloud Service Models*	*Virtual Machines*	*HDFS*	*Digital Signature, Public Key Infrastructure*	*SQL on Hadoop: Pig, Hive, and Impala*
	SLO-2	*Cloud Deployment Models*		*NoSQL Databases*		
S-6	SLO-1	*Cloud Service Providers and the Cloud Ecosystem*	*Full Virtualization and Para-virtualization*	*Cloud Databases (HBase, MongoDB, Cassandra, DynamoDB)*	*Identity and Access Management, Single Sign-On: Kerberos authentication*	*Current Cloud Applications and New Opportunities*
	SLO-2					

S-7	SLO-1 SLO-2	*Amazon Web Services(AWS), Google Clouds, Microsoft Azure Cloud*	*Hardware Support for Virtualization*	*Cloud Object Storage (Amazon S3, OpenStack Swift, Ceph)*	*One-time password, Basic cloud data security mechanisms*	*Design approaches with Case Study*
S-8	SLO-1 SLO-2	*SLA Management in Cloud Computing: A Service Providers Perspective*	*Kernel-Based Virtual Machine, Hypervisors*	*Data Storage for Online Transaction Processing Systems*	*Virtual Machine Security, Security of Virtualization, A Trusted Hypervisor*	*Design methodology for IaaS Service Model*
S-9	SLO-1 SLO-2	*Case Study on Open Source & Commercial Clouds: Eucalyptus, OpenStack, Aneka*	*Containers; Docker Containers, Kubernetes*	*Disk Locality versus Data Locality in Computer Clouds*	*Mobile Devices and Cloud Security*	*Google API, AWS EC2 Instances.*

Learning Resources	1. *Dan C. Marinescu," Cloud Computing Theory and Practice", Second Edition Copyright © 2018 Elsevier Inc. All.https://www.sciencedirect.com/book/9780128128107/cloud-computing* 2. *Rajkumar Buyya, James Broberg, AndrzejGoscinski, Cloud Computing Principles and Paradigms, Wiley Publications, 2017.* 3. *Thomas Erl, ZaighamMahmood, and RichardoPuttini, "Cloud Computing: Concepts, Technology & Architecture", Prentice Hall/PearsonPTR, Fourth Printing, 2014, ISBN: 978013338752.*	4. *K. Chandrasekaran, "Essentials of Cloud Computing", Chapman and Hall/CRC Press, 2014, ISBN 9781482205435* 5. *Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", University Press, 2016, ISBN-13: 978-0996025508.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	40%	-	30%	-	30%	-	30%	-	30%	-
Level 2	Apply Analyze	40%	-	40%	-	40%	-	40%	-	40%	-
Level 3	Evaluate Create	20%	-	30%	-	30%	-	30%	-	30%	-
	Total	100 %		100 %		100 %		100 %		100%	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
SuriyadeepanRamamoorthy Research Engineer at Saama Technology Puducherry, Puducherry, India Information Technology and Services	*Dr.E. Ilavarasan Professor,CSE Pondicherry Engineering college.*	*1.Mrs Krishnaveni,SRMIST,KTR-SWE*
		2.Dr.S.Ramamooorthy,SRMIST,KTR-CSE
		3.Mr.K. Venkatesh,SRMIST,KTR-IT
		4.Mr. S.VidhyaSagar,SRMIST,Vadapalani campus

Course Code	18CSE377T	Course Name	DATA CENTRIC NETWORKS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Critically discuss data center networking technologies*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Evaluate key concepts in modern Layer 2 & Layer 3 data center networks*			
CLR-3 :	*Concepts related to networking technologies in modern data centers.*			
CLR-4 :	*Design, build and configure complex routed and switched networks*			
CLR-5 :	*Expose to implementing the networking solutions in a virtualized environment*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*apply networking technologies in data centers*	*1*	*90*	*85*
CLO-2 :	*Design modern data centers which incorporate all dynamic routing protocols.*	*3*	*85*	*80*
CLO-3 :	*Design layer 2 and layer 3 protocols.*	*3*	*85*	*80*
CLO-4 :	*design and configure the data centers*	*3*	*80*	*75*
CLO-5 :	*implement various network solutions for data centers*	*3*	*80*	*75*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
L	-	-	*M*	-	-	-	-	-	-	-	*H*	*L*	-	-
M	*M*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	*M*	*H*	-
M	*H*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	*M*	*H*	-
M	*H*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	*H*	*H*	-
H	*H*	*H*	*H*	*H*	*H*	-	*M*	-	-	-	*H*	*M*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Data centric networking from different perspectives*	*Introduction to data center architectures*	*Introduction to server Architectures*	*Introduction to Layer 2 Networks*	*Introduction to Layer 3 Networks*
	SLO-2					
S-2	SLO-1	*Content-Centric Networking (CCN)*	*Top of rack (TOR)network connectivity*	*Clustering in server architectures*	*IEEE 802.3ba standards*	*Layer 3 Data Center technologies*
	SLO-2					
S-3	SLO-1	*Content Distribution Networks (CDN)*	*End of rack(EOR) network connectivity*	*scaling in server architectures*	*40 Gbps and 100 Gbps Ethernet*	*LocatorIdentifier Separation Protocol (LISP)*
	SLO-2					
S 4-5	SLO-1	*Requirements for modern data centers*	*Solutions that reduce cabling in architecture*	*Optimization in server architectures*	*IEEE 802.1D Spanning Tree Protocol (STP)*	*Layer 3 Multicasting*
	SLO-2					
S-6	SLO-1	*Design for flexibility*	*Solutions that reduce power in architecture*	*Stand-alone blades*	*RSTP protocol*	*Protocols; IPv4, IPv6*
	SLO-2					
S-7	SLO-1	*Design for scalability*	*TIA/EIA-942. Structured cabling standards*	*Redundant Layer 2 and Layer 3 designs*	*PVST protocol*	*Protocols; MPLS, OSPF*
	SLO-2	*Design for environmental control*			*MSTP protocol*	
S-8	SLO-1	*Design for electrical power*	*Cable management*	*Limitation of traditional server deployments*	*TRILL protocols*	*Protocols; IS-IS, BGP*
	SLO-2	*Design for Backup*	*Bandwidth requirements*		*IEEE 802.1Qbg Edge Virtual Bridging*	
S-9	SLO-1	*Flooring in data centers*	*I/O connectivity*	*Case study*	*Fiber Channel over Ethernet (FCoE) vs Internet*	*OTV& VPLS layer 2 extension*
	SLO-2					

Learning Resources	1. *MouricioArregoces,"Data Centre Fundamentals",CiscoPress,2003* 2. *SilvanoGai,Claudio DeSanti,"I/O Consolidation in the Data Center" Cisco Press;1 edition [ISBN:9781587058882].2009.* 3. *KevinCorbin,Ron Fuller,DavidJansen,"NX-OSand CiscoNexus Switching:Next-Generation Data Center Architectures"CiscoPress;1 edition [ISBN:9781587058929],2010.* 4. *Silvano Gai,Tommi Salli,RogerAndersson,"Cisco Unified Computing System" CiscoPress;1edition,[ISBN:9781587141935],2010.*	5. *NashDarukhanawalla,Patrice Bellagamba,"Interconnecting Data Centers Using VPLS"CiscoPress;1edition,[ISBN:9781587059926],2009.* 6. *RobertW.Kembel,Roger Cummings(Introduction),"The Fibre Channel Consultant" Northwest Learning Assoc;3rdedition,[ISBN:0931836840],1998.* 7. *Robert W Kembal"FiberChannelSwitchedFabric"Northwest Learning Associates,inc.[ISBN:0931836719],2009.* 8. *JohnL.Hufferd,"ISCSI",Addison-WesleyBoston[ISBN:978-0201784190],2003*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr.M.S.Sricharan/Wipro Technologies		*Dr. B.Amutha, Professor and Head, Department of CSE, SRM IST*
		Dr. G.Vadivu, Professor and Head, Department of IT, SRM IST

Course Code	18CSE343T	Course Name	WEB APPLICATION DEVELOPMENT	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Generate web pages using HTML,CSS, AJAX, JQUERY*			
CLR-2 :	*Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.*			
CLR-3 :	*Understand web site dynamic behavior and server side Programming*			
CLR-4 :	*Generate dynamic web pages using databases*			
CLR-5 :	*To understand the different web development frameworks*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Acquire the knowledge of HTML,CSS, AJAX, JQUERY*	*2*	*80*	*85*
CLO-2 :	*Design the dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms*	*2*	*75*	*80*
CLO-3 :	*Acquire the knowledge of web site dynamic behavior and server side Programming*	*2*	*85*	*80*
CLO-4 :	*Develop the dynamic web pages using databases*	*2*	*80*	*75*
CLO-5 :	*Understand the web development frameworks*	*2*	*75*	*85*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*M*		*H*	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*M*		*H*		-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*M*		*H*		*H*	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*M*		*H*	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*M*	-	*H*		*H*	-	-	-	-	-	-	-	-	-	-

Duration (hour)		11	9	9	7	9
S-1	SLO-1	*Introduction: Rich Internet Applications*	*Introduction Angular JS*	*Overview of JSP2*	*Struts Architecture*	*Web Services*
	SLO-2					
S-2	SLO-1	*Introduction to HTML*	*Expression*	*Overview of SERVLET*	*Struts classes , Action Forward*	*Consuming a RESTfull Web Service Java desktop application /JSP*
	SLO-2	*HTML5 : Responsive web design*			*Action Form*	*Building REST Service with spring*
S-3	SLO-1	*Introduction about CSS*	*Module ,Directive Databinding*	*Creating dynamic web pages using JSP*	*Action Servlet*	*Spring Security Architecture*
	SLO-2	*CSS types*			*Action classes*	
S-4	SLO-1	*Introduction to JavaScript*	*Controllers,Scope-Filter*	*Standard-Tag Library*	*Understanding struts*	*Accessing relational data using JDBC with spring*
	SLO-2			*Java Beans , Custom Tags*	*config.xml*	
S-5	SLO-1	*Control structure*	*Introduction to Mongo, DB-Documents*	*Relational Database*	*Understanding Action Mappings, Struts flow with an example application*	*Uploading Files using spring application*
	SLO-2			*Introduction to MYSQL*		
S-6	SLO-1	*Objects*	*Collection-Database*	*JBDC-Driver*	*Struts Tiles Framework*	*Validating form input*
	SLO-2					*Handling form submission*
S-7	SLO-1	*Events*	*Datatypes*	*Understanding JDBC ODBC Connection Management*	*Struts Validation Framework*	*Creation of Batch Service*
	SLO-2					*Securing web application*
S-8	SLO-1	*Basic AJAX, History of AJAX*	*Creating, Updating*	*Resultset, Statements*		*Integrating Data*
	SLO-2	*AJAX - using XMLHttpRequest object*				*Accessing data with MongoDB*
S-9	SLO-1	*XML- and DOM , creating a full scaled web design*	*Deleting documents-Querying*	*Prepared statement, Callable Statement.*		*Creating asynchronous method,*

	SLO-2	*AJAX- Enabled Application using JSON.*				*Using WebSocket to build an interactive web application*
S10	SLO-1	*JQuery basic*				
	SLO-2	*jQuery core, events, effects,*				
S11	SLO-1	*plugins- user interface using jQuery.*				
	SLO-2					

Learning Resources	1. *Deitel ,Deitel and Nieto, "Internet and World Wide Web – How to program",4th Edition, Pearson Education Publishers,2009* 2. *EricFreeman,Elisabeth Robson,"HTML5Programming",firstedition,O'ReillyPublishers, 2011.* 3. *RobinNixon,"LearningPHP,My SQL, JavaScript, CSS & HTML5 "ThirdEdition, O'REILLY, 2014.* 4. *Marty Hall, "Core Servlet &Java Sever Pages " SunMicrosystems,* 5. *JamesHolmes"Struts:The Complete Reference,"2ndEdition2007McGrawHillProfessional.* 6. *Patrick Naughton, "COMPLETE REFERENCE: JAVA2", 7th edition,Tata McGraw-Hill, 2010.*	7. *ThomasApowell,"ThecompletereferenceHTML&CSS",5th Edition.* 8. *CraigWalls,"SpringinAction,4thEditionKindleEdition,ManningPublication,2015.* 9. *JobineshPurushothaman,"RESTfulJavaWebServices"SecondEdition,Packt Publishing,2015* 10. *https://www.w3schools.com/angular/angular_filters.asp* 11. *KristinaChodorow,MongoDB:TheDefinitiveGuide,2ndEdition,2013,OReilly.*

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.M.Prakash Team Lead(Associate Consultant) ,Virtusa ,Chennai, prakashpm@virtusa.com	*1. Dr.KHANNA NEHEMIAH , Professor, Ramanujan Computing, Anna University*	*1. Dr. M.UMA, Assistant Professor, SWE*
		2. Dr.Madhavan, Associate Professor/CSE
		3.K.Navin AP/IT

Course Code	18CSE344T	Course Name	CLOUD ARCHITECTURE	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Observe the fundamentals of cloud architecture*			
CLR-2 :	*Observe the Technologies used in cloud platforms*			
CLR-3 :	*Understand the advanced cloud architecture and storage arrays*			
CLR-4 :	*Understand the importance of cloud architecture design*			
CLR-5 :	*Gain knowledge in virtualization architecture*			
CLR-6 :	*Gain knowledge in future trends and technologies in cloud structures*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*To understand the concept of basic cloud computing paradigms*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*To interpret the concepts of Cloud service structures*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*To Analyze the components of cloud computing showing how business agility in an organization can be created*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*To be familiar with the market service providers in cloud.*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*To understand the technologies of data center cloud structures.*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*To work with robust cloud architectural patterns*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to cloud computing fundamentals*	*Service Oriented Architecture*	*Introduction to cloud storage infrastructures*	*Management Of Cloud Services*	*Introduction to Cloud Architecture patterns*
	SLO-2	*Cloud Computing definition*	*REST*	*Concept, planning and Design*	*Reliability, availability and security of services deployed from the cloud*	*Horizontally Scaling Compute Pattern-Cloud Significance*
S-2	SLO-1	*Cloud deployment models*	*Systems of Systems*	*Business continuity*	*Performance and scalability of services*	*Queue-Centric Workflow Pattern*
	SLO-2	*Private, Public , Hybrid, community cloud*	*Web Services*	*Basic concepts of information security*	*Tools and technologies used to manage cloud services deployment*	*Auto-Scaling Pattern*
S-3	SLO-1	*Cloud services:*	*Publish-Subscribe Model*	*Managing VDC and cloud environments and infrastructures*	*Cloud Economics*	*Eventual Consistency Prime*
	SLO-2	*IaaS, PaaS, SaaS*	*Basics of Virtualization*	*Securing storage in virtualized and cloud environments*	*Cloud Computing infrastructures available for implementing cloud based services*	*MapReduce Pattern*
S-4	SLO-1	*Enabling technologies of cloud computing*	*Types of Virtualization*	*Monitoring and management*	*Economics of choosing a Cloud platform for an organization*	*. Database Sharding Pattern*
	SLO-2	*Benefits and challenges of cloud computing*	*Implementation Levels of Virtualization*	*Security auditing and SIEM*	*Runtime Support Services*	*Node Failure Pattern*
S-5	SLO-1	*Business Agility:*	*Virtualization Structures*	*Storage Network Design*	*Resource Provisioning and Platform Deployment-Provisioning of Compute Resources (VMs)*	*Network Latency Primer*
	SLO-2	*Benefits and challenges to Cloud architecture.*	*Tools and Mechanisms*	*Architecture of storage, analysis and planning.*	*Resource Provisioning Methods*	*CDN Pattern.*

S-6	SLO-1	*Cloud Applications*	*Virtualization of CPU Memory*	*Storage network design considerations*	*NIST Cloud Computing Reference Architecture*	*Multisite Deployment Pattern*
	SLO-2	*Application availability*	*I/O Devices*	*NAS and FC SANs*	*Demand-Driven, Event-Driven Resource Provisioning*	*Network connectivity optimization evolution: Top of rack (TOR), end of rack (EOR), connectivity.*
S-7	SLO-1	*Performance*	*Virtualization Support and Disaster Recovery*	*Hybrid storage networking technologies*	*Popularity-Driven Resource Provisioning*	*Stand-alone, blades, stateless,*
	SLO-2	*Security and disaster recovery*	*Server Virtualization*	*iSCSI, FCIP, FCoE*	*Dynamic Resource Deployment*	*clustering*
S-8	SLO-1	*Next generation of Cloud Applications.*	*Parallel Processing*	*Design for storage virtualization in cloud computing*	*Storage-as-a-Service*	*scaling*
	SLO-2	*Virtualization*	*Vector Processing*	*host system design considerations*	*Advantages of Cloud Storage - Global Exchange of Cloud Resources*	*optimization, virtualization.*
S-9	SLO-1	*Types of virtualization in cloud computing*	*Symmetric Multiprocessing Systems*	*Cloud Applications*	*Application Development*	*Limitation of traditional server deployments*
	SLO-2	*Advantages and Disadvantages*	*Massively Parallel Processing Systems*	*Technologies and the processes required when deploying web services*	*Service creation environments to develop cloud based applications*	*Case studies*

Learning Resources

1. *GautamShroff,"EnterpriseCloudComputingTechnologyArchitectureApplications",Cambridge University Press; 1 edition, [ISBN: 978-0521137355],2010.*
2. *Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach" McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948],2009*
3. *Greg Schulz, "Cloud and Virtual Data Storage Networking", Auerbach Publications [ISBN: 978-1439851739],2011*
4. *EMC,"InformationStorageandManagement"Wiley;2edition[ISBN:978-0470294215],2012.*
5. *VolkerHerminghaus,AlbrechtScriba,"StorageManagementinDataCenters"Springer;editioN[ISBN: 978-3540850229].2009.*
6. *KlausSchmidt,"HighAvailabilityandDisasterRecovery"Springer;edition[ISBN:978-3540244608],2006.*
7. *Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel ProcessingtotheInternetofThings",MorganKaufmannPublishers,2012.*
8. *Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Securityll, CRC Press, 2017.*
9. *SilvanoGai,ClaudioDeSanti,"I/OConsolidationintheDataCenter"CiscoPress;1edition[ISBN: 9781587058882].2009.*
10. *2. Bill wilder, Cloud Architecture patterns,2012*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Anil Nayer, JPA solutions	*Dr. Kanagachidambaresan, Professor, PSG-Tech*	*Mr K. Venkatesh, SRMIST*
		Dr Ramamoorthy, SRMIST
		Mr Vinoth, SRMIST

Course Code	18CSE441T	Course Name	CLOUD APPLICATION DEVELOPMENT	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Utilize the different types of cloud services*			
CLR-2 :	*Utilize the different storage services*			
CLR-3 :	*Utilize different algorithms for cloud computing*			
CLR-4 :	*Utilize virtualization techniques*			
CLR-5 :	*Utilize real-time cloud services from different vendors*			
CLR-6 :	*Utilize and understand cloud services with real-time cloud applications*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Understand different cloud architecture and models*	*3*	*80*	*70*	*L*	*H*	*-*	*H*	*L*	*-*	*-*	*-*	*L*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-2 :	*Create the different types of cloud applications using different languages*	*3*	*85*	*75*	*M*	*H*	*L*	*M*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-3 :	*Understand the concepts of virtualization*	*3*	*75*	*70*	*M*	*H*	*M*	*H*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-4 :	*Create simple cloud applications and deploy*	*3*	*85*	*80*	*M*	*H*	*M*	*H*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-5 :	*Understanding cloud application paradigms*	*3*	*85*	*75*	*H*	*H*	*M*	*H*	*L*	*-*	*-*	*-*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-6 :	*Analyze different cloud technologies and its implementations*	*3*	*80*	*70*	*L*	*H*	*-*	*H*	*L*	*-*	*-*	*-*	*L*	*L*	*-*	*H*	*-*	*-*	*-*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to cloud computing*	*Cloud Computing: Applications*	*Server virtualization*	*Amazon Web Services: EC2 Instances*	*Case studies – IaaS, PaaS, SaaS*
	SLO-2	*Cloud deployment models*	*Challenges for Cloud Computing*	*Hypervisor- based virtualization*	*Connecting Clients to Cloud Instances Through Firewalls*	*IaaS*
S-2	SLO-1	*business drivers for Cloud Computing*	*Existing Cloud Applications and New Application Opportunities*	*Techniques for Hypervisor*	*Security Rules for Application Layer Protocols in EC2*	*Storage as a Service*
	SLO-2	*cloud computing Delivery Models*	*Architectural Styles for Cloud Applications*	*Hardware support for Virtualization*	*Security Rules for Transport Layer Protocols in EC2*	*Storage as a Service – Amazon storage service S3*
S-3	SLO-1	*cloud computing Services*	*Workflows: Coordination of Multiple Activities*	*VMware virtualization software*	*How to Launch an EC2 Linux Instance and Connect to it*	*Compute as a service*
	SLO-2	*challenges of cloud computing*	*Coordination Based on a State Machine Model*	*XenServer Virtual Machine Monitor*	*How to Use S3 in Java*	*Compute as a service – Amazon EC2*
S-4	SLO-1	*Cloud Infrastructure : cloud computing at Amazon*	*The Zookeeper*	*Storage Virtualization*	*How to Manage SQS Services in C#*	*PaaS*
	SLO-2					
S-5	SLO-1	*Cloud computing The Google perspective*	*Scalable data storage techniques*	*File virtualization*	*How to Install the Simple Notification Service on Ubuntu*	*Microsoft Azure*
	SLO-2	*Microsoft Windows Azure*	*The MapReduce Programming Model*	*Example*	*Example*	*Google App Engine*
S-6	SLO-1	*Microsoft Windows Azure services*	*RIAs, simple Hello world example*	*Block Virtualization*	*How to Create an EC2 Placement Group*	*Apache hadoop*

	SLO-2	*Open-Source Software Platforms for Private Clouds*	*Client-server example , RSS Feed Reader*	*Examples*	*How to Use MPI*	*Yahoo Mashups*
S-7	SLO-1	*Cloud Storage Diversity, Cloud Storage Vendor lock-in*	*Advanced platform functionality*	*Grid Computing*	*Hadoop Ecosystem*	*SaaS : CRM as a Service*
	SLO-2	*Cloud Computing Inter-operability*	*Clouds for Science and Engineering*	*Grid Technologies*	*How to Install Hadoop on Eclipse on aWindows System*	*Salesforce.com*
S-8	SLO-1	*The inter cloud , Responsibilities of User*	*High-Performance Computing on a Cloud , social Computing , Digital Content*	*comparing Grid and Cloud*	*Cloud-Based Simulation of a Distributed Trust Algorithm*	*Social Computing services : What Constitutes Social computing?, Case study - Facebook*
	SLO-2					
S-9	SLO-1	*Responsibilities of service provider*	*Cloud computing*	*Creating sample hello world application in OpenShift*	*A Cloud Service for Adaptive Data Streaming*	*Micro Blogger : Twitter*
	SLO-2	*Responsibility Sharing Between User and Cloud Service Provide*	*A Case Study: The GrepTheWeb Application*	*Example*	*Cloud-Based Optimal FPGA Synthesis*	*Document services*

Learning Resources	1. *Dinkar Sitaram, Geetha Manjunath, Moving To The Cloud: Developing Apps in the New World of Cloud Computing, Syngress,2013.* 2. *DanC.Marinescu,CloudComputing:TheoryandPractice.,MorganKaufman,2013*	3. *AMichael P. McGrath, Understanding PaaS: Unleash the Power of Cloud Computing, O'Reilly Media,2012.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Venkatesh Varalu, New YorkTimes, USA	*Dr. Balaraman Ravindran, Professor, IITM*	*Mr. Venkatesh, SRMIST* *Dr Pradeep Mohan Kumar, SRMIST* *Mrs Krishnaven, SRMISTi*

Course Code	18CSE442T	Course Name	CLOUD SECURITY	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	*To understand the concept of cloud security*
CLR-2 :	*The issues related to virtualized infrastructure security*
CLR-3 :	*To have knowledge on the various issue in cloud security*
CLR-4 :	*To Learn the methods to improve virtualization security and technologies in security*
CLR-5 :	*Understand the cloud contracting Model and case study of commercial cloud*

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Articulate the main concepts of cloud security*	*3*	*80*	*70*	*L*	*H*	*L*	*H*	*L*	*M*	*H*	*L*	*L*	*L*	*L*	*H*	*H*	*L*	*M*
CLO-2 :	*Explain the architecture design of cloud storage.*	*3*	*85*	*75*	*H*	*H*	*L*	*M*	*L*	*M*	*H*	*L*	*M*	*L*	*H*	*H*	*L*	*H*	*L*
CLO-3 :	*Explain the core issues of cloud management and security*	*3*	*75*	*70*	*H*	*H*	*H*	*H*	*H*	*M*	*L*	*L*	*M*	*L*	*M*	*H*	*M*	*M*	*M*
CLO-4 :	*Be able to install and use current cloud Technologies.*	*3*	*85*	*80*	*H*	*H*	*H*	*H*	*H*	*L*	*L*	*L*	*M*	*L*	*M*	*H*	*L*	*L*	*H*
CLO-5 :	*Apply secure design for cloud Models*	*3*	*85*	*75*	*H*	*H*	*H*	*H*	*L*	*M*	*L*	*L*	*M*	*L*	*M*	*H*	*L*	*M*	*L*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Cloud Security Fundamentals- Infrastructure Security*	*Layered Cloud Architecture Design*	*Confidentiality, privacy, integrity, authentication,*	*IBM security virtual server protection*	*Authentication in cloud computing*
	SLO-2	*Network level security*				
S-2	SLO-1	*Host level security*	*NIST cloud computing Reference Architecture*	*non-repudiation, availability,*	*virtualization-based sandboxing*	*Client access in cloud*
	SLO-2	*Application level security*				
S-3	SLO-1	*Data security and Storage*	*Public ,Private and Hybrid Cloud*	*access control, defence in depth, least privilege,*	*Cloud Storage*	*Cloud contracting Model*
	SLO-2		*IaaS,PaaS,SaaS*			
S-4	SLO-1	*Data privacy and security Issues,*	*Architectural design Challenges*	*How these concepts apply in the cloud, what these concepts mean and their importance in PaaS, IaaS and SaaS.*	*Security- HIDPS*	*Commercial and business considerations*
	SLO-2					
S-5	SLO-1	*Jurisdictional issues raised by Data location*	*Cloud Storage*	*Cryptographic Systems- Symmetric cryptography*	*log management*	*Case Study on Open Source & Commercial Clouds*
	SLO-2					
S-6	SLO-1	*Identity & Access Management*	*Storage-as-a-service*	*stream ciphers, block ciphers, modes of operation*	*Data Loss Prevention*	*X.509 certificates, OpenSSL.*
	SLO-2					
S-7	SLO-1	*Access Control*	*Advantages of Cloud storage*	*Public-key cryptography, hashing*	*Security Governance*	*Eucalyptus*
	SLO-2					
S-8	SLO-1	*Trust, Reputation*	*Cloud storage Provider*	*digital signatures, public-key infrastructures*	*Cloud security Challenges*	*Microsoft Azure*
	SLO-2					
S-9	SLO-1	*Risk*	*Storage Provider-S3*	*key management*	*Virtual Machine Security*	*Amazon EC2*
	SLO-2					

Learning Resources	1. *Tim Mather, SubraKumaraswamy, ShahedLatif, "Cloud Security and Privacy:An Enterprise Perspective on Risks and Compliance" O'Reilly Media; 1edition [ISBN: 0596802765], 2009.* 2. *Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.* 3. *Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.*	4. *Ronald L. Krutz, Russell Dean Vines, "Cloud Security" [ISBN: 0470589876],2010.* 5. *Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.* 6. *George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100%	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.T.Madhan, Team Leader, Tata Consultancy Services, siruseri Campus, Chennai.	*Dr. R.Shyamala, Associate Professor [HOD-IT], Anna University College of Engineering Tindivanam.*	*1. Dr.R.Naresh*
		2. Dr.MB.Mukesh krishnan

Course Code	18CSE443T	Course Name	BIG DATA ESSENTIALS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Quick and easy approach to learn the fundamental concept of big data analytics*			
CLR-2 :	*Understand the concept of Hadoop and installation*			
CLR-3 :	*Get to know the concept of key value pair programming*			
CLR-4 :	*Learn about Map Reduce and its features*			
CLR-5 :	*Understanding and solving of case studies*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*The main objective is to provide the students the knowledge of big data analytics*	*1*	*90*	*85*	*L*	-	-	*M*	-	-	-	-	-	-	-	*H*	*L*	-	-
CLO-2 :	*The students are trained to have knowledge about the architecture, installation and command execution of Hadoop*	*3*	*85*	*80*	*M*	*M*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	*M*	*H*	-
CLO-3 :	*Able to develop a Map Reduce application*	*3*	*85*	*80*	*M*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	*M*	*H*	-
CLO-4 :	*Identify knowledge of Map Reduce and develop real world map reduce application*	*3*	*80*	*75*	*M*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	*H*	*H*	-
CLO-5 :	*Apply knowledge and solve various case study problems*	*3*	*80*	*75*	*H*	*H*	*H*	*H*	*H*	*H*	-	*M*	-	-	-	*H*	*M*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Data, Data storage and Analysis*	*Introduction of Big data programming Hadoop, History of Hadoop*	*Introduction of Map Reduce*	*Map Reduce Types*	*Case studies*
	SLO-2	*Comparison with other systems-Distributed computing vs Big data Framework*	*The eco system and stack*	*Configuration API*	*Default Map Reduce map*	*Healthcare*
S-2	SLO-1	*Basis of Distributed computing, Need for Big data framework*	*The Hadoop Distributed File System (HDFS)*	*Configuring the Development Environment, Writing a Unit Test, Running Locally on Test Data*	*Input Formats*	*Telecom*
	SLO-2					
S-3	SLO-1	*Introduction to Big Data- Big data definition*	*Hadoop file system*	*Running on a Cluster*	*Output formats*	*Privacy preserving Data analytics: Smart Homes*
	SLO-2	*enterprise / structured data, social / unstructured data, unstructured data needs for analytics*	*Java interfaces to HDFS*	*Running on a Cluster*	*Output formats*	*Privacy preserving Data analytics: Smart Homes*
S 4-5	SLO-1	*What is Big Data, Big Deal about Big Data*	*Architecture overview*	*Tuning a Job ,Map Reduce Workflows How Map Reduce Works, The Map Reduce Anatomy of a Map Reduce Job run*	*Map reduce features- counters, built in counters, user defined java and streams counters*	*Data analytics in Intelligent transport system*
	SLO-2					
S-6	SLO-1	*Big Data Sources, Industries*	*Hadoop installation*	*Failures, Job Scheduling*	*Sorting*	*Detection and identification of*

	SLO-2	*using Big Data, Big Data challenges.*				*influential spreaders in social media data streams*
S-7	SLO-1	*Big Data Technology*	*Hadoop commands execution*	*Shuffle and Sort*	*Joins*	*Predictive analytics in insurance*
	SLO-2	*Old vs. New Approaches*	*Hadoop commands execution*	*The Map Side*	*Programming Real-World Map Reduce*	*Predictive analytics in insurance*
S-8	SLO-1	*Data Discovery*	*Hadoop I/O*	*The Reduce Side, Configuration Tuning*	*Weather dataset*	*Pricing analytics in consumer products*
	SLO-2	*Open-Source Technology for Big Data Analytics*	*Data Integrity*	*Task Execution*	*data with Unix*	*Pricing analytics in consumer products*
S 9	SLO-1	*The Cloud and Big Data*	*Compression*	*Task Execution*	*data with Hadoop*	*Analytics in banking sector*
	SLO-2					

Learning Resources	1. *MichaelMinelli,Michele Chambers,AmbigaDhiraj,"BigData,BigAnalytics-Emerging Business Intelligence and Analytic Trends forToday's Businesses",Wiley.* 2. *TomWhite,"Hadoop–TheDefinitiveGuide",O'Reilly*	3. *FrankOhlhorst,"BigDataAnalytics-TurningBigDataintoBigMoney",Wiley* *AlanAderson,David Semmelroth,"Statistics for BigData for Dummies",JohnWiley&sons*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Dr. B.Amutha, Professor and Head, Department of CSE, SRM IST
		Dr. G.Vadivu, Professor and Head, Department of IT, SRM IST

Course Code	18CSE444T	Course Name	CLOUD STRATEGY PLANNING AND MANAGEMENT	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
CLR-1 :	*To learn the concepts and technological advances fueling the rapid adoption of cloud computing today.*	1	2	3
CLR-2 :	*To provide the students with the skills and knowledge required to plan and manage a Cloud Computing strategy within an organization.*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-3 :	*To enable students to evaluate the strategic value of Cloud Computing using IT Governance and Compliance.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Strategically assess how cloud computing enables IT Transformation and business value in an organization.*	*2*	*80*	*85*
CLO-2 :	*Analyze the role that cloud computing can play in the business process.*	*2*	*75*	*80*
CLO-3 :	*Evaluate how cloud computing and Service Oriented Architecture (SOA) can deliver business agility.*	*2*	*85*	*80*
CLO-4 :	*Implement IT governance to manage business realization from cloud IT services.*	*2*	*80*	*75*
CLO-5 :	*Critically appraise how the incorporation of cloud computing in an IT strategy can deliver on strategic business objectives.*	*2*	*75*	*85*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*The four pillars of cloud computing*	*Moving to a cloud architecture and strategy to achieve business value.*	*Develop an IT strategy to deliver on strategic business objectives in the business strategy*	*Shared services delivered by a Service Oriented Architecture (SOA) in a Private or Public Cloud*	*Benefit Realization and it Governance*
	SLO-2	*Cloud applications and Platforms*				
S-2	SLO-1	*Providing the cloud infrastructure*	*BPM, IS, Porter's Value chain model and BPR as a means of delivering business value*	*IT Project planning in the areas of ITaaS is essential in delivering a successful strategic IT Plan*	*Services, Databases and Applications on demand*	*Managing resources (people, process, technology), to realize benefit from Private/Public Cloud IT services*
	SLO-2	*Cloud computing, Spectral efficiency, Sensors and perspiration*				
S-3	SLO-1	*Strategic inflection points in information Technology*	*Developing Business Strategy: Investigate business strategy models to gain competitive advantage for organizations*	*IT Project planning in the areas of SaaSis essential in delivering a successful strategic IT Plan*	*The effect on Enterprise Architecture and its traditional frameworks such as Zachman).*	*Gartner's 5 pillars of benefit realization*
	SLO-2	*Cloud computing and its slogans*	*SWOT/PEST, Economies of scale, Porter's 3 Strategies and 5 Competitive Forces, D'Aveni's hyper competition models*	*IT Project planning in the areas of PaaSis essential in delivering a successful strategic IT Plan*	*The Open Group Architecture Framework (TOGAF).*	*IT governance as a service in measuring the delivery of IT Strategy from Cloud IT Services using Sarbannes Oxley (CobiT) and other commonly-used approaches*
S-4	SLO-1	*User centered solution and cloud computing*	*Emphasize the roles of the strategic IS/IT leaders such as Chief Information Officer (CIO)*	*IT Project planning in the areas of IaaSis essential in delivering a successful strategic IT Plan*	*Customer Relationship Management*	*High Technology for private banking and Asset Management*
	SLO-2	*For cloud vendors inflection point Is risk and opportunity*				

S-5	SLO-1	*Potential customers of cloud technology*	*The Chief Technology Officer (CTO) in planning and managing IT Strategic development in the organization.*	*Searching for an open architecture*	*Enterprise Resource Planning*	*Cloud Software for Private Banking*
	SLO-2					
S-6	SLO-1	*The cloud interests Small and Medium enterprises*	*Budgeting for cloud computing*	*Infrastructure as a Utility*	*Just-in-Time Inventories*	*Leadership Is based on Fundamentals*
	SLO-2					
S-7	SLO-1	*Virtual companies and the cloud*	*Service level agreements*	*Cloud System Architecture and its primitives*	*Machine-to-Machine and RFID Communications*	*Cloud Software For Asset Management*
	SLO-2	*Virtual networked objects*				
S-8	SLO-1	Consumer technologies and the cloud	Outsourcing, Infrastructural inter dependencies, and the cloud	The User Organizations Business Architecture	Challenges Presented by Organization	Cloud Technology can Improve Fund Management
	SLO-2					
S-9	SLO-1	Social networks and multimedia messaging	Human resources at the CIO level	Financial Services Applications Architecture	Challenges Presented by Commercial vision	Criteria of Success in Asset Management Technology
	SLO-2		*The transition from legacy to competitive system*			

Learning Resources	1. *Dimitris N. Chorafas: Cloud Computing Strategies, CRC Press, 2011.* 2. *Arnold J Cummins, "Easiest Ever Guide to Strategic IT Planning" http://strategicitplanningguide.com/.*	3. *David S. Linthicum, "Cloud Computing and SOA Convergence in Your Enterprise", Addison Wesley [ISBN: 0136009220], 2009.* 4. *Charles Babcock, "Management Strategies for the Cloud Revolution", 1st Ed., Tata McGraw/Hill [ISBN: 0071740759],2010.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Saju G Nair, IBM,Bangalore,sajugnair@gmail.com	*Dr.Khanna Nehemiah H, Professor, Ramanujan Computing Centre, Anna University*	*Mrs.J D Dorathi Jayaseeli,CSE,SRM IST*

Course Code	18CSE375T	Course Name	DISTRIBUTED COMPUTING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Layout foundations of Distributed Systems.*			
CLR-2 :	*Get familiar with the idea of middleware and related issues*			
CLR-3 :	*Understand in detail the system level and support required for distributed system*			
CLR-4 :	*Understand the issues involved in studying data and cryptographic algorithms*			
CLR-5 :	*Expose to the concept of design and implementation of distributed file systems*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Fundamentals of Distributed System Concepts and access System*	*2*	*80*	*85*
CLO-2 :	*An ability to familiar with various architecture models and Distributed File access techniques*	*2*	*75*	*80*
CLO-3 :	*An ability to understand the security aspects of distributed system*	*2*	*85*	*80*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1 SLO-2	*Introduction to Distributed Systems*	*Distributed Computing Model*	*Remote Procedure Call*	*Introduction of Security systems in distributed system* *Potential attacks and threats on computer systems*	*Distributed File Systems –Introduction*
S-2	SLO-1	*Characterization of Distributed Systems*	*Workstation model*	*Remote method invocation*	*Cryptography*	*File Service Architecture*
	SLO-2	*Examples of Distributed Systems*	*Workstation server model*		*Symmetric cryptosystem algorithm –DES*	
S-3	SLO-1	*Architecture of Distributed Systems*	*Process pool model*	*Client server model basics concepts*	*Asymmetric cryptosystems*	*File Models*
	SLO-2	*Shared and Distributed Memory Architechture*	*Comparison of Distributed computing model*	*Client server addressing*		
S-4	SLO-1	*Focus on resource sharing the web*	*Interprocess Communication*	*Client server implementations*	*Secure Channels-Authentication*	*DFS Design*
	SLO-2				*Message Integrity and confidentiality*	
S-5	SLO-1	*Challenges in Distributed Systems*	*External data representation and multicast Communication*	*Client Server Architecture*	*Access control*	*DFS implementation*
	SLO-2					
S-6	SLO-1	*Design issues in Distributed systems*	*API for Internet protocol*	*Group Communication publish and subscribe systems*	*Security Management*	*File catching in DFS*
	SLO-2				*Issues in key distribution*	
S-7	SLO-1	*Networking and Internetworking basic introduction Types of Network*	*Network Virtivalization and overlay networks*	*Shared memory approach*	*Secure group management*	*Implementation in DFS*
	SLO-2			*Distributed objects*	*Authorization management*	

S-8	SLO-1	*Network Principles*	*Case Study : interprocess Communication in UNIX*	*Case study : java RMI*	*Case study - Kerberos*	*Case study – Sun network File systems*
	SLO-2					
S-9	SLO-1	*Internet protocol*	*Case study - MPI*	*Case Study - CORBA*	*Case study - Epayment*	*Case study - Google File systems*
	SLO-2					

Learning Resources	1. *GeorgeCoulouris,JeanDollimore,TimKindberg,"DistributedSystemsConceptsandDesign"Fifth edition – 2011- AddisonWesley* 2. *SunitaMahajan,SeemaShah,"DistributedComputing"SecoundEdition–OxfordPress*	3. *Liu M.L., "Distributed Computing, Principles and Applications", Pearson and education,2004.* 4. *Tanenbaum A.S., Van Steen M., " Distributed Systems: Principles and Paradigms" , PearsonEducation,2007.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. M.Ravichandran,CEO, Terafast	*1.. Dr.K.Vivekanadan, Professor,PEC,k.vivekanandan@pec.edu*	*1. Dr. A.Murugan , SRMIST*
2.		*2. Dr. G.Maragatham,SRMIST* *3. Ms. S. Aruna ,SRMIST*

Course Code	18CSE376T	Course Name	OPTICAL NETWORKS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Study the fundamentals of optical networks*
CLR-2 :	*Gather knowledge about different types of components*
CLR-3 :	*Learn single hop and multi hop networks*
CLR-4 :	*Acquire knowledge about different WDM network design*
CLR-5 :	*Understand about OADM architecture*
CLR-6 :	*Gather knowledge about optical TDM and CDMA*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire knowledge about basic fundamentals of optical networks*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Understand various classifications of optical components*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Develop the ability to apply optical concepts in single and multihop networks*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Gather knowledge about various multiplexing techniques*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Acquire knowledge about OADM concept*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Apply various techniques to handle spectrum with a different perspective*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to optical networks*	*Components :Couplers – Principle of operation*	*Broadcast optical networks – characteristics of single hop networks*	*WDM Network Elements :Optical line terminals*	*Optical TDM Networks*
	SLO-2	*TeleCommunication Network Architecture and services*	*Conservation of energy*	*Experimental WDM Systems*	*optical line amplifiers*	*Basics of TDM*
S-2	SLO-1	*Optical Networks- Multiplexing Techniques*	*Isolators*	*Other Non – Pretransmission Coordination protocols*	*Optical Add/Drop Multiplexers*	*Optical TDM*
	SLO-2	*Second Generation Optical Networks*	*Circulators*	*Pretransmission coordination protocols*	*OADM Architecture*	*Optical Sources*
S-3	SLO-1	*Optical Layer*	*Multiplexers – Gratings, Diffraction Patterns*	*Special Case: Linear Bus with Attempt- and-Defer Nodes*	*Optical crossconnects*	*Modulation*
	SLO-2	*Optical packet switching*	*Bragg and Fiber Gratings*	*AMTRAC and multichannel probabilistic scheduling*	*OXC Configurations*	*multiplexing*
S-4	SLO-1	*Transmission Basics – wavelengths, Frequencies, and channel spacing*	*Filters – fabryperot filters*	*Single- Hop Case study : IBM Rainbow Protocol*	*WDM Network Design: Cost trade-offs*	*Transmission of Ultrafast OTDM signal using soliton*
	SLO-2	*Standards, optical power and loss*	*Mach-Zehnder Interferometers, Arrayed Waveguide gratings*	*Model, Analysis*	*LTD and RWA problems*	*Demultiplexing*
S-5	SLO-1	*WDM Networking Evolutions*	*Optical Amplifiers – Emissions*	*Multihop Networks: characteristics, topological optimization studies*	*Light path topology design*	*Clock Recovery*
	SLO-2	*WDM Network Constructions*	*Erbium -Doped fiber amplifiers, Raman Amplifiers and Semiconductor optical amplifiers*	*Regular structures*	*Routing and wavelength assignment and conversion*	*Optical processing*

S-6	SLO-1	*Optical Fiber- Transmission*	*Transmitters – Lasers, Light emitting diodes,tunable lasers*	*Near- Optimal Node Placement*	*Dimensioning Wavelength*	*Optical TDM network Architectures*
	SLO-2	*Single mode vs Multimode fiber*	*Direct and external modulation, pump sources*	*Shared- channel multihop systems*	*Routing Networks*	*Optical TDM proposals*
S-7	SLO-1	*Attenuation in Fiber*	*Detectors – photo detectors*	*Multihop case study – GEMNET*	*Statistical Dimensioning Models : First passage model*	*Optical CDMA Networks:*
	SLO-2	*Dispersion in Fiber*	*Front end amplifiers*	*GEMNET Architecture and properties*	*Blocking model*	*Basics of CDMA*
S-8	SLO-1	*Non Linear Effects – self phase modulation*	*Switches – large optical switches, optical switch technologies*	*Channel sharing*	*Maximum load dimensioning model : offline lightpath requests*	*Spread spectrum*
	SLO-2	*Cross phase modulation*	*Large electronic switches*	*Multicasting*	*Online RWA in rings*	*Code sequences*
S-9	SLO-1	*Solitons*	*Wavelength converters – optoelectronic Approach, optical gating*	*Shared – channel Multihop GEMNET*	*Access Networks : Network Architecture overview*	*CDMA Example*
	SLO-2	*Dispersion- Managed Solitons*	*Interferometric techniques, wave mixing*	*Performance Evaluation*	*Enhanced HFC*	*Optical CDMA*

Learning Resources	1. *Rajiv Ramaswami, Kumar N. Sivarajan, Galen H. Sasaki, Optical Networks A Practical Perspective, thirdEdition* 2. *OpticalSwitchingNetworks:Mayer&Martin,CambridgeUniversityPress,2008.*	3. *U.Black,"OpticalNetworks:ThirdGenerationTransportSystems"/PearsonEducations* 4. *R.Ramaswami,&K.N.Sivarajan,"OpticalNetworksaPracticalperspective",MorganKaufmann Publishers, 3rdEd.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Madhumaran, NOKIA digital and Networking, Technical Lead, p.madhumaran@nokia.com	*1. Prof. NilanjanDey, Techno India College of Technology , Kolkata, nilanjan.dey@tict.edu.in*	*1. Prof. V.Sivakumar, SRMIST*
2. Mr. N.Ramkumar, TCS Assistant Consultant, ram.kumarn@tcs.com	*2. Prof. E.Rajesh, GalgotiasUniversity,Delhi, rajesh.e@galgotiasuniversity.edu.in*	*2. Prof. P.Visalakshi, SRMIST*

Course Code	18CSE379T	Course Name	INTERNET OF THINGS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the basic concepts of IoT and its possible application areas*			
CLR-2 :	*Understand the various IoT architectures along with compute and management stack across layers*			
CLR-3 :	*Understand the architecture dissected at physical, Communication and Access levels*			
CLR-4 :	*Introduce existing toolkits, available platforms, boards, software and laguages for easy development of IoT products*			
CLR-5 :	*Understand the various enabling technologies for IoT including Big data analytics, Machine learning, Cloud and Streaming analytics*			
CLR-6 :	*Understand the underlying business model for IoT and also acquire skills for DiY (Do it Yourself)*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*				Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Appreciate the omnipotent presence of IoT in all fields across globe*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Compare and contrast various architectures and be able to justify the right choice for adoption*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Choose appropriate protocols for various levels/layers based on the requirement in hand*	*2*	*85*	*80*	*H*	*M*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Implement using the available resources and demonstrate quick to deployment sills wherever applicable*	*2*	*80*	*75*	*H*	*H*	*H*	*M*	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Apply the tools and techniques towards integration in relevant areas of IoT product development*	*2*	*75*	*85*	*H*	*M*	*H*	*M*	*H*	-	-	-	*M*	-	-	*H*	-	-	-
CLO-6 :	*Showcase DiY approach given any implementable idea to product*	*2*	*80*	*85*	*H*	*M*	*H*	*H*	*H*	-	-	-	*H*	-	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to IOT*	*Drivers Behind New Network Architectures*	*Smart Objects: The "Things" in IoT*	*Data Analytics for IoT- Overview*	*Business Models for IoT: Introduction*
	SLO-2	*What, Where and How of IoT?*	*Comparing IoT Architectures*	*Sensors, Actuators, and Smart Objects*	*IoT Data Analytics Challenges*	*Business Models*
S-2	SLO-1	*Data Flow of IoT*	*The IoT World Forum (IoTWF) Standardized Architecture*	*Micro-Electro-Mechanical Systems (MEMS)*	*Relevance of ML and IoT- Overview*	*Business Model Innovation*
	SLO-2	*Definition and characteristics of IOT*	*IT and OT Responsibilities in the IoT Reference Model*	*Smart Objects,Smart Objects: A Definition*	*Relevance of Big data and IoT- Overview*	*Value Creation in IoT*
S-3	SLO-1	*Architecture of Internet of Things: Physical- Things*	*A simplified IoT architecture*	*Trends in Smart Objects*	*ML and getting Intelligence from Big Data*	*Laws of Information*
	SLO-2	*Architecture of Internet of Things: Protocols-an Introduction*	*The core IoT functional stack*	*Sensor Networks*	*Big data analytics tools and techniques for IoT: Overview*	*Revenue Generation in the Internet of Things*
S-4	SLO-1	*Architecture of Internet of Things: Logical- Functional Blocks*	*Layer 1: Things: Sensors Layer*	*Wireless Sensor Networks (WSNs)*	*MPP, NoSQL*	*Exemplary Business Model Scenarios for the Internet of Things*
	SLO-2	*Architecture of Internet of Things: Logical- Communication Models*	*Layer 1: Things: Actuators Layer*	*Communication Protocols for WirelessSensor Networks- a Introduction*	*Hadoop and YARN*	*Scenario 1: Product as a Service (PaaS)*
S-5	SLO-1	*Architecture of Internet of Things: Logical- Communication API*	*Layer 2: Communications Network Layer: Access, Gateway*	*Communication Criteria- Introduction*	*Hadoop Eco system*	*Scenario 2: Information Service Providers*
	SLO-2	*IOT enabling technologies*	*Layer 2: Communications Network Layer: Network, Management*	*Communication Criteria- Definitions*	*Apache Kafk, Spark, Storm, Flink,*	*Scenario 3: End-user Involvement*

S-6	SLO-1	*Introduction to IoT Levels and Deployments*	*Layer 3: Applications and Analytics Layer:*	*IoT Access Technologies-Introduction*	*Lamba Architecture*	*Scenario 4: Right-time Business Analysis and Decision making*
	SLO-2	*IoT Deployment Levels: 1 to 6*	*Analytics Versus Control Applications,*	*IoT Access Technologies-Definitions*	*Edge Streaming Analytics for IoT*	*DIY- Smart Experience (DiYSE) Projects- a introduction*
S-7	SLO-1	*IoT Security and Privacy*	*Data Versus Network Analytics*	*IoT Application transport methods- Definitions*	*Edge Analytics core functions*	*Requirements for Enabling DiY in Eco- awareness Applications*
	SLO-2	*IoT Data Analytics, Protocols*	*Data Analytics Versus Business Benefits*	*The Toolkit Approach for End-user Participation in the Internet of Things:*	*Distributed analytics systems*	*Technologies and Standards Relevant for DiY Eco-awareness*
S-8	SLO-1	*IoT Environmental challenges: excess waste disposal*	*Smart Services*	*Existing Toolkits*	*Network Analytics*	*Sensor-actuator Technologies and Middleware as a Basis for a DiY Service Creation Framework*
	SLO-2	*Legal Challenges for a Privacy Framework- an IoT perspective*	*Iot Data Management And Compute Stack: The Hierarchy Of Edge, Fog, And Cloud*	*I/O Boards*	*IoT physical servers and cloud offerings (Cloud computing for IoT)*	*Device Integration, Middleware Technologies*
S-9	SLO-1	*Privacy Enhancing Technologies for IoT*	*Fog Computing*	*HW Based Systems, Introduction to Open source boards (Arduino, Raspberry Pi and other variants)*	*Relevance of Cloud connectivity and IoT-Overview*	*Semantic Interoperabity- a requirement for IoT DiY*
	SLO-2	*Case Studies: Domain specific IOT Applications*	*Edge Computing*	*SW Based Solutions*	*Logical design using Python, Useful IoT libraries*	*DiY Smart Experiences Service Framework-an Introduction*

Learning Resources	1. *ArshdeepBahga, Vijay Madisetti, "Internet of Things, A Hands -on Approach", 1st Edition 2015, University Press, ISBN: 978-81-7371-954-7* 2. *InternetofThings:LegalPerspectivesbyRolfH.Weber,RomanaWeber,Springer,2010* 3. *Uckelmann, D., Harrison, M., & Michahelles, F. (Eds.). Architecting the Internet of Things.doi:10.1007/978-3-642-19157-2 ,2011*	4. *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by Rob Barton, Gonzalo Salgueiro, David Hanes, Publisher: Cisco Press, Release Date: June 2017, ISBN: 9780134307091 (https://www.oreilly.com/library/view/iot-fundamentals-networking/9780134307091/)*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. Paventhan Arumugum, Director (R&D), ERNET India	*Dr. S. Srinivasan, Professor and Head, Dept. of Computer Science & Engineering, Anna University, Madurai*	*Dr.Kayalvizhi Jayavel, SRMIST*
Mr. Vinay Solanki, Head IoT, Lenovo (APAC & MEA)	*Dr. R. Krishnamoorthy, Professor, Department of CSE and IT, BIT Campus, Anna University, Trichy*	*Dr. Sreekumar, SRMIST*
Mr.Hariharan Ramalingam, Vertical Delivery Head, Wipro ltd	*Dr.S.Chithra Selvaraj, Associate Professor, Department of IT, SSN College of Engineering*	*Mr.V.Haribaabu, SRMIST*

Course Code	18CSE380T	Course Name	PERVASIVE COMPUTING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understanding the basics of pervasive computing and its application*			
CLR-2 :	*Gain knowledge on the voice enabling*			
CLR-3 :	*Understand the fundamental elements of pervasive computing.*			
CLR-4 :	*Learn the design process of Pervasive Computing Environments and its solutions*			
CLR-5 :	*Familiarize with device connectivity & web applications concepts*			
CLR-6 :	*Introduce the concepts of wearale computing and security in pervasive computing*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Understand the fundamental elements of pervasive computing.*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Learn the design process of Pervasive Computing Environments and its solutions*	*2*	*75*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Familiarize hardware, software and the aspects involved in pervasive computing*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Apply the knowledge for implementing security*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Organize the functionalities and components of PDA in pervasive computing.*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Describe the user interface issues in pervasive computing.*	*2*	*75*	*80*	*H*	-	-	*M*	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*- INTRODUCTION*	*Device connectivity*	*WAP & VOICE TECHNOLOGY, WAP and Beyond: Introduction*	*Wearable Computing and Sensor Systems for Healthcare - Introduction*	*Security and Privacy in Pervasive Networks - Introduction*
	SLO-2	*Pervasive Computing: Past, Present and Future Pervasive computing*	*Protocols: wireless*	*Components of the WAP*	*The Health Body Area Network*	*Security Classics - Perimeter Security - Access Control*
S-2	SLO-1	*Pervasive Computing Market,*	*mobile phone technologies*	*architecture*	*Medical and Technological Requirements of Health Sensors*	*Hardening Pervasive Networks - Pervasive Computational Paradigms*
	SLO-2	*m-Business*	*mobile phone technologies*	*WAP infrastructure,*	*Wearable Sensors for Vital Signals Monitoring*	*Pervasive Hardware*
S-3	SLO-1	*Application examples: Retail,*	*mobile internet protocol*	*WAP security issues*	*Wearable Sensors for Activity Recognition*	*Pervasive Networking and Middleware*
	SLO-2	*Application examples: Airline check-in and booking,*	*mobile internet protocol*	*Wireless Markup Language*	*Sensors and Signals for Emotion Recognition*	*Pervasive Applications*
S-4	SLO-1	*Healthcare*	*Synchronization and replication protocol*	*WAP push*	*ntra-BAN Communications in Pervasive Healthcare Systems: Standards and Protocols - IEEE 802.15.4 and ZigBee*	*Pervasive Distributed Application*
	SLO-2	*Tracking, Car information system,*	*Synchronization and replication protocol*	*Products*	*Bluetooth*	*Logic Based Level Security*
S-5	SLO-1	*Sales Force Automation*		*i-Mode*	*Bluetooth Low Energy*	*Deterministic Access Models*
	SLO-2	*Email access via WAP and voice*	*distributed services*	*VoiceTechnology: Basics of Speech recognition,*	*Integrated and Additional Solutions for Health BAN Communications*	*Predictive Statistical Schemes*

S-6	SLO-1	*A Pervasive System for Volcano Monitoring*	*distributed message*	*VoiceTechnology: Basics of Speech recognition,*	*Introduction - Pervasiveness and Mobility in Computing and Communications*	*Privacy in Pervasive Networks - Problem Definition*
	SLO-2	*A Pervasive Computing Platform for Individualized Higher Education*	*transaction protocols*	*Voice Standards*	*Context Awareness*	*Challenges to Privacy Protection*
S-7	SLO-1	*Device Technology*	*Security*	*Voice Standards*	*Heterogeneity*	*Location Dependency*
	SLO-2	*Hardware,*	*Device Management*		*Wireless Technologies and Standards*	*Data Collection*
S-8	SLO-1	*Human machine interface*	*Web Application Concepts: WWW Architecture*	*Speech Applications,*	*Middleware*	*Internet Service Provider (ISP) Role*
	SLO-2	*Bio metrics,*	*Protocols*	*Speech Applications,*	*Future Trends: Beyond the Middleware*	*Data Ownership Private Systems*
S-9	SLO-1	*Operating systems*	*Transcoding*	*Speech and Pervasive Computing*	*Pervasive Computing in Extreme Areas; The Hiker's Personal Digital Assistant*	*Quality of Privacy (QoP)*
	SLO-2	*Java for pervasive devices*	*Client Authentication via Internet*	*Speech and Pervasive Computing*	*Pervasive Computing in Personal Health Systems; The MyHealthService Approach*	*Open Issues in Privacy of Systems 'Sharing' in Personal Networks*

Learning Resources	1. *JochenBurkhardt, Horst Henn, Stefan Hepper, Thomas Schaech & Klaus Rindtorff, "Pervasive Computing, Technology and Architecture of Mobile Internet Applications", Pearson Education,2012.ISBN-13: 978-0201722154* 2. *UweHansmann, L. Merk, M. Nicklous, T. Stober, U. Hansmann, "PervasiveComputing (Springer Professional Computing) ", 2003, Springer Verlag,ISBN:3540002189* 3. *S. Poslad, "Ubiquitous Computing: Smart Devices, Environments and Interactions," Wiley, 2009* 4. *Frank Adelstein, Sandeep KS Gupta, Golden Richard III, Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing", McGraw Hill edition, 2006. ISBN-13: 978-0071412377*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Suganya Anbumani *Director of Engineering, Wealth Management, Redi2 Technologies* *Greater Boston Area*	*1. Dr. J. Prakash, MIT, Chennai, prakaiit@rediffmail.com*	*1.Dr.V.Kavitha, SRMIST*
Saranya A T *Associate at Cognizant* *Chennai*	*2. 2.Dr. Latha Karthigaa, PhD ,* *Innovation Research Assistant,* *The University of Auckland*	*2. Mr. Haribaabu V, SRMIST*

Course Code	18CSE381T	Course Name	CRYPTOGRAPHY	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand OSI security architecture and classical encryption techniques.*			
CLR-2 :	*Acquire fundamental knowledge on the concepts of finite fields and number theory*			
CLR-3 :	*Understand various block cipher and stream cipher models*			
CLR-4 :	*Describe the principles of public key cryptosystems, hash functions and digital signature.*			
CLR-5 :	*Gain a first-hand experience on encryption algorithms, encryption modes.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Implement the Classical Encryption Techniques.*	*2*	*80*	*85*
CLO-2 :	*Comprehend fundamental concepts of finite field and number theory.*	*2*	*75*	*80*
CLO-3 :	*Categorize block cipher modes of operation and comprehend digital signature functions*	*2*	*85*	*80*
CLO-4 :	*Implement Public Key Cryptography and hash functions.*	*2*	*80*	*75*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*H*									*H*					
CLO-2 :	*H*														
CLO-3 :	*H*														
CLO-4 :	*H*							*H*							

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Cryptography and Network Security*	*Groups, Rings, Fields*	*Block cipher principles-Introduction*	*Principles of Public-key Cryptosystems - Structure and key management*	*Message Authentication Codes*
	SLO-2					
S-2	SLO-1	*OSI Security Architecture*	*Modular arithmetic*	*Data Encryption Standard*	*Principles of Public-key Cryptosystems – Applications for Public-key Cryptosystems*	*Requirements for Message Authentication Codes*
	SLO-2					
S-3	SLO-1	*Introduction to Security attacks*	*Euclid's Algorithm*	*DES Example, Strength of DES*	*Requirements for Public-key Cryptosystems and Public – Key Cryptanalysis*	*Applications of Cryptographic Functions - Message Authentication*
	SLO-2					*Two Simple Hash Function*
S-4	SLO-1	*Security mechanisms*	*Polynomial Arithmetic*	*Block cipher Modes of operation – Multiple Encryption*	*RSA algorithm - Key management*	*Security Requirements for Cryptographic hash Functions*
	SLO-2					
S-5	SLO-1	*Symmetric cipher model*	*Finite Fields*	*Block cipher Modes of operation – Triple DES*	*RSA algorithm - Encryption and Decryption*	*Hash Algorithms - MD5*
	SLO-2					
S-6	SLO-1	*Substitution techniques: Caesar cipher*	*Prime Numbers, Testing for Primality*	*Electronic Code Book, Cipher Block Chaining Mode*	*Diffie Hellman key exchange – Algorithm, Key Exchange Protocols*	*Hash Algorithms - SHA*
	SLO-2	*Play fair Cipher*		*Cipher Feedback Mode, Output Feedback Mode and Counter Mode*	*Diffie Hellman key exchange – Man-in-the-Middle Attack*	
S-7	SLO-1	*Mono alphabetic cipher*	*Fermat's and Euler's Theorem*	*Advanced Encryption Standard – Structure and Transformation Functions*	*Elliptic curve: Arithmetic – Abelian Groups, Elliptic Curves over Real Numbers*	*Digital Signature Standard*
	SLO-2	*Poly alphabetic ciphers , Onetime pad*		*AES Key Expansion and AES Example*		
S-8	SLO-1	*Hill Cipher -Encryption*	*The Chinese remainder theorem*	*Blowfish*	*Elliptic Curves over Zp, Elliptic Curves over*	*Applications pertaining to Encryption*

	SLO-2	*Decryption*			*GF(2^m)*	*using different ciphers and modes*
S-9	SLO-1	*Transposition techniques, Steganography*	*Discrete Logarithms*	*RC5 algorithm*	*Elliptic Curve Cryptography*	*One-way hash algorithms.*
	SLO-2					

Learning Resources	1. *WilliamStallings,"CryptographyandNetworkSecurity",6th Edition, 2014,Pearson Education, ISBN:9789332518773.* 2. *AtulKahate,"CryptographyandNetworkSecurity",2nd Edition, 2009, McGraw Hil lEducation India Pvt Ltd,ISBN:100070151458.*	3. *WebTutorial: http://www.cis.syr.edu/~wedu/seed/cryptography.htmlas on 14/04/2016*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mohanraj N - PayPal	*1. Dr. E.Sivasankar – Assistant Professor – NIT, Trichy*	*1.Dr.E.Sasikala, SRMIST*
		2. Ms. S. Aruna, SRMIST
		3. Ms. G. Sujatha, SRMIST

Course Code	18CSE382T	Course Name	FORENSICS AND INCIDENT RESPONSE	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Gain knowledge on the basics of procedures for identification, preservation of electronic evidence*			
CLR-2 :	*Understand the purpose and usage of various forensic tools*			
CLR-3 :	*Gain knowledge on how scientific evidence collection/extraction during investigation*			
CLR-4 :	*Acquire knowledge on file systems and its innerworking*			
CLR-5 :	*Understand the windows and linux investigation procedures*			
CLR-6 :	*Introduce the report writingguidelines and principles*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Acquire the knowledge on basics of procedures for identification, preservation of electronic evidence*	*2*	*80*	*85*
CLO-2 :	*Acquire the ability to identify the purpose and usage of various forensic tools*	*2*	*75*	*80*
CLO-3 :	*Understand how scientific evidence collection/extraction during investigation*	*2*	*85*	*80*
CLO-4 :	*Appreciate the concepts of file systems and its importance in forensic science.*	*2*	*80*	*75*
CLO-5 :	*Apply the knowledge of windows and Linux investigation procedures*	*2*	*75*	*85*
CLO-6 :	*Acquire the knowledge on forensic report writing guidelines and principles*	*2*	*80*	*85*

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	*H*	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Incident*	*Introduction to ACPO Principles*	*Introduction to File System Analysis*	*Introduction to Investigating Systems*	*Investigating Hacker Tools*
	SLO-2	*Goals of Incident Response*	*ACPO Principles of Computer Based Evidence*	*What is a File System?*	*Investigating Windows Systems*	*What are the goals of tool analysis?*
S-2	SLO-1	*Introduction to Incident Response Methodology (IRM)*	*Introduction to computer Storage Formats*	*Five Data Categories*	*Where Evidence resides on Windows Systems*	*How are files compiled?*
	SLO-2	*Steps in Incident Response Methodology*	*Understanding Storage Formats for Digital Evidence*	*FAT Concepts*	*Conducting a Windows Investigation I*	*Static Analysis of Hacker Tools I*
S-3	SLO-1	*IRM: Pre-incident preparation*	*Forensic Duplication*	*FAT Analysis*	*Conducting a Windows Investigation II*	*Static Analysis of Hacker Tools II*
	SLO-2	*IRM: Detection of incidents*	*Forensic Duplication tools*	*FAT - The Big Picture*	*File Auditing*	*Dynamic Analysis of Hacker Tools I*
S-4	SLO-1	*IRM: Initial Response*	*Forensic Duplicate creation of HDD*	*Introduction to NTFS*	*Theft of Information*	*Dynamic Analysis of Hacker Tools II*
	SLO-2	*IRM: Formulate a Response Strategy*	*Qualified Forensic Duplicate creation*	*Files in NTFS*	*Handling the departing employee*	*Evaluating Computer Forensics Tools*
S-5	SLO-1	*IRM: Investigate the Incident*	*Restored Image*	*MFT Concepts*	*Investigating Unix Systems*	*Types of Forensic Tools*
	SLO-2	*IRM: Reporting*	*Mirror Image*	*MFT Attribute Concepts*	*Overview of steps - Unix Investigation*	*Tasks performed by Forensic Tools*
S-6	SLO-1	*Creating response toolkit - Windows*	*Forensic Duplication Tool Requirements*	*Other MFT Attribute Concepts*	*Reviewing pertinent logs*	*Tool comparisons*
	SLO-2	*Volatile Data Collection - Windows*	*Creating a Forensic Duplicate of a Hard Drive*	*Indexes in NTFS*	*Performing keyword searches*	*Computer Forensics Software Tools*
S-7	SLO-1	*In-depth data collection - Windows*	*Evidence Handling*	*NTFS Analysis - File System Category*	*Reviewing relevant files*	*Computer Forensics Hardware Tools*
	SLO-2	*Storing collected data - Windows*	*Types of Evidence*	*NTFS Analysis - Content Category*	*Identifying unauthorized user*	*Validating and Testing Computer*

					accounts/groups	*Forensics Software*
S-8	SLO-1	*Creating response toolkit - Unix*	*Challenges in Evidence Handling*	*NTFS Analysis - Metadata Category*	*Identifying rogue processes*	*Introduction to Forensic Report Writing*
	SLO-2	*Volatile Data Collection - Unix*	*Overview of Evidence Handling Procedure.*	*NTFS Analysis - File Name Category*	*Checking for unauthorized access points*	*Understanding the Importance of Reports*
S-9	SLO-1	*In-depth data collection - Unix*	*Evidence Handling Procedure*	*NTFS Analysis - Application Category*	*Analyzing trust relationships*	*Guidelines for Writing Reports*
	SLO-2	*Storing collected data - Unix*	*Evidence Handling reports*	*NTFS - The Big Picture*	*Detecting loadable kernel modules*	*A Template for Computer Forensics Reports*

Learning Resources	1. *KevinMandia,ChrisProsise,"IncidentResponseandcomputerforensics",TataMcGrawHill,2006.* 2. *Bill Nelson,Amelia Philips and Christopher Steuart, "Guide to computer forensics and investigations", coursetechnology,CengageLearning;4thedition,ISBN:1-435-49883-6,2009.*	3. *EoghanCasey,"HandbookComputerCrimeInvestigation'sForensicToolsandTechnology",Academic Press, 1st Edition,2001.* 4. *Brian Carrier, "File System Forensic Analysis", Addison-Wesley Professional; 1st edition 2005, ISBN-13: 978-0321268174*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr.Balan C, Scientist F, CDAC, cbalan@cdac.in	*1.*	*1. Mr. A.R. Nagoor Meeran, SRMIST*
2.	*2.*	*2. Dr. C.N.S.Vinoth Kumar, SRMIST*

Course Code	18CSE383T	Course Name	INFORMATION ASSURANCE AND SECURITY	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the different ways the information systems may be compromised.*			
CLR-2 :	*Learn to model the various types of threats.*			
CLR-3 :	*Understand the Information Assurance planning strategies.*			
CLR-4 :	*Acquire knowledge by analyzing software systems.*			
CLR-5 :	*Understand and apply different countermeasures and protect information.*			
CLR-6 :	*Perform vulnerability testing.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the basic knowledge about the Information Assurance.*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Design an appropriate Policies for the organization.*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Deliver professional, ethical, legal, security and social issues and responsibilities in an effective manner.*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	*M*	-	-	-	-	-	-	-
CLO-4 :	*.Develop risk management strategies for an enterprise.*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Provide the understanding of different security mechanisms used in various areas of computing*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Apply the current technical concepts and practices in the core information technologies.*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	*M*	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Information Assurance Basics*	*Information Security Planning*	*Information Assurance Process : Managing Information Assurance*	*Benefits of Incorporating Security Considerations*	*Information Assurance Detection and Recovery Processes*
	SLO-2	*The Need for Information Assurance*	*Information Security Governance*	*Information Security project management*	*System Development Life Cycle*	*Intrusion Detection and Prevention System(IDPS)*
S-2	SLO-1	*Key Information Security concepts*	*Policy, Standards and Practices*	*Technical aspects of implementing Information Security*	*Information Assurance in System Development Life Cycle*	*IDPS types*
	SLO-2	*Critical characteristics of Information*	*Policy Management, Information Security Blueprint*	*Non-Technical aspects of implementing Information Security*	*Information Assurance in the Service Acquisition Life Cycle*	*IDPS detection methods*
S-3	SLO-1	*MSR Model*	*Continuity Strategies*	*Structure of an Information Assurance*	*Physical and Environmental Security Controls*	*IDPS - Analysis*
	SLO-2	*Security in System lifecycle*	*Crisis Management*	*Organizational Maturity, Asset Management*	*Handling of Media*	*Log Management Tools: SIEM*
S-4	SLO-1	*NIST Approach to Securing SDLC*	*Information Asset Life Cycle, Plan,Do,Check,Act Model*	*APM Maturity model*	*Information Assurance Awareness, Training, and Education (AT and E), Purpose, Benefits*	*Honeypot/Honeynet*
	SLO-2	*Security Professionals and Organizations*	*Current Practices : Due Care and Due Diligence*	*Overview of Risk Management*	*AT and E : Design, Development*	*Scanning and Analysis tools*
S-5	SLO-1	*Communities of Interest*	*Specific Laws and Regulations*	*Risk Identificaion*	*AT and E : Assessment*	*Malware Detection*

	SLO-2	*Information Security: Is it an art or Science?*	*International Laws and Acts*	*Risk Assessment*	*Types of Learning Programs*	*Penetration Test*
S-6	SLO-1	*Information Assurance Concepts : Defense in Depth*	*Standards and Best Practices*	*Risk control*	*Employment Policies and Practices*	*Physical Controls*
	SLO-2	*Information Assurance in Cyber Security*	*Plans for Information Assurance Strategy*	*Quantitative vs Qualitative Risk management practices*	*Securty considerations for temporary employees, consultants and other workers*	*Special considerations for Physical security*
S-7	SLO-1	*CIA Triangle*	*Cryptology*	*Recommended risk control practices*	*Preventive Information Assurance Tools*	*Information Assurance Measurement Process*
	SLO-2	*The Need for Security*	*Cipher methods*	*Process , Secure design through threat modeling*	*Preventive Information Assurance controls*	*Metrics Program*
S-8	SLO-1	*Categories of Threats*	*Cryptographic algorithms*	*Importance of Policy*	*Positioning and staffing the Security function*	*Incident Handling Process*
	SLO-2	*Software Attacks types*	*Cryptographic tools*	*Information Assurance Policy*	*Credentias for Information Security Professionals*	*Continuity Strategies*
S-9	SLO-1	*Other vulnerabilities*	*Protocols for secure Communications*	*Policy Development Steps*	*Access control benefits*	*Computer Forensics*
	SLO-2	*Implications from Lack of Information Assurance*	*Approaches to implement Information Assurance*	*Certification, Accreditation, and Assurance*	*Access control Techniques, Administration*	*Examiner Prerequisites, Team Establishment*

Learning Resources	1. *MichaelE.WhitmanandHerbertJ.Mattord,"PrinciplesofInformationSecurity",5thedition,2015, Thomson Publications, ISBN1111899134.* 2. *Steven Hernandez, Corey Schou, "Information Assurance Handbook: Effective Computer Security and Risk Management Strategies" ,1st Edition, 2014, McGraw Hill Osborne Media ,ISBN:0071821651, ISBN : 9780071821650*	3. *William Stallings, " Cryptography and Network Security- Principles and Practice", 6 th Edition, 2013, Pearson, ISBN:9780136073734.* 4. *CoreySchou, Dan Shoemaker,"InformationAssurancefortheEnterprise",TataMcGraw -HillEdition,2007.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Mr.SurenderPalanivel, GM, GGS Information Services Pvt. Ltd., Pune.		*2. Dr.Vinothkumar,SRMIST vinothks1@srmist.edu.in*

Course Code	18CSE384T	Course Name	SECURE SOFTWARE DEVELOPMENT LIFE CYCLE	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1 :	*Identify project security risks & selecting risk management strategies.*	1
CLR-2 :	*Analyze software security standards, policies, and guidelines to articulate and elaborate requirements*	2
CLR-3 :	*Use automated tools and secure coding practices to analyze and test existing code and reduce vulnerabilities*	3
CLR-4 :	*Select and integrate established security design patterns and address threat assessments to mitigate common vulnerabilities and achieve the target design*	
CLR-5 :	*Participate in team-based peer reviews to analyze the security development life cycle and mitigate risks and vulnerabilities*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Explain terms used in secured software development and life cycle process*	*3*	*80*	*70*
CLO-2 :	*Incorporate requirementsinto secured software development process and testsoftware for security vulnerability*	*3*	*85*	*75*
CLO-3 :	*Identify vulnerable code in implemented software and describe attack consequences*	*3*	*75*	*70*
CLO-4 :	*Apply mitigation and implementation practices to construct attack resistant software*	*3*	*85*	*80*
CLO-5 :	*Apply secure design principles for developing attack resistant software*	*3*	*85*	*75*

Program Learning Outcomes (PLO)	1 Engineering Knowledge	2 Problem Analysis	3 Design & Development	4 Analysis, Design, Research	5 Modern Tool Usage	6 Society & Culture	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLO-1	*L*	*H*	-	*L*	*L*	-	-	-	*L*	*L*	-	*H*	-	-	-
CLO-2	*M*	*H*	*L*	*M*	*L*	-	-	-	*M*	*M*	-	*H*	-	-	-
CLO-3	*M*	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-4	*M*	*H*	*M*	*H*	*L*	-	-	*M*	*M*	*M*	-	*H*	-	-	-
CLO-5	*H*	*H*	*M*	*H*	*L*	-	-	-	*M*	*M*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Software Engineering- Process model*	*A Risk Management Framework*	*Introduction toArchitectural Risk Analysis*	*Code Review with a Tool*	*Software Penetration Testing*
	SLO-2				*Catching Implementation Bugs with a Tool)*	
S-2	SLO-1	*Agile development-Agile Process*	*The Five Stages of Activity*	*Common Themes among Security Risk Analysis Approaches*	*Approaches to Static Analysis*	*Software Penetration Testing—a Better Approach*
	SLO-2	*Extreme Programming*				
S-3	SLO-1	*Need to secure development life cycle*	*Understanding the Business Context*	*Traditional Risk Analysis Terminology*	*Modern Rules*	*Using Penetration Tests to Assess the Application Landscape*
	SLO-2		*Gathering the Artifacts*			
S-4	SLO-1	*Current Software Development Methods Fail to Produce Secure Software .*	*Identifying the Business and Technical Risks*	*Knowledge Requirement*	*Tools from Researchland*	*Risk-Based Security Testing*
	SLO-2	*Incentive to Review Code*				
S-5	SLO-1	*Understanding Security Bugs*	*Synthesizing and Ranking the Risks*	*The Necessity of a Forest-Level View*	*Commercial Tool Vendors*	*Abuse Cases*
	SLO-2	*Critical Mass*		*A Traditional Example of a Risk Calculation*		
S-6	SLO-1	*Proprietary Software Development Methods- CMMI, TSP, and PSP*	*Defining the Risk Mitigation Strategy*	*Modern Risk Analysis*	*Key Characteristics of a Tool*	*Software Security Meets Security Operations*
	SLO-2					
S-7	SLO-1	*SDL for Management*	*Carrying Out Fixes and Validating*	*Touchpoint Process: Architectural Risk Analysis*	*The Fortify Knowledge Base*	*Knowledge for Software Security*
	SLO-2					
S-8	SLO-1	*Managing the SDL*	*The Importance of Measurement*	*Limitations of Traditional Approaches*	*Touchpoint Process: Code Review*	*Establishing a Metrics Program*
	SLO-2					

S-9	SLO-1 SLO-2	*Case study: A Short History of the SDL at Microsoft*	*The Cigital Workbench*	*Getting Started with Risk Analysis*	*Use a Tool to Find Security Bugs*	*Continuous Improvement*

Learning Resources	1. *The Security Development Lifecycle: SDL: A Process for Developing Demonstrably More Secure Software (1st Edition) By Michael Howard,2017.* 2. *Software Security: Building Security In by Gary McGraw. Addison-Wesley.2006*	3. *Software Security Engineering: A Guide for Project Managers by Julia H. Allen, Sean Barnum, Robert J. Ellison, Gary McGraw, and Nancy Mead. Addison-Wesley,2012*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100%	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.V.SelvaKumar,Assistant General Manager,Hexaware Technologies.	*Dr.N.Prakash,Associate Professor,Department of Information technology,B.S.A Crescent Institute of Science and Technology.*	1. *Mr.Arivazhagan*
		2. *Dr. Naresh*
		3. *Mrs.B.Jothi, SRMIST*

Course Code	18CSE385T	Course Name	SECURITY AUDIT AND RISK ASSESSMENT	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CSE	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the security audit planning strategies*			
CLR-2 :	*Gain knowledge about information risk*			
CLR-3 :	*Discover knowledge in collecting data about organization*			
CLR-4 :	*Acquire knowledge in various analysis on Information Risk Assessment*			
CLR-5 :	*Introduce the System Risk analysis*			
CLR-6 :	*Understand the organizational and system specific risk*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Acquire the knowledge on various secure auditing techniques*	*2*	*80*	*85*
CLO-2 :	*Acquire the ability to identify knowledge in information risk*	*2*	*75*	*80*
CLO-3 :	*Understand the basic ideas about data collection workload*	*2*	*85*	*80*
CLO-4 :	*Appreciate the concepts of vulnerability catalogs and impact analysis scheme*	*2*	*80*	*75*
CLO-5 :	*Identify the knowledge in risk classification techniques*	*2*	*75*	*85*
CLO-6 :	*Acquire the knowledge on system specific risk*	*2*	*80*	*85*

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge on various secure auditing techniques*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Acquire the ability to identify knowledge in information risk*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Understand the basic ideas about data collection workload*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Appreciate the concepts of vulnerability catalogs and impact analysis scheme*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Identify the knowledge in risk classification techniques*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Acquire the knowledge on system specific risk*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Need for Audit Planning*	*What is Risk?*	*Data Collection-Introduction*	*Compiling Observations from Organizational*	*System Risk Analysis*
	SLO-2	*Steps in Audit Planning*	*Going Deeper with Risk*	*The Sponsor*	*Risk Documents*	*Risk Classification*
S-2	SLO-1	*Audit Risk Assessment*	*Components of Risk*	*The Project Team*	*Preparation of Threat and Vulnerability Catalogs*	*Risk Rankings*
	SLO-2	*Performing Audit*	*Putting it Altogether*	*The size and Breadth of the Risk Assessment*	*Threat Catalog*	*Risk Prioritization and Treatment*
S-3	SLO-1	*Internal Controls*	*Information Security Risk*	*Scheduling and Deadlines*	*Vulnerability Catalogs*	*Review of Audit Findings*
	SLO-2	*Audit Evidence*	*Information Security Risk Assessment Overview*	*Assessor and Organization Experience*	*Threat Vulnerability Pairs*	*Review of Security Incidents*
S-4	SLO-1	*Audit Testing*	*Assess Information Security Risk*	*Work load*	*Overview of the System Risk Computation*	*Review of Security Exceptions*
	SLO-2	*Follow up activities*	*Risk assessment and security Program*	*Data Collection Mechanisms*	*Designing the Impact Analysis Scheme*	*System Specific Risk Treatment*
S-5	SLO-1	*Security Monitoring and Auditing*	*Information Security Management in a Nutshell*	*Collectors*	*Confidentiality, Integrity*	*Information Security Risk Assessment Reporting*
	SLO-2	*Assurance and Trust*	*Drivers, Laws and Regulations*	*Containers*	*Availability*	*Risk Analysis Executive Summary*
S-6	SLO-1	*Need for Assurance*	*Federal Information Security Management*	*Executive Interview*	*Preparing the Impact Score*	*Methodology*
	SLO-2	*Role of Requirements in Assurance*	*Gramm-Leach-Blile(GLBA)*	*Document Requests*	*Designing the Control analysis Scheme*	*Organizational*
S-7	SLO-1	*Audit Assurance in Software*	*Health Insurance Portability and*	*IT Asset Inventories*	*Designing the Likelihood Analysis Scheme*	*System Specific*

		Development Phases	*Accountability Act(HIPAA)*			
	SLO-2	*Building Secure and Trusted Systems*	*State Governments*	*Asset Scoping*	*Exposure*	*Results*
S-8	SLO-1	*Designing an Auditing System*	*ISO 27001*	*Business Impact Analysis and Other Assessments*	*Frequency*	*Organizational Analysis*
	SLO-2	*Auditing to detect Violations of a Security Policy*	*Drivers,Laws and Regulations*	*Critical Success Factor Analysis*	*Controls*	*System Specific*
S-9	SLO-1	*Auditing Mechanisms*	*Risk Assessment Framework*	*Profile & Control Survey*	*Likelihood*	*Risk Register*
	SLO-2	*Audit Browsing*	*Practical Approach*	*Consolidation*	*Final Risk Score*	*Post Mortem*

Learning Resources	1. *Mark Talabis, "Information Security Risk Assessment Toolkit: Practical Assessments through DataCollectionandDataAnalysis",Syngress;1Edition.ISBN:978-1-59749-735-0.Nov2012.* 2. *David L. Cannon, "CISA Certified Information Systems Auditor Study Guide", SYBEX Publication. ISBN:978-0-470-23152-4.*	3. *Thomas R.Peltier, "Information Security Risk Analysis", CRC Press, 2001*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	18CSE386T	Course Name	PENETRATION TESTING AND VULNERABILITY ASSESSMENT	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Gain knowledge on various security testing techniques and asses sensitiveness of assets.*			
CLR-2 :	*Gain knowledge on weaknesses of various OS, network and applications.*			
CLR-3 :	*identify how security controls can be improved to prevent hackers gaining access to operating systems and networked environments.*			
CLR-4 :	*Acquire knowledge on methodologies and techniques of Hacking*			
CLR-5 :	*To test and exploit systems using various tools.*			
CLR-6 :	*Understand the impact of hacking in real time machines*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Acquire the knowledge on identifying security vulnerabilities	2	80	85
CLO-2 :	Acquire the ability to identify problems in network, OS and applications commonly exploited by hackers	2	75	80
CLO-3 :	Understand management of static and dynamic security controls in firewalls, IPS, IDS	2	85	80
CLO-4 :	Appreciate the concepts of hacking and gaining access to remote and local systems.	2	80	75
CLO-5 :	Apply the knowledge for creating better security controls.	2	75	85
CLO-6 :	Acquire the knowledge to prevent threats in targeted attacks and real time systems.	2	80	85

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Acquire the knowledge on identifying security vulnerabilities	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Acquire the ability to identify problems in network, OS and applications commonly exploited by hackers	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Understand management of static and dynamic security controls in firewalls, IPS, IDS	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Appreciate the concepts of hacking and gaining access to remote and local systems.	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Apply the knowledge for creating better security controls.	H	-	-	H	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Acquire the knowledge to prevent threats in targeted attacks and real time systems.	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to penetration testing*	*Types of Scanning*	*Meterpreter Basics*	*Social engineering*	*DOS Attack*
	SLO-2	*Introduction to penetration testing -2*	*Black, White and Grey Scanning*	*Working with Meterpreter session*	*Electronic and Non Electronic Social Engineering*	*DDOS Attack*
S-2	SLO-1	*Understanding basic Ethical Hacking terminologies*	*Foot Printing Stages*	*Exploit Modules*	*SET- Social Engineering Toolkit*	*Web application Vulnerability*
	SLO-2	*Understanding basic Ethical Hacking terminologies -2*	*Foot Printing Stages-2*	*Payload Modules*	*Social Engineering Prevention Techniques*	*Security assessment of public Domains*
S-3	SLO-1	*Batch Programming Basics*	*DNS Information Gathering*	*Privilege Escalation*	*Buffer Over Flow Attack*	*Phishing and its Types*
	SLO-2	*Batch Programming Basics - 2*	*NS Lookup*	*Vertical and horizontal Privilege Escalation*	*Stack Based Buffer overflow*	*Cross Site Request Forgery*
S-4	SLO-1	*Taking control using batch programs*	*Network Information Gathering*	*Token Stealing*	*Heap Based buffer overflow*	*DOM Based XSS*
	SLO-2	*Taking control using batch programs-2*	*NMap*	*Active and Passive stealing*	*Deep packet inspection*	*Brup Suite*
S-5	SLO-1	*Open web Application Security Project(OWASP)*	*Scanning*	*Network Sniffing*	*SQL Injection –Introduction*	*Password Cracking*
	SLO-2		*Port, Network and OS*	*Active and passive sniffing*	*SQL Injection Types*	*John the Ripper*
S-6	SLO-1	*Stages of Ethical Hacking*	*Nmap Scripting*	*Creating Backdoors*	*Error Based SQL,*	*Dictionary Attack, Brute Force Attack*
	SLO-2			*Persistent and Non-Persistent*	*Union Based SQL*	*Rainbow Table Attack,*
S-7	SLO-1	*Vulnerability Research*	*Vulnerability Scanning*	*Key Loggers*	*Blind SQL*	*Shoulder Sniffing, Spidering*

	SLO-2		*Nessus*	*Software and Hardware Key loggers*	*Boolean-based SQL injection, Time-based SQL injection*	*Offline Cracking*
S-8	SLO-1	*Impact of Hacking*	*'Who is' Information Gathering*	*ARP Poisoning*	*SQL Map,DVWA*	*Wifi Hacking*
	SLO-2		*Wireshark*	*Maltigo*	*SQL injection Counter Measures*	*AIrcrack*
S-9	SLO-1	*Introduction to Kali OS*	*Enumeration*	*Man In The Middle Attack*	*Steganography*	*Documentation and Reporting*
	SLO-2	*Installation and configuration*	*Active and Passive Enumeration*	*Port Forwarding*	*Steganography counter measures*	*Dradis Framework*

Learning Resources	1. *David Kennedy, Jim O'Gorman, Devon Kearns, and Mati Aharoni, METASPLOIT The Penetration Tester's Guide, No Starch Press,2011.* 2. *Wil Allsopp, Advanced Penetration Testing: Hacking theworlds most Secure Networks, 1st Edition, John Wiley & Sons,2017*	3. *Sean-Philip Oriyano, Penetration Testing Essentials, JohnWiley & Sons,2017.* 4. *Leebrotherston,AmandaBerlin,DefensiveSecurityhandbook,O'reilly,2017*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. S Manigandan, prnc Cyber Researcher, Symantec Inc manigandan_s@symantec.com		*1. Geogen George,SRMIST*
		2. Ms. Poornima,SRMIST
		3. Mr.Selvakumaraswamy,SRMIST

Course Code	18CSE472T	Course Name	MALWARE ANALYSIS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the fundamentals of static and dynamic analysis.*			
CLR-2 :	*Gain knowledge about running malware in virtual environment.*			
CLR-3 :	*Study about disassembly constructs and its structures.*			
CLR-4 :	*Study about new processors and file types using the IDA SDK*			
CLR-5 :	*Explore popular plug-ins that make writing IDA scripts easier, allow collaborative reverse engineering*			
CLR-6 :	*Understand how to best approach the subject of Android malware threats and analysis.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Gain knowledge about the different forms of malware.*	*2*	*80*	*85*
CLO-2 :	*Set up a safe virtual environment to analyze malware.*	*2*	*75*	*80*
CLO-3 :	*Navigate, comment, and modify disassembly.*	*2*	*85*	*80*
CLO-4 :	*Use code graphing to quickly make sense of cross references and function calls*	*2*	*80*	*75*
CLO-5 :	*Use IDA's built-in debugger to tackle hostile and obfuscated code.*	*2*	*75*	*85*
CLO-6 :	*Learn procedures for recognizing and analyzing Android malware threats quickly and effectively.*	*2*	*80*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*The Goals of Malware Analysis*	*The Structure of a Virtual Machine*	*Disassembly Theory*	*Cross-References*	*Introduction to the Android Operating System and Threats*
	SLO-2	*Malware Analysis Techniques*	*Creating Your Malware Analysis Machine*	*The Why and how of Disassembly*	*Function Calls*	*Malware Threats, Hoaxes, and Taxonomy*
S-2	SLO-1	*Types of Malware*	*Using Your Malware Analysis Machine*	*Reversing and Disassembly Tools.*	*IDA Graphing*	*Open Source Tools*
	SLO-2	*General Rules for Malware Analysis*	*The Risks of Using VMware for Malware Analysis*	*Getting started with IDA.*	*Console Mode IDA*	*Collections*
S-3	SLO-1	*Antivirus Scanning*	*Record/Replay: Running Your Computer in Reverse*	*IDA Data Displays*	*IDA's Batch Mode*	*File Data, Metadata*
	SLO-2	*Hashing- Fingerprint for Malware*	*Sandboxes: The Quick-and-Dirty Approach*	*Disassembly Navigation.*	*Customizing IDA's*	*Creating a JAR File, VisualThreat Modeling*
S-4	SLO-1	*Finding Strings*	*Running Malware*	*Disassembly Manipulation.*	*Library Recognitions*	*Automation*
	SLO-2	*Packing Files*	*Monitoring with Process Monitor*	*Recognizing Data Structure Use*	*Augmenting Function Information*	*Processor Emulation*
S-5	SLO-1	*Detecting Packers with PEiD*	*Viewing Processes with Process Explorer*	*Creating IDA Structures*	*Augmenting Predefined Comments*	*Configuring Emulated Devices within AVD*
	SLO-2	*Portable Executable File Format*	*Comparing Registry Snapshots with Regshot*	*Using Structure Templates*	*The Infamous Patch Program Menu*	*Using the ADB Tool*
S-6	SLO-1	*Static, Runtime, and Dynamic Linking*	*Faking a Network*	*Importing New Structures*	*IDA Output Files and Patch Generation*	*Installing Samples to Devices and Emulators*
	SLO-2	*Exploring Dynamically Linked Functions with Dependency Walker*	*Packet Sniffing with Wireshark*	*Using Standard Structures*	*IDA Scripting*	*Application Storage and Data Locations*

S-7	SLO-1	*Imported and Exported Functions*	*Using INetSim*	*IDA TIL Files*	*IDA Software Development Kit*	*Devices View, LogCat View*
	SLO-2	*PotentialKeylogger.exe: An Unpacked Executable*	*Basic Dynamic Tools in Practice*	*C++ Reversing Primer- The this Pointer*	*The IDA Application Programming Interface*	*Application Tracing*
S-8	SLO-1	*Examining PE Files with PEview*	*Levels of Abstraction*	*Virtual Functions and Vtables*	*Writing a Plug-in, Plug-in User Interface Options*	*Build Your Own Sandbox*
	SLO-2	*Viewing the Resource Section with Resource Hacker*	*Reverse-Engineering*	*The Object Life Cycle*	*IDA Loader Modules*	*USB-cleaver, Torec*
S-9	SLO-1	*Using Other PE File Tools*	*The x86 Architecture*	*Name Mangling, Runtime Type Identification*	*Processor Module Architecture*	*Static and Dynamic Analysis of Uploaded Malware Samples.*
	SLO-2	*PE Header Summary*	*Recognizing C Code Construct in Assembly*	*Inheritance Relationships, C++ Reverse Engineering References*	*Real World Applications- Vulnerability Analysis.*	*Capabilities and Limitations of the Emulators.*

Learning Resources	1. *Michael Sikorski, Practical Malware Analysis – The Hands–On Guide to Dissecting Malicious Software, Kindle Edition, No Starch Press; 1 edition (1 February 2012), ISBN: 1593272901.* 2. *Chris Eagle, The IDA Pro Book, 2nd Edition, No Starch Press, 2011. ISBN-10: 1-59327- 289-8.*	3. *Ken Dunham, Android Malware and Analysis, Kindle Edition, Auerbach Publications.InternationalStandardBookNumber-13:978-1-4822-5220-0.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. P.Santhosh, *Information Security Risk Analyst,* *PricewaterhouseCoopers Pvt Ltd, Bangalore, Karnataka 560008. Email: santhoshshivam72@gmail.com*	*Dr.L.Kavisankar Associate Professor,* *Dept. Of CSE, Hindustan Institute of Science and Technology Email: lkavis@hindustanuniv.ac.in*	*1. Mr. V. Joseph Raymond, SRMIST*
		2.Ms. Ida Seraphim, SRMIST

Course Code	18CSE474T	Course Name	CYBER LAW	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the basics of cyber law and cyber security*
CLR-2 :	*familiarize the issues those are specific to amendment rights*
CLR-3 :	*Become aware on copyright issues in software's*
CLR-4 :	*Understand the Cyber-crimes and Cyber Frauds*
CLR-5 :	*Understand the Legal Framework*
CLR-6 :	understand ethical laws of computer for different countries

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning 1 Level of Thinking (Bloom)	2 Expected Proficiency (%)	3 Expected Attainment (%)	PLO 1 Engineering Knowledge	2 Problem Analysis	3 Design & Development	4 Analysis, Design, Research	5 Modern Tool Usage	6 Society & Culture	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLO-1 :	*Gain in-depth knowledge on information on cyber security and issues specific to amendment rights*	*3*	*80*	*70*	*L*	*H*	*H*	*H*	*L*	*H*	*L*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*
CLO-2 :	*Apply the knowledge on copyright issues within software packages*	*3*	*85*	*75*	*L*	*H*	*H*	*H*	*L*	*H*	*L*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*
CLO-3 :	*Comprehend ethical laws of computer for various countries*	*3*	*75*	*70*	*L*	*H*	*H*	*H*	*L*	*H*	*L*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*
CLO-4 :	*Defines the Cyber-crimes and frauds*	*3*	*85*	*80*	*L*	*H*	*H*	*H*	*L*	*H*	*L*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*
CLO-5 :	*Apply the knowledge of Legal framework*	*3*	*85*	*75*	*L*	*H*	*H*	*H*	*L*	*H*	*L*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*
CLO-6 :	*Construct the secured environment*	*3*	*80*	*70*	*L*	*H*	*H*	*H*	*L*	*H*	*L*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction*	*Overview Of The Information Technology Act, 2000*	*Cyber-crimes / Cyber Frauds*	*Cyber Crimes& Legal Framework*	*Cyber Security*
	SLO-2	*History of Internet and World Wide Web*	*Applicability of the Act*	*Definition of cyber crime*	*Cyber Crimes against Individuals, Institution and State*	*Network and website Security Risks*
S-2	SLO-1	*Need for cyber law*	*Scheme of the Act*	*First Cyber crime*	*Hacking*	*Hacking*
	SLO-2	*Cyber-crime on the rise*	*Important provisions of the Act*		*Digital Forgery*	*E-business Risk management issues*
S-3	SLO-1	*Important terms related to cyber law*	*Digital Signature under the IT Act, 2000*	*Types of cyber frauds*	*Cyber Stalking/Harassment*	*Firewall*
	SLO-2		*E-Governance*		*Cyber Pornography*	*Security framework*
S-4	SLO-1	*Cyber law in India*	*Attribution, Acknowledgement and Dispatch of Electronic Records*	*Cyber frauds in India*	*Identity Theft & Fraud*	*Cryptocurrency*
	SLO-2		*Certifying Authorities*	*Preventive measures*	*Cyber Terrorism*	*Blockchain –Technology Stack :Protocol, Currency*
S-5	SLO-1	*Need for cyber law in India*	*Controller of Certifying Authorities (CCA)*	*Cyber crimes*	*Cyber Defamation*	*Crowd Funding*
	SLO-2		*Security Guidelines for Certifying Authorities*	*Who commits cyber-crimes?*	*Right to Privacy and Data Protection on Internet*	*Bitcoin Prediction Markets*
S-6	SLO-1	*History of cyber law in India*	*Electronic Signature Certificates*	*Penalties and offences under the IT Act, 2000*	*Concept of privacy*	*Smart Property*
	SLO-2		*Duties of Subscribers*		*Self-regulation approach to privacy*	*Smart Contract*

S-7	SLO-1	*Information Technology Act, 2000*	*Penalties and Offences*	*Offences under other legislations*	*Ingredients to decide confidentiality of information*	*Decentralized Governance Services*
	SLO-2				*Intellectual Property Issues in Cyber Space*	*E Payments*
S-8	SLO-1	*Overview of other laws amended by the IT Act, 2000*	*Intermediaries*	*Investigation of cyber-crimes in India*	*Interface with Copyright Law*	*Digital Token based E payment systems*
	SLO-2				*Interface with Patent Law*	*E Wallet*
S-9	SLO-1	*National Policy on Information Technology 2012*	*rules issued under the IT Act, 2000*	*Regulatory Authorities*	*Trademarks &Domain Names Related issues*	*Online financial services in India*
	SLO-2				*Dispute Resolution in Cyberspace*	*Law to Protect online financial service fraud*

Learning Resources	1. *Justice Yatindra Singh,Cyber Laws, Universal Law Publishing Co, New Delhi, (2012).* 2. *Verma S, K, Mittal Raman,Legal Dimensions of Cyber Space, Indian Law Institute, New Delhi, (2004)* 3. *S. R. Bhansali, Information Technology Act, 2000, University Book House Pvt. Ltd., Jaipur (2003).* 4. *Blockchain, Blueprint for a new Economy , Melanie Swan, 2017 –O'Reilly*	5. *SudhirNaib, The Information Technology Act, 2005: A Handbook, OUP, New York, (2011)* 6. *Upadhyaya and A. Upadhyaya, Material Science and Engineering, Anshan Publications, 2007* 7. *Vasu Deva, Cyber Crimes and Law Enforcement, Commonwealth Publishers, New Delhi, (2003).* 8. *Essential CyberSecurity Science, Josiah Dykstra, 2017 –O'Reilly*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Kesawan HCL Technologies	*Dr. Surendran Rajendran* *AMA International University Bahrain*	*Dr.M.B Mukesh Krishnan, SRMIST*
Mr.Celeian, Symantec		*Mrs.R.Vidhya, SRMIST*

Course Code	18CSE475T	Course Name	MOBILE AND WIRELESS SECURITY	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*understand the fundamentals of mobile cellular networks and IEEE wireless networks*
CLR-2 :	*Learn the basic security fundamentals*
CLR-3 :	*understand the security issues in Wi-Fi.and Wi-Max*
CLR-4 :	*explore the security issues in Next generation mobile networks*
CLR-5 :	*understand the security issues and key management in ad-hoc networks.*
CLR-6 :	*study the hacking techniques in IEEE 802.11*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*understand the fundamentals of mobile cellular networks and IEEE wireless networks*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Identify various possibilities for security threats in wireless networks.*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Handle the security threats in Wi-Fi networks.*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Solve the security attacks in mobile IP networks*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Prevent the attacks in ad-hoc networks.*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Protect the 802.11 Networks from attacks.*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to mobile cellular networks*	*Wi-Fi Security*	*Security in Next Generation Mobile Networks*	*Security in Ad Hoc Networks*	*Overview of Wireless security-Hacking*
	SLO-2	*Cellular network basic concepts*	*Attacks on wireless networks*	*SIP*	*Motivations and application fields*	*Scanning and Enumerating 802.11 Networks*
S-2	SLO-1	*IEEE wireless networks, WLAN: IEEE 802.11*	*IEEE 802.11 security mechanisms*	*VoIP security flaws*	*Routing protocols*	*Windows Sniffing/Injection Tools*
	SLO-2	*WMAN mobile: IEEE 802.20*	*WEP (Wired Equivalent Privacy) and Shortcomings*	*Making VoIP secure*	*Attacks to routing protocols*	*Attacking 802.11 Wireless Networks*
S-3	SLO-1	*Mobile Internet networks*	*Security in 802.1x*	*IP Multimedia Subsystem (IMS)*	*Security mechanisms - Basic protections and existing tools*	*Security Through Obscurity*
	SLO-2	*Security in the digital age*	*Authentication*	*IMS architecture and security*	*Key management architectures*	*Attacking WPA-Protected 802.11 Networks*
S-4	SLO-1	*Threats and risks to TeleCommunication systems*	*The 802.11i security architecture*	*4G security*	*Protections using asymmetric cryptography*	*Breaking Authentication: WPA-PSK*
	SLO-2	*From wireline vulnerabilities to vulnerabilities in wireless Communications*	*Radio security policies*	*Confidentiality*	*Protections using symmetric cryptography*	*Breaking Authentication: WPA Enterprise*
S-5	SLO-1	*Security services*	*Authentication in wireless networks*	*Security of IP-Based Mobile Networks*	*Protection against data modification*	*Attack 802.11 Wireless Clients*
	SLO-2	*Symmetric and asymmetric*	*Layer 3 security mechanisms*	*Vulnerabilities of Mobile IP networks*	*Protection against tunnel attacks*	*Attacking the Application Layer*

		cryptography				
S-6	SLO-1	*Hash functions*	*WiMAX Security*	*Discovery mechanisms and Authenticity of the mobile location*	*Key Management in Ad Hoc Networks*	*Dynamically Generating Rogue APs and Evil Servers with Karmetasploit*
	SLO-2	*Electronic signatures and MAC*	*Security evolution in WiMAX standards*	*Data protection (IP tunnels)*	*The threshold cryptography technique and Self-managed PKI*	*Direct Client Injection Techniques*
S-7	SLO-1	*Public Key Infrastructure (PKI) and electronic certificates*	*WiMAX low layers*	*IPv6 mobility mechanisms*	*Key agreement technique within MANETs and Cryptographic identifiers*	*Overview of Bluetooth Scanning and Reconnaissance*
	SLO-2	*Management of cryptographic keys*	*Security according to the IEEE-802.16e standard*	*Mobile IPv6 bootstrapping*	*The Resurrecting Duckling technique*	*Bluetooth Eavesdropping*
S-8	SLO-1	*Cryptographic protocols*	*Authentication with PKMv2-RSA, PKMv2-EAP*	*Mobility with Mobile IPv4*	*Group key management within ad hoc networks*	*Commercial Bluetooth Sniffing*
	SLO-2	*IPsec protocol suite*	*SA-TEK 3-way handshake*	*Protocol and security*	*Security services and challenges for group Communications within MANETs*	*Open-Source Bluetooth Sniffing*
S-9	SLO-1	*Authentication mechanisms*	*GTEK updating algorithm*	*Mobility with MOBIKE*	*Comparison metrics*	*ZigBee Security*
	SLO-2	*Access control-Firewalls*	*Algorithms associated with the TEKs*	*IP mobility with HIP*	*Approaches for Group key management*	*ZigBee Attacks*

Learning Resources	1. *Hakima Chaouchi, Maryline Laurent-Maknavicius, "Wireless and Mobile Network SecuritySecurity Basics,SecurityinOn-the-shelfandEmergingTechnologies",JohnWiley&SonsInc,2009.* 2. *JohnnyCache,JoshuaWright,VincentLiu,"HackingExposedWireless:WirelessSecuritySecrets& Solutions", Second Edition, McGraw-Hill,2010.*	3. *LeiChen,JiahuangJi,ZihongZhang,"WirelessNetworkSecurity:TheoriesandApplications",Higher Education Press,2013.*

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts

Course Code	18CSE476T	Course Name	DATABASE SECURITY	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1 :	*Demonstrate understanding of Fundamentals of Security in database technology with its security architecture in modern computer systems in a typical enterprise.*	1
CLR-2 :	*Formulate a working definition of database security and administration and Identify contemporary practices of operating system security.*	2
CLR-3 :	*To identify risks and vulnerabilities in operating systems from a database perspective.*	3
CLR-4 :	*Demonstrate the knowledge and skills for administration of user, profiles, password policies, privileges and roles.*	
CLR-5 :	*Manage database security Model on application level and Conduct database auditing for security and reliability*	
CLR-6 :	*Implement typical security projects on enterprise systems.*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Students are able to identify fundamentals of data , securityof data and security issues*	*3*	*85*	*75*	*M*	*H*	*L*	*H*	*L*	*-*	*-*	*-*	*H*	*H*	*M*	*H*	*-*	*-*	*-*
CLO-2 :	*Students are obtaining knowledge about architecture of data base security and Operating System Security*	*3*	*85*	*75*	*M*	*H*	*L*	*M*	*L*	*-*	*-*	*-*	*M*	*L*	*M*	*H*	*-*	*-*	*-*
CLO-3 :	*Develop and implement a security plan for an enterprise level database (password policies, auditing policies, user privileges, profile, and roles).*	*3*	*75*	*70*	*M*	*H*	*M*	*H*	*H*	*H*	*-*	*-*	*M*	*L*	*H*	*H*	*-*	*-*	*-*
CLO-4 :	*Students are able to design and implement access control rules to assign privileges and protect data in databases.*	*3*	*85*	*85*	*M*	*H*	*H*	*H*	*L*	*-*	*H*	*-*	*M*	*L*	*H*	*H*	*-*	*-*	*-*
CLO-5 :	*Identify some of the factors driving the need for Database security and classify particular examples of attacks*	*3*	*85*	*75*	*H*	*H*	*M*	*H*	*L*	*M*	*-*	*M*	*M*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-6 :	*Students implement database auditing and Virtual Private Database to protect data in databases*	*3*	*80*	*85*	*H*	*H*	*H*	*H*	*H*	*-*	*-*	*-*	*H*	*H*	*M*	*H*	*-*	*-*	*-*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Importance of Data,Identity Theft*	*Installing a typical database product*	*Introduction-Authentication-Creating Users*	*Database Application Security Models: Introduction*	*Virtual Private Databases: Introduction-Overview*
	SLO-2			*SQL Server User*	*Types of Users*	*Implementation of VPD using Views*
S-2	SLO-1	*Levels of data security*	*Security architecture: Database Management Systems*	*Removing,Modifying Users-Default, Remote Users*	*Security Models*	*Application Context in Oracle*
	SLO-2	*Authorization in databases*	*Information Security Architecture*			*Implementing Oracle VPD*
S-3	SLO-1	*ACL Application Vulnerabilities*	*Database Security,Basics of Security in distributed databases*	*Database Links-Linked Servers*	*Application Types-Application Security Models*	*Viewing VPD Policies and Application contexts using Data Dictionary*
	SLO-2		*Asset Types and value-Security Methods*			*Policy Manager Implementing Row and Column level Security with SQL Server*
S-4	SLO-1	*Database security issues*	*Operating system security principles*	*Remote Servers-Practices for Administrators and Managers*	*Data Encryption.Excessive privileges, SQL Injections*	*Auditing Database Activities:*
	SLO-2	*Access to key fields,Access to surrogate information*				
S-5	SLO-1	*Problems with data extraction*	*Security Environment*	*Best Practices Profiles*	*Countermeasures of Malware, Countermeasures of Weak Audit Trail*	*Creating DLL Triggers with Oracle*
	SLO-2	*Access control in SQL*		*Password Policies*		

S-6	SLO-1	*Discretionary security in SQL,Schema level*	*Components*	*Introduction-Defining and Using Profiles*	*DB Vulnerabilities and Misconfiguration*	*Auditing Server Activity with SQL Server 2000*
	SLO-2					
S-7	SLO-1	*Authentication, Table level*	*Authentication Methods*	*Designing and Implementing Password Policies*	*Countermeasures of Denial of Service,Stolen Database Backups*	*Using Oracle Database Activities*
	SLO-2		*User Administration*			
S-8	SLO-1	*SQL system tables, Mandatory security in SQL*	*Password Policies*	*Granting and Revoking User Privileges*	*CONTROL METHODS: Access Control,Access control models for XML databases, Inference Policy*	*Security Project Case study-*
	SLO-2		*Vulnerabilities*			
S-9	SLO-1	*Data protection,*	*E-mail Security*	*Creating, Assigning and Revoking User Roles-Best Practices*	*User Identification,Authentication, Accountability,PasswordCrptography*	*Security and Auditing Project Case Study Data Protection and the IoT*
	SLO-2					

Learning Resources	1. *Alfred Basta ,Melissa Zgola and Dana Bullaboy "Database Security" 1st Edition Cingage ,2012 (Unit 1 toIII)* 2. *Michael Gertz and SushilJajodia (Editors) ,Handbook of Database Security: Applications and Trends , ISBN-10: 0387485325. Springer, 2007*	3. *Hassan A. Afyouni, "Database Security and Auditing", Third Edition, Cengage Learning,2009.(UNIT III to V)* 4. *http://aircconline.com/ijist/V6N2/6216ijist18.pdf (UnitIV)*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*20%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	*10%*	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*20%*	*10%*	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		-	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Prithivi R , Teradata DBA,T.C.S Company	*Dr.N.P.Gopal,Professor,Department of Computer Applications , National Institute of Technology,Triuchy*	*1. Mrs.S.Amudha/SWE, SRMIST*
Mr.JeroTerrence,Project Developer in Datawarehousing and DataMining,T.C.S Company	*Dr.G.R.KanagaChidambaresan,Asso.Prof,VelTechUniveristy,Chennai*	*2. Dr. Madhavan/CSE, SRMIST*
-	*Dr.KannimuthuAsso.Prof,KarpagamCollege of Engineering,Coimbatore*	*3.Dr.MB.MukeshKrishnan/IT,SRMIST*

Course Code	18CSE477T	Course Name	SECURITY GOVERNANCE, RISK AND COMPLIANCE	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Analyze the expanding role of IT governance and its effect on organizations*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Be aware of management issues in IT governance*			
CLR-3 :	*Analyze the role of risk to an organization and ways to identify key risk factors*			
CLR-4 :	*Evaluate various risks and appropriate actions*			
CLR-5 :	*Develop naming conventions for the resources in a system*			
CLR-6 :	*Create and justify several appropriate policies and procedures to manage resources in a system.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Having an overview of IT governance*	*3*	*80*	*70*
CLO-2 :	*Undergo an risk assessment*	*3*	*85*	*75*
CLO-3 :	*Describe legal and ethical considerations related to the handling and management of enterprise information assets.*	*3*	*75*	*70*
CLO-4 :	*Specify what constitutes admissible evidence in a legal proceeding and how to acquire and maintain this information.*	*3*	*85*	*80*
CLO-5 :	*Create a set of policies that implement a specified organizational objective.*	*3*	*85*	*75*
CLO-6 :	*Justify several appropriate policies and procedures to manage resources in a system.*	*3*	*80*	*70*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*M*	*H*	*H*	*H*	*H*	*M*	*M*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*
CLO-2 :	*M*	*H*	*H*	*H*	*H*	*M*	*M*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*
CLO-3 :	*M*	*H*	*H*	*H*	*H*	*M*	*M*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*
CLO-4 :	*M*	*H*	*H*	*H*	*H*	*M*	*M*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*
CLO-5 :	*M*	*H*	*H*	*H*	*H*	*M*	*M*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*
CLO-6 :	*M*	*H*	*H*	*H*	*H*	*M*	*M*	*M*	*H*	*M*	*H*	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to IT Governance*	*overview of Industry Best Practice Standards*	*Security mindset*	*Trends*	*Creation of policies*
	SLO-2					
S-2	SLO-1	*IT Risk Management Life Cycle*	*Model and Guidelines covering some aspect of IT governance*	*Design principles*	*Auditing*	*Maintenance of policies*
	SLO-2					
S-3	SLO-1	*IT Risk framework*	*principles of Business/IT Alignment Excellence,*	*System/security life-cycle*	*Cost / benefit analysis*	*Prevention*
	SLO-2					
S-4	SLO-1	*IT Risk identification*	*principles of Program/Project Management Excellence*	*Security implementation mechanisms*	*Asset management*	*Avoidance*
	SLO-2					
S-5	SLO-1	*IT Risk Security Governance*	*principles of IT Service Management and Delivery Excellence*	*Information assurance analysis model*	*Standards*	*Incident response*
	SLO-2					
S-6	SLO-1	*IT Risk assessment*	*principles of Vendor Management*	*Disaster recovery*	*Enforcement*	*Domain integration*
	SLO-2					
S-7	SLO-1	*IT Risk evaluation*	*Outsourcing Excellence*	*Forensics*	*Legal issues*	*Social engineering*
	SLO-2					
S-8	SLO-1	*IT Risk response,*	*critical success factors*	*threats*	*Disaster recovery*	*Protocol attacks*
	SLO-2			*vulnerabilities*		

S-9	SLO-1	*IT Risk monitoring and reporting*	*Case Study*	*attacks*	*security related issues and incidents*	*Security awareness*
	SLO-2			*countermeasures*		

Learning Resources	1. *Iannarelli, J. G., & O'Shaughnessy, M. O. (2015). Information governance and security: Protecting and managing your company's proprietary information. Waltham, MA: Butterworth Heinemann, Elsevier.* 2. *van Wyk, K. R., Graff, M. G., Peters, D. S., & Burley, D. L. (2015). Enterprise software security: A confluence of disciplines. Upper Saddle River, NJ: Pearson Education.*	3. *Legal Issues in Information Security, Joanna Lyn Grama, 2015. Jones & Bartlett Learning, Second Edition, ISBN: 978-1-284-05474-3.* 4. *Ethics of Big Data, Kord Davis, 2012. O'Reilly Media, ISBN: 978-1449311797*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Kesawan HCL Technologies	*Dr. Surendran Rajendran* *AMA International University Bahrain*	1. *Dr.M.B Mukesh Krishnan, SRMIST*
Mr.Celeian, Symantec		2. *Ms. Ramaprabha.J,SRMIST*
		3. *Dr. G. Usha,SRMIST*

Course Code	18CSE478T	Course Name	OPERATION SYSTEM SECURITY	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*To introduce students to a broad range of operating system security topics*			
CLR-2 :	*To introduce students network and system security plans*			
CLR-3 :	*To introduce students security design*			
CLR-4 :	*To introduce students security threats and risks*			
CLR-5 :	*To introduce students system and application security tools*			
CLR-6 :	*To introduce students Network monitoring and audit logs and resolution of any security breach*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Identify and assess current and anticipated security risks and vulnerabilities*	*3*	*80*	*70*
CLO-2 :	*Monitor, evaluate and test security conditions and environment*	*3*	*85*	*75*
CLO-3 :	*Develop an organizational security plan that provides for periodic reviews of security policies and procedures*	*3*	*75*	*70*
CLO-4 :	*Evaluate tools and technologies for use in protecting the network and individual network systems*	*3*	*85*	*80*
CLO-5 :	*Implement security plan and monitor solutions*	*3*	*85*	*75*
CLO-6 :	*Monitor and evaluate audit logs and set administrator alerts*	*3*	*80*	*70*

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Identify and assess current and anticipated security risks and vulnerabilities*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*H*	*M*	*L*	*H*	*H*	*H*	*H*
CLO-2 :	*Monitor, evaluate and test security conditions and environment*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*H*	*M*	*L*	*H*	*H*	*H*	*H*
CLO-3 :	*Develop an organizational security plan that provides for periodic reviews of security policies and procedures*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*H*	*M*	*L*	*H*	*H*	*H*	*H*
CLO-4 :	*Evaluate tools and technologies for use in protecting the network and individual network systems*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*H*	*M*	*L*	*H*	*H*	*H*	*H*
CLO-5 :	*Implement security plan and monitor solutions*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*H*	*M*	*L*	*H*	*H*	*H*	*H*
CLO-6 :	*Monitor and evaluate audit logs and set administrator alerts*	*H*	*H*	*M*	*M*	*M*	*L*	*L*	*L*	*H*	*M*	*L*	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Secure operating systems*	*What is a secure OS?*	*Information Protection And Security*	*Kali Linux*	*Implementation of strong password*
	SLO-2	*Security goals*				
S-2	SLO-1	*Trust model*	*Nature of threats/attacks*	*Requirements*	*Installation and Configuration*	*Implementation of buffer overflow attack*
	SLO-2			*Computer System Assets*		
S-3	SLO-1	*Threat model*	*Parts of an OS*	*Design Principles*	*Information Gathering Tools*	*Creation of child process using fork() function*
	SLO-2					
S-4	SLO-1	*Access Control fundamentals: Lampson's access matrix*	*Processes & Threads*	*Protection of Memory*	*Vulnerability Analyses Tools*	*Executing programs with exec() functions*
	SLO-2					
S-5	SLO-1	*Mandatory protection systems*	*Secure handling of Processes & Threads, Concurrency*	*User-Oriented Access Control*	*Wireless Attacks*	*Communication among multiple processes*
	SLO-2					
S-6	SLO-1	*Reference monitor*	*Memory management*	*Data-Oriented Access Control*	*Website Penetration Testing*	*Automating simple jobs simple scripts*
	SLO-2					
S-7	SLO-1	*Secure operating system definition*	*Secure memory management*	*File Sharing*	*Exploitation Tools*	*Executing programs at periodic intervals using at and crontab*
	SLO-2			*Access Rights*		

S-8	SLO-1	*Assessment criteria*	*Secure Communication and messaging*	*Simultaneous Access*	*Forensics Tools*	*Building own shell interpreter with limited features (mini project)*
	SLO-2			*Trusted Systems*		
S-9	SLO-1	*OS Security Assessment*	*Security perspective: end-user*	*Trojan Horse Defense*	*Social Engineering*	*Retrofitting security into operating systems*
	SLO-2		*Hardware/Architecture support for OS security*			

Learning Resources	1. *Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons ,Inc., 9th Edition, 2012* 2. *William Stallings, "Operating System: Internals and Design Principles", Prentice Hall, 7th Edition,2012* 3. *Tom Adelstein and Bill Lubanovic, "Linux System Administration", O'Reilly Media, Inc., 1st Edition, 2007*	4. *Trent Jaeger, "Operating Systems Security", Morgan & Claypool Publishers, 2008* 5. *Michael J.Palmer, "Guide to Operating Systems Security", Thomson/Course Technology, 2004*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Kesawan HCL Technologies	*Dr. Surendran Rajendran* *AMA International University Bahrain*	*1. Dr.M.B Mukesh Krishnan, SRMIST*
Mr.Celeian, Symantec		*2. Mr. M.V. Ranjith Kumar,SRMIST*
		3. Mrs. S. Aruna Sankaralingam, SRMIST

Course Code	18CSE361T	Course Name	WEB PROGRAMMING	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	Web has become ubiquitous in nature
CLR-2 :	Organizations have integrated the Internet "seamlessly" into their information systems and the Web offers endless opportunity to do so.
CLR-3 :	This course provides the basic concepts and techniques used to design, develop, and deploy web applications satisfying the requirements in terms of flexibility, availability and scalability.

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning 1: Level of Thinking (Bloom)	Learning 2: Expected Proficiency (%)	Learning 3: Expected Attainment (%)	PLO 1: Engineering Knowledge	PLO 2: Problem Analysis	PLO 3: Design & Development	PLO 4: Analysis, Design, Research	PLO 5: Modern Tool Usage	PLO 6: Society & Culture	PLO 7: Environment & Sustainability	PLO 8: Ethics	PLO 9: Individual & Team Work	PLO 10: Communication	PLO 11: Project Mgt. & Finance	PLO 12: Life Long Learning	PLO 13: PSO - 1	PLO 14: PSO - 2	PLO 15: PSO – 3
CLO-1 :	Understand different internet Technologies, web 2.0 and create a basic website using HTML and Cascading Style Sheets	1	80	70	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-2 :	Design a dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms	1	85	75	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-3 :	Design a server side program using Servlets and JSP	1	75	70	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-4 :	Design a simple web page in PHP, and to present data in XML format.	2	85	80	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M
CLO-5 :	Get overviews of java specific web services architecture and to enable rich client presentation using AJAX.	2	85	75	H	H	H	H	H	M	L	M	H	M	M	H	H	H	M

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Understanding Internet , Difference between websites and web server	An introduction to JavaScript	Java Servlet Architecture	An introduction to PHP	Introduction to Ajax
	SLO-2	Internet technologies Overview	Java Script Terminologies	Servlet Life Cycle	Using PHP, Variables, Program control	Ajax Client Server Architecture
S-2	SLO-1	Understanding websites and web servers:	Introduction to DOM Model	Form GET and POST actions	Built-in functions	Introduction to XMLhttpRequest Object
	SLO-2	Understanding the difference between internet and	DOM Model	Session Handling ,	Connecting to Database	XMLhttpRequest Object
S-3	SLO-1	Web 2.0: Basics, RIA Rich Internet Applications	Introduction to Objects	Understanding Cookies,	Using Cookies	Introduction to Call Back Methods
	SLO-2	collaborations tools	Built-in objects: Math Object	Installing and Configuring Apache Tomcat Web Server	Regular Expressions	Call Back Methods
S-4	SLO-1	HTML5.0 Introduction	Built-in objects: String Object	Introduction to JSP	Introduction to XML	Introduction to Web Services
	SLO-2	HTML5.0 Elements Headers ,Linking,Images,List	Date Object	Understanding Java Server Pages	Basic XML Concepts	Java web services Basics
S-5	SLO-1	HTML5.0 Elements Tables, Formatting,Frames	Boolean Object	Applications on JSP	Introduction to DTD	Introduction to SOAP
	SLO-2	CSS Introduction	Object Collections	Introduction to JSTL	Document Type Definition	Elements of SOAP
S-6	SLO-1	CSS Types	Regular Expressions	Understanding of JSTL	Introduction to XML	Introduction to WSDL

	SLO-2	*CSS : Positioning,Text Flow and Box Model*	*Examples of Regular Expressions*	*JSP Standard Tag Library(JSTL)*	*XML Schema*	*Creating, Publishing a WSDL*
S-7	SLO-1	*XHTML Introduction*	*Exception Handling*	*Creating HTML forms by embedding JSP code*	*DOM and Presenting XML*	*Testing and Describing a Web services(WSDL)*
	SLO-2	*XHTML Elements:Headers ,Linking,Images,List*	*Validation*	*Creating HTML forms by embedding JSP code*	*XML Parsers*	*Consuming a web service*
S-8	SLO-1	*XHTML Elements:Tables, Formatting,Frames*	*Event Handling Concept*	*Creating HTML forms by embedding JSP code*	*XML Validation*	*Introduction to Database Driven web service from an application*
	SLO-2	*CSS 3 Introduction*	*Introduction to DHTML*	*Creating HTML forms by embedding JSP code*	*XSLTransformation*	*Database Driven web service from an application*
S-9	SLO-1	*CSS 3 Types*	*DHTML with JavaScript*	*Lab 6:Creating HTML forms by embedding JSP code*	*XSLT Transformation*	*Applications on Database Driven web service*
	SLO-2	*CSS 3: Positioning,Text Flow and Box Model*		*Creating HTML forms by embedding JSP code*	*News Feed (RSS and ATOM)*	*Applications on Database Driven web service*

Learning Resources	1. *Deitel, Deitel and Nieto, Internet and World Wide Web : How to Program, 5 thEdition, 2012, Prentice Hall,. ISBN-13:978-0-13-215100-9* 2. *Stephen Wynkoop, Running a perfect website, QUE, 2ndEdition,2001. ISBN 13: 9780789709448* *3.Chris Bates, Web Programming : Building Intranet applications, 3rdEdition,2009, Wiley Publications,. ISBN 13:9780470017753.*	*3.Jeffrey C. Jackson, "Web Technologies A computer Science Perspective", 2011, Pearson, ISBN 9780133001976* 4. *https://www.W3Schools.com*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100%	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Dr.R.Jebakumar

Course Code	18CSE362T	Course Name	INTEGRATIVE PROGRAMMING AND TECHNOLOGY	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the concepts and features of Integrative programming*			
CLR-2 :	*Gain knowledge on Java network programming and JDBC for integrating applications*			
CLR-3 :	*Gain knowledge on Java component based technology for integrating reusable components across applications*			
CLR-4 :	*Acquire knowledge on XML and JSON technology for data representation and exchange in integrating applications*			
CLR-5 :	*Acquire knowledge in Java Messaging Service*			
CLR-6 :	*Understand interoperability between programming languages*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Understand the basic ideas in Integrative coding*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Acquire the ability to code java socket programming and java application to integrate databases*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Acquire the ability to develop Enterprise Java bean components and Java based Web services*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Appreciate the concepts of ML and JSON techniques in data representation and exchange for integrating applications*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Acquire the knowledge for developing JMS based enterprise application integration*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Programming paradigms an overview*	*Java network programming and RMI overview*	*Component Based technology overview*	*Data representation and exchange techniques in integrating applications overview*	*Interoperability between programming languages an overview*
	SLO-2	*Integrative programming an overview,*	*Java networking basics*	*Java beans concept and feature for reusability*	*Understanding XML and JSON for data representation and exchange*	*Understanding Java platform runtime environment and JVM*
S-2	SLO-1	*Integrative coding and its supporting Object Oriented concepts like inheritance, interface polymorphism .*	*Socket programming for TCP*	*Visual Java Beans components features and steps for creation*	*Understanding XML validation, Schema,*	*Understanding Java Native Interface(JNI) concepts in integrating native application code in java applications*
	SLO-2	*Object oriented design pattern for integrative coding overview..*	*Options and features for socket programming*	*Integrating visual beans to different applications*	*Understanding XML parsers DOM and SAX variant parsers.*	*Java tools for JNI programming*
S-3	SLO-1	*Creational design pattern, structural design pattern, Behavioral design pattern*	*UDP programming using Datagram*	*Enterprise Java platform overview*	*Understanding Integration of Enterprise applications with XML*	*Java libraries for JNI support*
	SLO-2	*Concept of Inversion of Control*	*options and features for UDP programming*	*Enterprise java bean components features and types*	*JSON encoding and decoding implementation*	*Understanding Usage of IDE for JNI programming*
S-4	SLO-1	*Application Architecture overview*	*Secure socket Communication*	*Session bean concepts and its types*	*Concept of Messaging Queue in integrating software systems to exchange information Asynchronously*	*Understanding concepts in JNI programming .Name mangling and function signatures DLL ,The JNIEnv argument*
	SLO-2	*Multi-tier architecture for integrating application packages like client side,*	*IP multicast and Multicast socket programming*	*Entity bean concepts and types*	*JMS and its role in integrating application in java enterprise platform*	*Understanding Accessing of Java Strings, Passing and using Java objects in native code*

		middleware and databases				
S-5	SLO-1	*Enterprise application architecture, overview*	*RMI and distributed applications*	*Implementing Enterprise application through integrating session and Entity beans*	*JMS features and benefits*	*Exception handling in JNI*
	SLO-2	*JEE platform and its features*	*Understanding stub and skeleton concept in RMI*	*Java web services an overview*	*JMS service providers*	*Threading concept in JNI*
S-6	SLO-1	*Understanding Design principles in Enterprise applications*	*RMI programming application steps*	*SOAP based web services .WSDL,SOAP message*	*Concept of Message queues*	*Python integration in java platform overview*
	SLO-2	*Enterprise application integration overview*	*RMI programming implementation*	*JAX-WS implementation for SOAP based webservices*	*Point to point messaging domain features*	*Jython programming concepts and features*
S-7	SLO-1	*Role of Design Patterns in Enterprise application integration,*	*Concepts in Java Database connectivity in integrating java applications with various databases*	*RESTful web services features*	*Application scenario for integrating applications through p2p messaging*	*Installation of Jython for developing applications to run in java platform.*
	SLO-2	*Designing distributed object interfaces*	*Understanding Types of data base connectivity Different drivers*	*JAX-RS implementation for Restful web services*	*Concept of publish/subscribe method of messaging*	*Jython programming basics*
S-8	SLO-1	*Front controller patterns*	*JDBC application program concepts and implementation*	*Integrating web services component to client application*	*Application scenario for integrating applications through publish/subscribe method based messaging*	*Accessing Java features and libraries of java in Jython code*
	SLO-2	*Facade patterns,*	*Java persistence API overview*	*Service discovery, UDDI*	*Message driven beans in Enterprise JavaBeans*	*Java swing based GUI development in Jython*
S-9	SLO-1	*Adapter patterns*	*Java Data Objects(JDO) concepts*	*Policy and security for web services*	*Features and environmental setup for implementing Message driven beans*	*Understanding Jython JDBC connectivity*
	SLO-2	*Concepts of DAO*	*Java persistence API frameworks overview*	*Comparison between SOAP and RESTful web services*	*Understanding and using JMS in Message driven beans*	*Integrating Jython code in Java application*

Learning Resources	1. *KogentLearningSolutionsInc,JAVA Serve rProgramming Java EE7 BlackBook , 5th ed., Weily India, 2016.* 2. *ElliotteRustyHarold,JavaNetworkprogramming,O'Reilly,2013*	3. *Cay S. Horstmann , D. R., Core Java Volume II - Advanced Features 10nd ed., John Wiley & Sons, 2013.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Venketasan Palavesam Delivery Head L &T		*1.Mr. K. Navin, SRMIST*
2. K.S.Kumar COO MindZen,India private Ltd		*Mr S.Ramaraj and Dr. Parthiban*

Course Code	18CSE364T	Course Name	SYSTEM ADMINISTRATION AND MAINTENANCE	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the factors that make Authentication/Authorization and stores of system Administration*			
CLR-2 :	*Acquire a knowledge and understanding of the specific problems in the Enterprise Security, and be able to apply some of the techniques*			
CLR-3 :	*Identify the specific challenges that inherent in the Budget and Desktop Deployment of system Administration that are able to apply some of the techniques that can be of use in comprehending and changing them*			
CLR-4 :	*Evaluate and understand the specific problems inherent in the system maintenance and evolution of package- based operating system, and be able to apply techniques for designing change-resistant systems from pre- packaged code.*			
CLR-5 :	Analyze and apply system maintenance technical concepts that relate to UPS software administration			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Explain terms used in make Authentication/Authorization and stores of system Administration*	*3*	*80*	*70*
CLO-2 :	*Incorporate a knowledge and understanding of the specific problems Enterprise Security, and be able to apply some of the*	*3*	*85*	*75*
CLO-3 :	*Identify challenges that inherent in maintenance and evolution of package-based operating system, and be able to apply techniques*	*3*	*75*	*70*
CLO-4 :	*Apply techniques for designing change-resistant systems from pre-packaged code.*	*3*	*85*	*80*
CLO-5 :	*Apply system maintenance technical concepts that relate to UPS software administration*	*3*	*85*	*75*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	*H*	-	*H*	-	-	-
CLO-2 :	*M*	*H*	*H*	*M*	*H*	-	-	-	*M*	*H*	-	*H*	-	-	-
CLO-3 :	*M*	*H*	*M*	*H*	*H*	-	-	-	*M*	*H*	-	*H*	-	-	-
CLO-4 :	*M*	*H*	*M*	*H*	*H*	-	-	-	*M*	*H*	-	*H*	-	-	-
CLO-5 :	*H*	*H*	*M*	*H*	*H*	-	-	-	*M*	*H*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Authentication/Authorization*	*Thin client support:*	*Issues relating to proposal construction and endorsement: New project development issues,*	*Customization of Operating System and maintenance of system:3 types of media to use when backing up your data and when each method is appropriate,*	*UPS: Identify the specifications of UPS,*
	SLO-2					
S-2	SLO-1	*Storage: Storage Area Networks*	*LTSP, Citrix*	*RFC construction, RFP Process,*	*How to create automated backups to ensure you always have a recent backup,*	*Switch-on and Switch-off procedure of UPS,*
	SLO-2					
S-3	SLO-1	*Network Attached Storage*	*Windows Terminal services,*	*Budgeting,*	*Learn how to manually backup data, How to make an exact copy of a hard drive*	*Measurement of Input/output voltage/current levels, battery charge level,*
	SLO-2					
S-4	SLO-1	*Storage Virtualization, Enterprise Backup and Restoration Issues*	*Sun Ray Services*	*Budgeting for new projects*	*Hardware Troubleshooting: The danger in not diagnosing problems first,*	*Identifying status of UPS from front panelindicators,*
	SLO-2					
S-5	SLO-1	*Enterprise Service Deployment: Clustering and fault tolerance,*	*Enterprise Security:*	*Desktop Deployment and Management, Alternative Desktops: SUS*	*Learn how to test your RAM ,*	*carryout routine maintenance of battery, battery terminals, loose contacts etc.,*
	SLO-2					
S-6	SLO-1	*Virtualization of services, Grids/On Demand/N1*	*Disaster Recovery*	*RIS,*	*check your hard drive for errors*	*Test UPS as per specification. Verification of back-up time.*
	SLO-2					
S-7	SLO-1	*Enterprise Applications: Enterprise Resource Planning,*	*Policies*	*Sun Java Desktop,*	*PC Cleaning: The best cleaning supplies to use,*	*Circuit tracing and fault finding practice*
	SLO-2					

S-8	SLO-1 SLO-2	*Customer Relationship Management,*	*Planning*	*Xandros*	*How to increase airflow and increase your computers lifespan*	*Servicing of UPS by simulating more likely faults and systematic approach to identify and rectify them*
S-9	SLO-1 SLO-2	*Office Automation*	*Procedures*	*Lindows*	*How to clean your computer*	*backup times its dependence on battery's load and its calculations*

Learning Resources	1. *Tittel, et al, A Guide to Microsoft Exchange Server 5.5, Course Technology*	2. *2.Hughes and Thomas, Novell's Guide to NetWare 5 Networks, IDG* 3. *3.Harvel et al, Unix and Windows 2000 Handbook, Prentice Hall*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100%	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. MrS.Selvakumara Samy., SRMIST

Course Code	18CSE365T	Course Name	FUNDAMENTALS OF VIRTUALIZATION	Course Category	E	*Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand about Computing Virtualization tools, applications and techniques*			
CLR-2 :	*Understand CPU virtualization, memory virtualization*			
CLR-3 :	*How to configure VM CPU and memory options*			
CLR-4 :	*Understand storage and network virtualization*			
CLR-5 :	*Acquire knowledge about virtualization security*			
CLR-6 :	*Learn about many case studies*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Able to define, distinguish Computing Virtualization tools, applications and techniques*	*3*	*80*	*70*
CLO-2 :	*Create a virtual environment and install VM with several guest operating systems*	*3*	*85*	*75*
CLO-3 :	*Able to configure virtual machine CPU and memory options*	*3*	*75*	*70*
CLO-4 :	*Able to configure VM storage and network options*	*3*	*85*	*80*
CLO-5 :	*Identify threats and able to security to virtualized environment*	*3*	*85*	*75*
CLO-6 :	*Investigate and discuss about case studies*	*3*	*80*	*70*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*L*	*H*	-	*H*	*L*	-	-	-	*L*	*L*	-	*H*	-	-	-
CLO-2 :	*M*	*H*	*L*	*M*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-3 :	*M*	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-4 :	*M*	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-5 :	*H*	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-6 :	*L*	*H*	-	*H*	*L*	-	-	-	*L*	*L*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Overview Of Virtualization -Basics of Virtualization -*	*Creating a Virtual machine- Performing P2V Conversions*	*Managing Storage for a virtual machine-Understanding storage virtualization*	*Theory Network Device Virtualization - VLANs*	*Case study: Load balancing*
	SLO-2	*Virtualization Types – Desktop Virtualization*	*Loading your Environment*	*Configuring VM Storage options*	*VRF Instances- VFIs -Virtual Firewall Contexts Network Device Virtualization*	*Autonomic computing*
S-2	SLO-1	*Storage Virtualization – System-level Operating Virtualization – Application Virtualization-*	*Building a new Virtual machine*	*Tuning practices for VM storage*	*Fundamentals of Virtualization security- Virtualization architecture*	*Xen para virtualization*
S-3	SLO-1	*Virtualization Advantages*	*Managing CPUs for a virtual machine- Understanding CPU Virtualization*	*SCSI- Speaking SCSI- Using SCSI buses – Fiber Channel – Fiber Channel Cables – Fiber Channel Hardware Devices – iSCSI Architecture – Securing iSCSI*	*Threats to a virtualized environment*	*Any Simulation tool*
S-4	SLO-2		*Configuring VM CPU options*	*Server virtualization concepts*	*How security must adapt to virtualization*	*Webhosting*
S-5	SLO-1	*Understanding Hypervisors*	*Tuning practices for VM CPUs*	*Introduction to server virtualization, Types of server virtualization technologies*	*Securing hypervisors-Hypervisor configuration and security*	*KVM virtualization*
S-6	SLO-2			*Limitations of server virtualization*		
S-7	SLO-1	*Understanding Virtual Machines* Assignment-Installing windows, Linux on a virtual machine	*Managing Memory for a virtual Machine- Understanding memory virtualization, Configuring VM memory options*	*Managing Networking for a virtual machine- understanding network virtualization*	*Designing virtual networks for security- comparing virtual and physical networks*	*Microsoft Virtual Server*

S-8	SLO-2		*Tuning practices for VM memory*	*Configuring VM network options*	*Virtual network security considerations*	*Live migration*
S-9				*Tuning practices for Virtual networks*	*Configuring virtual switches for security*	

Learning Resources	1. *William von Hagen, Professional Xen Virtualization, Wrox Publications, January, 2008* 2. *Virtualization Essentials by Matthew Portnoy ISBN: 978-1118176719*	3. *Virtualization Security: Protecting Virtualized Environments, Dave shackleford, sybex publications,2013* 4. *Kumar Reddy, Victor Moreno, Network virtualization, Cisco Press, July, 2006.* 5. *David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach Publications, 2006.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	Ms.SS.Subashka, SRMIST, Ramapuram	*1. Mrs. TYJ Naga Malleswari SRMIST*
	Mr. B.S. Vidhyasagar, SRMIST, Vadapalani	*2. Mrs Sasirekha Sankar, SRMIST*
		3. Dr.MB.Mukesh krishnan SRMIST

Course Code	18CSE366T	Course Name	HUMAN COMPUTER INTERACTION	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*NA*	Co-requisite Courses	*NA*	Progressive Courses	*//Course code*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*NA*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understandthe basic concepts of HCI*
CLR-2 :	*Learn the various design and software processes*
CLR-3 :	*Become familiar with different models of HCI and evaluation techniques*
CLR-4 :	*Learn web interface design*
CLR-5 :	*Learn mobile interface design*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Explain why it is important to design interactive products that are usable*	3	75	70
CLO-2 :	*Explain key terms used in interactive design*	3	75	70
CLO-3 :	*Explain the need for different models and the importance of evaluation*	3	65	60
CLO-4 :	*Gain knowledge on web interface design*	3	55	50
CLO-5 :	*Attain knowledge on mobile interface design*	3	55	50

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
			M											
			M											
													M	
			M	H				M					M	
			M	H				M					M	

Duration (hour)	9	9	9	9	9
S-1	*Human: I/O Channels, Memory*	*Interactive design basics: Design process, Navigation design*	*Cognitive models: Introduction and GOMS*	*Designing web interfaces:*	*Mobile Interface design:*
S-2	*Thinking: Reasoning and Problem Solving, Emotion*	*Screen design and layout, Iteration and prototyping*	*Linguistic model*	*Introduction and Brainstorming session*	*Introduction and Brainstorming session*
S-3	*Individual differences, Psychology design of interactive systems*	*Software process: Software lifecycle, Usability engineering*	*Physical and device models*	*Drag and Drop,*	*Mobile Ecosystem: Platforms*
S-4	*Computer: Devices, Physical controls, sensors and special devices*	*Iterative design and prototyping, Design rationale*	*Organizational issues, Capturing requirements*	*Direct Selection*	*Application frameworks*
S-5	*Readability of text, Memory, Processing and networks*	*Design rules: Principles, Standards*	*Communication and collaboration models:*	*Contextual tools*	*Types of mobile applications: Widgets,*
S-6	*Interaction: Basics and Models*	*Guidelines, Golden rules*	*face-to-face and conversation*	*Overlays*	*Application, Games*
S-7	*Frameworks, Ergonomics, Interaction styles*	*Evaluation techniques: Goals, evaluation through expert analysis*	*Text based Communication and Group working*	*Inlays and Virtual pages*	*Mobile Information Architecture*
S-8	*WIMP interface elements, Interactivity*	*Evaluation through user participation*	*Task analysis: Introduction and Task decomposition comparison*	*Process flow*	*Mobile design: Elements and Tools*
S-9	*Paradigms: Interactive paradigms*	*Universal design: Principles, Multi-modal interaction User support: Requirements and Approaches*	*Knowledge based analysis*	*Case Study discussion*	*Case Study discussion*

Learning Resources	1. *Human Computer Interaction by Alan Dix, Janet Finlay, Gregory D.Abowd and Russell Beale – Third Edition - Pearson Education – 2004* 2. *Human Computer Interaction by K.Meena and R.Sivakumar – 2015 – Prentice Hall India* 3. *Designing the User Interface: Strategies for Effective Human Computer Interaction by Ben Shneiderman and Catherine Plaisant – Fifth Edition - 2009 – Pearson Addison Wesley*	4. *Designing Web Interfaces by Bill Scott and Theresa Neil – First Edition – O'Reilly Media Inc. – 2009* 5. *Mobile Design and Development by Brian Fling - First Edition – O'Reilly Media Inc. – 2009*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,
SLO – Session Learning Outcome

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	Dr.T.Nagarajan, Professor and Head,Dept. of IT, SSN college of Engineering.	*1. Dr. M. Thenmozhi, SRMIST*
		2. Dr.S Prabakaran, SRMIST
		3. Dr. Alice Nithya , SRMIST

Course Code	18CSE397T	Course Name	COMPUTATIONAL DATA ANALYSIS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the underlying assumptions, verify them, and propose appropriate actions if some assumptions do not hold*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Identify appropriate statistical learning methods for the given problem involving real data.*			
CLR-3 :	*Evaluate performance of the chosen regression and classification techniques and compare them*			
CLR-4 :	*Show, analytically or empirically, the optimal balance between precision within training data and prediction power.*			
CLR-5 :	*Use training and testing data to evaluate performance of the chosen regression and classification techniques and compare them.*			
CLR-6 :	*Illustrate results with appropriate plots and diagrams.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge on methods, theory, mathematics and algorithms in data analysis*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Acquire the ability to To formulate and model mathematical and computational tasks*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Understand the basic ideas about high-level data analysis, concepts and techniques*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Acquire the ability identify other possible problems with messy data, such as multi-collinearity, understand their consequences, and propose solutions.*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Apply the knowledge To build from scratch the basic components of a data analysis pipeline*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*To Show, analytically or empirically, the optimal balance between precision within training data and prediction power.*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*General Introduction*	*Generative Algorithms: Multivariate Normal*	*Unsupervised Learning:*	*Regularization and Model Selection:*	*Decision Tree and Random Forest:*
	SLO-2	*Supervised Learning*	*Linear Discriminant Analysis*	*PCA*	*Cross Validation,*	*Entropy*
S-2	SLO-1	*Least Squares and Nearest Neighbors*	*Naive Bayes*	*Mixture Models*	*Hill Climbing*	*Building Tree Bagging features*
	SLO-2	*Statistical Models*	*Laplacian Smoothing*	*Bayesian Graphical Models*	*Bayesian Optimization*	*Bagging Samples*
S-3	SLO-1	*Discriminative Algorithms*	*Multiclass Classification*	*Power Method*	*Bayesian Regression*	*Random Forest Adaboost*
	SLO-2	*Supervised Learning Concept*	*K-NN*	*Oja's algorithm*	*Bayesian Logistic*	*Gradient Tree Boosting*
S-4	SLO-1	*Linear Regression*	*Multi-class Fisher Discriminant Analysis*	*EM Algorithm*	*Regression Forward and*	*Boosting and Regularization Paths*
	SLO-2	*The Gauss–Markov Theorem*	*Multinomial Regression*	*Variational Inference*	*Backward Regression*	*Learning Ensembles*
S-5	SLO-1	*Multiple Regression*	*Support Vector Machines and Kernel Methods*	*Matrix Factorization/Completion*	*Lasso*	*Proximity Plots*
	SLO-2	*Maximum Likelihood*	*Intuition, Geometric Margins,*	*Independent Component Analysis*	*elastic-net*	*Random Forests and Overfitting*
S-6	SLO-1	*Normal Equation*	*Optimal Margin Classifier*	*The Google PageRank Algorithm*	*Proximal Gradient*	*Neural Network: Concept*
	SLO-2	*Gradient Descent*	*Lagrangian Duality, Soft-margin,*	*Principal Components, Curves and Surfaces*	*Prox-SVRG*	*Deep Neural Network*
S-7	SLO-1	*Stochastic Gradient*	*Loss function, Stochastic Subgradient*	*Cluster Analysis*	*Coordinate Proximal Gradient*	*Backpropagation*

			Method			
	SLO-2	*SVRG*	*Kernel, SMO algorithm*	*Proximity Matrices*	*Pathwise Coordinate Descent*	*Convolutional Neural Network;*
S-8	SLO-1	*Linear Classification*	*Coordinate Gradient Descent*	*Dissimilarities Based on Attributes*	*Principal Components Regression*	*Bayesian Neural Nets*
	SLO-2	*Linear Discriminant Analysis*	*Kernel PCA, Kernel Logistic Regression*	*Object Dissimilarity*	*Incremental Forward Stage wise Regression*	*Bayes, Boosting and Bagging*
S-9	SLO-1	*Logistic Regression*	*Kernel Ridge Regression*	*Clustering Algorithms*	*The Dantzig Selector*	*Fitting Neural Networks*
	SLO-2	*Newton Method*	*Multiclass SVM*	*Combinatorial Algorithms*	*The Grouped Lasso*	*Issues in Training Neural Networks*

Learning Resources	1. *Hastie,Tibshirani and friedman,The Elements of Statistical Learning, Data Mining, Inference and Prediction, 2nd ed., Springer,2008.* 2. *Mohri, Rostamizadeh and Talwalker , Foundations of Machine Learning, The MIT Press Cambridge,Massachusetts London,England,2012*	3. *AndrewNg.CS229Lecturenotes:http://cs229.stanford.edu/notes/cs229-notes1.pdf*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Jayaraj Chandrasekaran, UST Global,Chennai, jayaraj.chandrasekaran@ust-global.com	*Dr.Devaki,Rajalakshmi Engineering College,Professor, Department of Computer Science and Engineering,*	*Mrs.S.Nagadevi*
		Dr.G.Vadivu

Course Code	18CSE461T	Course Name	INTERNET SECURITY AND CYBER FORENSICS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*18CSC302J*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Study about various threats associated with security and information warfare*			
CLR-2 :	*Study about email security and the Importance of Firewalls and their types*			
CLR-3 :	*Impart an introduction to the need of computer forensics*			
CLR-4 :	*Study the tools and tactics associated with cyber forensics*			
CLR-5 :	*Analyze and validate computer forensics data*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Have thorough knowledge about various threats associated with security and information warfare*	*2*	*85*	*80*	*L*	*H*	-	*L*	*L*	-	-	-	*L*	*L*	-	*H*	-	-	-
CLO-2 :	*Have in-depth knowledge about email security and understand the Importance of Firewalls and their types*	*2*	*85*	*75*	*M*	*H*	-	*M*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-3 :	*Understand the need of computer forensics*	*2*	*80*	*75*	*M*	*H*	*M*	*H*	*L*	-	-	*H*	*M*	*M*	-	*H*	-	-	-
CLO-4 :	*Utilize the tools and tactics associated with cyber forensics*	*3*	*75*	*70*	*M*	*H*	*M*	*H*	*H*	-	-	*H*	*M*	*M*	-	*H*	-	-	-
CLO-5 :	*Analyze and validate computer forensics data and apply them for solving computer forensics issues*	*3*	*75*	*70*	*H*	*H*	*M*	*H*	*M*	-	-	*H*	*M*	*M*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*IPSec Protocol – Basics*	*PGP – Confidentiality and Authentication*	*Computer Forensics Fundamentals: Introduction to Computer Forensics, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings*	*Processing Crime and Incident Scenes: Identifying Digital Evidence*	*Computer Forensics Analysis and Validation, Determining what data to collect and analyze*
	SLO-2	*IPSec Protocol - Documents*	*PGP – Compression and E-mail compatibility via Radix-64 conversion*	*Computer Forensics Services, Benefits of Professional Forensics Methodology, Steps Taken by Computer Forensics Specialists, Who Can Use Computer Forensic Evidence?*	*Collecting Evidence in Private-Sector Incident Scenes, Processing Law Enforcement Crime Scenes*	*Validating Forensics Data, Validating with Hexadecimal Editors, Validating with Computer Forensics Programs*
S-2	SLO-1	*IPSec Protocol – Security Associations*	*MIME*	*Types of Computer Forensics Technology: Types of Military Computer Forensic Technology*	*Preparing for a Search*	*Data Hiding Techniques - Hiding Partitions, Marking Bad Clusters, Bit-Shifting*
	SLO-2	*Hashed Message Authentication Code (HMAC)*	*S/MIME*	*Types of Law Enforcement: Computer Forensic Technology*	*Securing a Computer Incident or Crime Scene , Seizing Digital Evidence at the Scene*	*Using Steganography to Hide Data,*
S-3	SLO-1	*IP Authentication Header*	*Internet Firewalls for Trusted System: Roles of Firewalls*	*Types of Business Computer Forensic Technology*	*Storing Digital Evidence, Obtaining a Digital Hash*	*Examining Encrypted Files, Recovering Passwords*
	SLO-2	*IP ESP*	*Firewall related terminology*	*Specialized Forensics Techniques*	*Reviewing a Case*	*Performing Remote Acquisition, Remote Acquisitions with Runtime Software*
S-4	SLO-1	*Key Management Protocol for IPSec – OAKELY Key Determination Protocol*	*Types of Firewalls*	*Types of Computer Forensics Systems: Internet Security Systems, Intrusion Detection Systems, Firewall Security Systems*	*Working with Windows and DOS Systems*	*Network Forensics*

	SLO-2	*Key Management Protocol for IPSec – ISAKMP*	*Packet filters*	*Storage Area Network Security Systems, Network Disaster Recovery Systems, Public Key Infrastructure Systems*	*Understanding File Systems, Exploring Microsoft File Structures*	*Securing a Network*
S-5	SLO-1	*Transport layer Security : SSL and TLS*	*Circuit level gateways*	*Wireless Network Security Systems, Satellite Encryption Security Systems, Instant Messaging (IM) Security Systems , Net Privacy Systems*	*Examining NTFS Disks*	*Email Investigations – Exploring the Role of E-mail in Investigations, Exploring the Roles of the Client and Server in E-mail*
	SLO-2	*SSL Protocol*	*Application level gateways*	*Identity Management Security Systems, Identity Theft, Biometric Security Systems, Homeland Security Systems*	*Understanding Whole Disk Encryption*	*Investigating E-mail Crimes and Violations: Examining E-mail Messages, Viewing E-mail Headers, Examining E-mail Headers, Examining Additional E-mail Files*
S-6	SLO-1	*SSL Record Protocol*	*Firewall designs*	*Understanding Computer Investigation: Preparing a Computer Investigation, Taking a Systematic Approach*	*Understanding the Windows Registry*	*Tracing an E-mail Message,Using Network E-mail Logs*
	SLO-2	*SSL Change Cipher Spec Protocol*	*Screened Host Firewall (Single – Homed Bastion Host)*	*Procedures for Corporate High-Tech Investigations*	*Understanding Microsoft Startup Tasks, Understanding MS-DOS Startup Tasks, Understanding Virtual Machines*	*Understanding E-mail Servers - Examining UNIX E-mail Server Logs, Examining Microsoft E-mail Server Logs, Examining Novell GroupWise E-mail Logs, Using Specialized E-mail Forensics Tools*
S-7	SLO-1	*SSL Alert Protocol*	*Screened Host Firewall (Dual – Homed Bastion Host)*	*Understanding Data Recovery Workstations and Software*	*Current Computer Forensics Tools: Software/ Hardware Tool*	*Cell Phone and Mobile Devices Forensics*
	SLO-2	*SSL Handshake Protocol*	*Screened Subnet Firewall*	*Conducting an Investigation, Completing the Case*	*Evaluating Computer Forensics Tool Needs*	*Understanding Mobile Device Forensics*
S-8	SLO-1	*Cryptographic Computations – Computing the Master Secret*	*SET for E-Commerce Transactions: Business requirements for SET*	*Data Acquisition: Understanding Storage Formats for Digital Evidence, Determining the Best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools*	*Types of Computer Forensics Tools, Tasks Performed by Computer Forensics Tools*	*Mobile Phone Basics, Inside Mobile Devices*
	SLO-2	*Cryptographic Computations – Converting the Master Secret into Cryptographic Parameters*	*SET System Participants*	*Validating Data Acquisitions, Performing RAID Data Acquisitions*	*Computer Forensics Software Tools, Command-Line Forensics Tools, UNIX/Linux Forensics Tools, Other GUI Forensics Tools*	*Inside PDAs*
S-9	SLO-1	*TLS Protocol*	*SET Cryptographic Operation Principles, Dual Signature, Authentication and Message Integrity*	*Using Remote Network Acquisition Tools*	*Computer Forensics Hardware Tools, Forensic Workstations, Using a Write-Blocker, Recommendations for a Forensic Workstation*	*Understanding Acquisition Procedures for Cell Phones and Mobile Devices*
	SLO-2	*Cryptographic Computations for TLS*	*SET Payment Processing*	*Using Other Forensics Acquisition Tools*	*Validating and Testing Forensics Software, Using National Institute of Standards and Technology (NIST) Tools, Using Validation Protocols*	*Mobile Forensics Equipment*

Learning Resources	1. *Man Young Rhee, "Internet Security: Cryptographic Principles, Algorithms and Protocols", Wiley Publications, 2003* 2. *Christopher Steuart, Bill Nelson, Amelia Phillips, "Guide Computer Forensics and Investigations", Cengage Learning, India, Fourth Edition, 2013.*	2. *John R.Vacca, "Computer Forensics: Computer Crime Scene Investigation", Charles RiverMedia, 2002.* 3. *Richard E.Smith, "Internet Cryptography", Pearson Education, 3rd Edition, 2008.* 4. *Marjie T.Britz, "Computer Forensics and Cyber Crime: An Introduction", Pearson Education, 3rd Edition, 2013.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	1. Dr.L.Kavisankar, Associate Professor, Department of Computer Science and Engineering, Hindustan Institute of Technology and Science, Chennai, India	*1. Mr. S.Saminathan, SRMIST*
		2. Dr.M.B.Mukesh Krishnan, SRMIST

Course Code	18CSE462T	Course Name	DATA CENTRE ADMINISTRATION AND MANAGEMENT	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Critically discuss data center networking technologies*			
CLR-2 :	*Evaluate key concepts in data center design*			
CLR-3 :	*Concepts related to data center maintenance*			
CLR-4 :	*Design, build and configure a data centers*			
CLR-5 :	*Expose to implementing the various system management practices*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Manage Server Systems and Data Centres Infrastructure Management*	*1*	*90*	*85*
CLO-2 :	*Utilize the Storage, Bandwidth, Efficiency of systems and other resources for Data centre.*	*3*	*85*	*80*
CLO-3 :	*Monitoring the Networks and Resources. .*	*3*	*85*	*80*
CLO-4 :	*Planning for Flexible resource allocation*	*3*	*80*	*75*
CLO-5 :	*Administer the data centers*	*3*	*80*	*75*

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Manage Server Systems and Data Centres Infrastructure Management*	*L*	-	-	*M*	-	-	-	-	-	-	-	*H*	*L*	-	-
CLO-2 :	*Utilize the Storage, Bandwidth, Efficiency of systems and other resources for Data centre.*	*M*	*M*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	*M*	*H*	-
CLO-3 :	*Monitoring the Networks and Resources. .*	*M*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	*M*	*H*	-
CLO-4 :	*Planning for Flexible resource allocation*	*M*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	*H*	*H*	*H*	-
CLO-5 :	*Administer the data centers*	*H*	*H*	*H*	*H*	*H*	*H*	-	*M*	-	-	-	*H*	*M*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Data center Architecture*	*Data Center design*	*Data Center Maintenance*	*Data Center HVAC*	*System Management Best Practices*
	SLO-2					
S-2	SLO-1	*Data center Requirements*	*Characteristics of an Outstanding Design*	*Network Operations Center, Network Monitoring*	*Reasons for Strict Environmental Requirements*	*Server Cluster Best Practices*
	SLO-2					
S-3	SLO-1	*Data center prerequisites*	*Characteristics of an Outstanding Design*	*Datacenter physical security*	*Need for Energy-Efficient HVAC Systems*	*Data Storage Best Practices*
	SLO-2					
S-4-5	SLO-1	*Physical Area for Equipment and Unoccupied Space*	*Guidelines for Planning a Data Center*	*Data center Logical security*	*Air-Conditioning Systems*	*Network Management Best Practices*
	SLO-2					
S-6	SLO-1	*Required power to run all the devices*	*Data Center structures*	*Data center Cleaning*	*Air Circulation in a Data Center*	*Security Guidelines Internet security*
	SLO-2					
S-7	SLO-1	*Required cooling and HVAC Required weight*	*Raised Floor Design and Deployment*	*Floor Surface Cleaning*	*Placement of Hardware Racks*	*Best Practices for System Administration*
	SLO-2				*Bottom-to-Top Cooled Racks*	
S-8	SLO-1	*Budget Constraints*	*Design and Plan against Vandalism*	*Subfloor and Above-Ceiling Plenum Cleaning*	*Top-to-Bottom Cooled Racks*	*Device Naming, Naming Practices*
	SLO-2				*Front-to-Front Cooled Racks*	
S-9	SLO-1	*Selecting a Geographic Location Safety from Natural hazards*	*Data center design case study*	*Equipment Cleaning*	*Front-to-Back Cooled Racks*	*Load balancing, Terminology, Advantages &Types of load balancing*
	SLO-2					

Learning Resources	1. *Mouricio Arregoces, "Data Centre Fundamentals", Cisco Press ,2003* 2. *Administering Data Centers: Servers, Storage and Voice over IP, Kailash Jayaswal.* 3. *Kevin Corbin, Ron Fuller, David Jansen, "NX-OS and Cisco Nexus Switching: Next-Generation Data Center Architectures" Cisco Press; 1 edition [ISBN: 9781587058929], 2010.* 4. *SilvanoGai, TommiSalli, Roger Andersson, "Cisco Unified Computing System" Cisco Press; 1 edition, [ISBN: 9781587141935], 2010.*	5. *Nash Darukhanawalla, Patrice Bellagamba, "Interconnecting Data Centers Using VPLS" Cisco Press; 1 edition, [ISBN: 9781587059926], 2009.* 6. *Robert W. Kembel, Roger Cummings (Introduction), "The Fibre Channel Consultant" Northwest Learning Assoc; 3rd edition, [ISBN: 0931836840], 1998.* 7. *Robert W Kembal"Fiber Channel Switched Fabric" Northwest Learning Associates, inc. [ISBN: 0931836719], 2009.* 8. *John L. Hufferd, "ISCSI", Addison-Wesley Boston [ISBN: 978- 0201784190], 2003.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr.M.S.Sricharan/Wipro Technologies		*Dr. B.Amutha, Professor and Head, Department of CSE, SRM IST*
		Dr. G.Vadivu, Professor and Head, Department of IT, SRM IST

Course Code	18CSE463T	Course Name	IT SERVICE MANAGEMENT AND OPERATIONS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*To develop an awareness of the opportunities that information technology can have for enhancing service firms' competitiveness.*			
CLR-2 :	*To appreciate the organizational significance of managing the IT service encounter to achieve internal and external customer satisfaction.*			
CLR-3 :	*To understand new service development from both a product and process perspective.*			
CLR-4 :	*To gain an appreciation of the complexities associated with implementing change during IT services.*			
CLR-5 :	*to understand how an integrated ITSM framework*			
CLR-6 :	*To Understand practical implementation of Information Technology Service Management*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Illustrate the basic concepts of Service Science, Management, and Engineering*	*3*	*80*	*70*	*L*	*H*	*L*	*H*	*L*	*L*	*M*	*L*	*L*	*L*	*M*	*L*	*L*	*L*	*L*
CLO-2 :	*Examine the principle of IT service processes*	*3*	*85*	*75*	*L*	*H*	*L*	*H*	*L*	*L*	*M*	*L*	*L*	*L*	*M*	*L*	*L*	*L*	*L*
CLO-3 :	*Skills for planning, estimating, and resourcing for IT services*	*3*	*75*	*70*	*L*	*H*	*L*	*H*	*L*	*L*	*M*	*L*	*L*	*L*	*M*	*L*	*L*	*L*	*L*
CLO-4 :	*Manage the scope changes and the organizational changes in IT services*	*3*	*85*	*80*	*L*	*H*	*L*	*H*	*L*	*L*	*M*	*L*	*L*	*L*	*M*	*L*	*L*	*L*	*L*
CLO-5 :	*Ability to identify IT services as a means to provide functionality and value to customers in the context of specific case studies*	*3*	*85*	*75*	*L*	*H*	*L*	*H*	*L*	*L*	*M*	*L*	*L*	*L*	*M*	*L*	*L*	*L*	*L*
CLO-6 :	*Ability to understand the needs and targets of the different stakeholders (service providers, customers, suppliers/partners) in the services value chain.*	*3*	*80*	*70*	*L*	*H*	*L*	*H*	*L*	*L*	*M*	*L*	*L*	*L*	*M*	*L*	*L*	*L*	*L*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction*	*IT Project/Service Management*	*Communication Management*	*Service management concepts and frameworks*	*Planning and delivery processes*
	SLO-2	*Overview of Service Science, Management, Engineering*				
S-2	SLO-1	*IT Infrastructure*	*Planning*	*Team Building in IT Services*	*Services and service management*	*Service reporting*
	SLO-2					
S-3	SLO-1	*RFID Applications*	*Estimating*	*IT service project in a start-up company*	*Customer-facing services*	*Service availability and continuity management*
	SLO-2					
S-4	SLO-1	*Data Storage Management*	*Resourcing*	*Smaller IT service organization*	*Resource-facing services*	*Capacity management*
	SLO-2					
S-5	SLO-1	*IT Service Strategy*	*IT Project/Service Change*	*Soft Skills in IT Service Management*	*The service lifecycle. Processes. Functions. Roles*	*Information security management*
	SLO-2					
S-6	SLO-1	*Approach, and Practice*	*Quality*	*Presentation skills*	*Service strategy*	*Customer relationship management*

	SLO-2					
S-7	SLO-1	*IT Infrastructure Library*	*Issue*	*Negotiation skills*	*Service portfolio*	*Supplier relationship management.*
	SLO-2					
S-8	SLO-1	*e-Business Case Study*	*Risk Management*	*Job interview skills*	*Service catalog management*	*Service management tools*
	SLO-2					
S-9	SLO-1	*IT service report of IBM e-business at Ford Motor*	*Evaluate issue, and mitigate risk in IT service management*	*IBM perspectives of IT Service Management*	*Service level agreements.*	*Tool assessment framework*
	SLO-2				*Operational level agreements*	*Analysis of specific ITSM tools*

Learning Resources	1. Service Management, Fourth Edition, J.A. Fitzsimmons and M.J. Fitzsimmons, McGraw Hill. 2. Services Marketing, Valerie Zeithaml, Mary Jo Bitner, and Dwayne Gremler, McGraw-Hill. 3. Introduction to Operations Research, Hillier and Lieberman	4. Service modeling, Principles and Applications. Vilho Råisånen, Wiley 5. Understanding Service Business, S.E. Sampson, Wiley.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Kesawan HCL Technologies	*Dr. Surendran Rajendran* *AMA International University Bahrain*	*1. Dr.M.B Mukesh Krishnan, SRMIST*
Mr.Celeian, Symantec		*2. Mr.C.Santhanakrishnan, SRMIST*
		3. Mr. G. Senthil Kumar , SRMIST

Course Code	18CSE464T	Course Name	COMPUTER GRAPHICS AND GAME PROGRAMMING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the fundamental concepts of generating basic output primitives*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Know the basics of transformations and curves and surface representations*			
CLR-3 :	*Know the various visible surface detection methods and various color models*			
CLR-4 :	*Learn the interfaces of Unity and its installation procedure*			
CLR-5 :	*Know the various objects in Unity to develop games*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Have a very good understanding of generating various output primitives*	2	80	85	-	-	H	-	-	-	-	-	-	-	-	-	-	M	-
CLO-2 :	*Posses the ability to represent various curves and surfaces*	2	75	80	-	-	-	-	-	-	-	-	-	-	-	-	-	M	-
CLO-3 :	*Have a clear understanding of various visible surface detection algorithms and color models*	2	85	80	-	-	-	-	-	-	-	-	-	-	-	-	-	M	-
CLO-4 :	*Apply the knowledge to install and explore the interfaces of Unity*	2	80	75	-	-	H	-	H	-	-	-	H	-	-	-	-	-	-
CLO-5 :	*Possess the ability to design and implement games using Unity*	2	75	85	-	-	H	-	H	-	-	-	H	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Graphics systems Overview and IO devices*	*Basic Three-Dimensional Concepts*	*Classification of visible surface detection Algorithms*	*Introduction to Unity Installation and its interface*	*Concept of collisions*
	SLO-2					
S-2	SLO-1	*Applications of Computer Graphics*	*Clipping operations-Point, Line and Polygon*	*Back-face detection, Depth buffer method and A-buffer method*	*Game objects, 2D&3D and its transformation*	*Introduction to Prefabs*
	SLO-2					
S-3	SLO-1	*Line drawing algorithms*	*Curve, Text and Exterior Clipping*	*Scan line method, Depth sorting method, BSP and Area sub division method*	*Fundamentals of models, materials and shaders*	*Handling sprites and adding UI to the game*
	SLO-2					
S-4	SLO-1	*Circle drawing algorithms*	*Polygon Clipping algorithms*	*Octree, Ray casting method and curved surfaces*	*How to sculpt terrain*	*Basics of particle systems*
	SLO-2					
S-5	SLO-1	*Ellipse drawing algorithms*	*Plane equations and meshes*	*Basic models of illumination*	*Adding environments*	*Basics of animation*
	SLO-2					
S-6	SLO-1	*Filled area primitives*	*Curved line& surfaces*	*Halftone and ditheringtechniques*	*Using lights*	*Designing a complex game*
	SLO-2					
S-7	SLO-1	*Basics of Geometric transformations*	*Quadratic surfaces and Blobby objects*	*Properties of Light, RGB Color Model*	*Using cameras*	*Basics of audio in Unity*
	SLO-2					
S-8	SLO-1	*Reflection and shearing -2D*	*Fractals*	*YIQ, and CMY color model*	*Designing a basic game*	*Basics of audio in Unity*

	SLO-2					
S-9	SLO-1	*2D viewing and window to viewport*	*Bezier and B-Spline curves and surfaces*	*HSV and HLScolor model, Color selection*	*Introduction to scripting*	*Requirements for mobile game development*
	SLO-2					

Learning Resources	1. *Donald Hearn & M.PaulineBaker,"Computer Graphics C Version", 2nd Edition, Pearson Education, 2010, ISBN 978-93-325-3587-9* 2. *John F.Hughes, Andries VanDam, Morgan McGuire, David F.Sklar, James D.Foley, Steven K.Feiner, KurtAkeley, "Computer Graphics: Principles and Practice",3rd Edition, Addison-Wesley Professional, 2013, ISBN-13: 0785342399523* 3. *Mike Geig, "Unity 2018 Game Development in 24 Hours, Sams Teach Yourself " 3rd Edition, Pearson Education, 2018, ISBN-13:978-0134998138, ISBN-10:0134998138*	4. *Joseph Hocking, "Unity in Action: Multiplatform game development in C#", 2nd Edition, Manning Publications Company, ISBN: 9781617294969* 5. *Dr. Edward Lavieri, "Getting Started with Unity 2018 - Third Edition: A Beginner's Guide to 2D and 3D game development with Unity ", Packt Publishing Ltd., 2018, ISBN-10: 1788830105, ISBN-13: 978-1788830102.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Valiyullasha, Bugtreat Technologies, UK, coe@bugtreat.com	*C.M.T.Karthigeyan, Assistant Professor, Government College of Engineering, Bargur, email: c.m.t.karthikeyan@gcebargur.ac.in*	*P.Rajasekar, Assistant Professor, Department of Information Technology, Faculty of E&T,&SRMIST, email: rajasekp@srmist.edu.in*

Course Code	18CSE465T	Course Name	COMPUTATIONAL MEDIA	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the fundamental concepts of analog and digital data*			
CLR-2 :	*Know the basics of bitmap, DCT and color models*			
CLR-3 :	*Learn the various tools for digital image processing*			
CLR-4 :	*Know the basics of digital audio representation*			
CLR-5 :	*Understand the concepts of video and its compression methods*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Have a very good understanding of analog and digital data*	*2*	*80*	*85*
CLO-2 :	*Have a clear understanding of bitmap, DCT and color models*	*2*	*75*	*80*
CLO-3 :	*Possess the ability to handle various tools for digital image processing*	*2*	*85*	*80*
CLO-4 :	*Apply the knowledge to represent digital audio*	*2*	*80*	*75*
CLO-5 :	*Possess the ability to compress the video*	*2*	*75*	*85*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	-	-	*H*	-	-	-	-	-	-	-	-	-	-	*M*	-
CLO-3 :	-	-	*H*	-	-	-	-	-	-	-	-	-	-	*M*	-
CLO-4 :	-	-	*H*	-	*H*	-	-	-	*H*	-	-	-	-	*M*	-
CLO-5 :	-	-	*H*	-	*H*	-	-	-	*H*	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction*	*Bitmaps- Frequency in digital images*	*Tools for digital image processing*	*Introduction of digital audio representation*	*Tools for digital audio processing*
	SLO-2					
S-2	SLO-1	*Analog to digital conversion*	*Discrete Cosine Transform*	*Digital image file types*	*Audio waveforms*	*Dynamics processing- Audio restoration*
	SLO-2					
S-3	SLO-1	*Data storage*	*Aliasing*	*Indexed colors - Dithering*	*Pulse code modulation & audio digitization*	*Digital audio filters and related processing*
	SLO-2					
S-4	SLO-1	*Data Communication*	*Color models*	*Channels, layers and masks*	*Sampling rate and aliasing*	*Pulse code modulation & audio digitization*
	SLO-2					
S-5	SLO-1	*Data Communication*	*Color models*	*Blending modes*	*quantization and quantization error*	*Designing and implementing your own file*
	SLO-2					
S-6	SLO-1	*Compression methods*	*Color models*	*Pixel point processing*	*Frequency analysis*	*Digital audio compression*
	SLO-2					
S-7	SLO-1	*Compression methods*	*Vector graphics*	*Spatial filtering*	*Frequency analysis*	*Fundamental concepts in video*
	SLO-2					
S-8	SLO-1	*Standards and standardization organizations*	*Vector graphics*	*Resampling and interpolation*	*Statistical analysis of an audio file*	*Basic video compression*
	SLO-2					
S-9	SLO-1	*Mathematical modeling tools for the study of digital media*	*Algorithmic art and procedural modeling*	*Digital image compression*	*MIDI*	*MPEG 1 and 2*
	SLO-2					

Learning Resources	1. *Jennifer Burg, "The Science of Digital Media", Pearson Education, ISBN: 978-01324335802* 2. *Ze-Nian Li and Mark.s.Drew, "Fundamentals of Multimedia", Pearson Education International, ISBN 0-13-127256-X*	3. *Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Pearson Education India, 2002, ISBN-10: 8131709949 and ISBN-13: 978-8131709948*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Valiyullasha, Bugtreat Technologies, UK, coe@bugtreat.com	*C.M.T.Karthigeyan, Assistant Professor, Government College of Engineering, Bargur, email: c.m.t.karthikeyan@gcebargur.ac.in*	*P.Rajasekar, Assistant Professor, Department of Information Technology, Faculty of E&T,&SRMIST, email: rajasekp@srmist.edu.in*

Course Code	18CSE345T	Course Name	INTERNET OF THINGS ARCHITECTURE AND PROTOCOLS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand Data and Knowledge Management and use of Devices in IoT Technology.*			
CLR-2 :	*Understand State of the Art – IoT Architecture.*			
CLR-3 :	*To Understand the Architectural Overview of IoT*			
CLR-4 :	*Understand the IoT Reference Architecture and RealWorld Design Constraints*			
CLR-5 :	*To Understand the various IoT Protocols (Datalink, Network, Transport, Session, Service)*			
CLR-6 :	*Understand and apply IoT protocols appropriately*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Interpret the vision of IoT architecture from a global context.*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Implement state of the art architecture in IoT.*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Compare and Contrast the use of Devices, Gateways and Data Management in IoT.*	*2*	*85*	*80*	*H*	*M*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Implement using the available resources and demonstrate quick to deployment protocols wherever applicable*	*2*	*80*	*75*	*H*	*H*	*H*	*M*	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Apply the protocols and Techniques towards integration in relevant areas of IoT Product development*	*2*	*75*	*85*	*H*	*M*	*H*	*M*	*H*	-	-	-	*M*	-	-	*H*	-	-	-
CLO-6 :	*Choose appropriate protocols for various layers (Datalink, Network, Transport, Session, Service)*	*2*	*80*	*85*	*H*	*M*	*H*	*H*	*H*	-	-	-	*H*	-	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*M2M and IoT- Relevance and Transition*	*Data Management- Introduction*	*Introduction to RFID*	*Transport Layer Protocols - Introduction*	*Service Layer Protocols- Introduction*
	SLO-2	*Building an architecture*	*Managing M2M data: Data generation,*	*Introduction to NFC*	*TCP*	*oneM2M*
S-2	SLO-1	*Main design principles and needed capabilities*	*Data acquisition, Data validation*	*WSN(Large topic),*	*MPTCP*	*ETSI M2M*
	SLO-2	*IoT architecture outline*	*Data storage, Data processing*	*Narrow band IoT (NbIOT)*	*UDP*	*OMA*
S-3	SLO-1	*M2M and IoT Technology Fundamentals*	*Data remanence, Data analysis*	*WiFi*	*DCCP*	*BBF*
	SLO-2	*Devi ces and Gateways-Introduction*	*Data management,*	*PLC Communication Protocols: A comparison*	*SCT*	*Understanding Security and Interoperability*
S-4	SLO-1	*Basic Devices*	*Business processes in IoT*	*Popular radio protocols and its security drawbacks*	*TLS*	*Modes of attack: DoS, Getting Access, Guess, Man in Middle, Sniff, Post Scan*
	SLO-2	*Gateways*	*Everything as a Service (XaaS)*	*802.15.4 in depth*	*DTLS*	*Modes of attack: Web Crawl, Search Features and Wild Cards, Breaking Cipher*
S-5	SLO-1	*Advanced devices*	*M2M and IoT Analytics*	*Network Layer Protocols- Introduction*	*Session Layer-HTTP*	*Tools for achieving Security: VPN, X.509, Authentication,*
	SLO-2	*Need for networking*	*Knowledge Management*	*IPv4*	*CoAP*	*Tools for achieving Security: User names and Passwords, Message Brokers,*
S-6	SLO-1	*State of the art-ETSI M2M*	*Data Link Layer Protocols: PHY/MAC Layer:3GPP MTC*	*IPv6*	*Implementation demo of CoAP*	*Tools for achieving Security: Provisioning servers, Centralization versus decentralization,*

	SLO-2	*IoT Reference model-IoT Domain model*	*IEEE 802.11*	*6LoWPAN in depth*	*MQTT*	*The need for interoperability:*
S-7	SLO-1	*Information model*	*IEEE 802.15*	*6TiSCH*	*Implementation demo of MQTT*	*Combining Security and Interoperability*
	SLO-2	*Functional model*	*Wireless HART*	*ND*	*MQTT-SN*	*Need for Security in IoT Protocols – Introduction*
S-8	SLO-1	*Communication model*	*Z-Wave*	*DHCP*	*Implementation demo of MQTT-SN*	*Security in IoT Protocols :MAC 802.15.4*
	SLO-2	*Safety, privacy, trust, security model*	*Bluetooth, Bluetooth Low Energy*	*ICMP*	*XMPP*	*Security in IoT Protocols :6LoWPAN,*
S-9	SLO-1	*Introduction to Protocols- Physical, Data Link*	*Zigbee, Zigbee Smart Energy*	*RPL*	*AMQP*	*Security in IoT Protocols :RPL*
	SLO-2	*Introduction to Protocols- Network, Transport, Application*	*DASH7*	*CORPL, CARP*	*Introduction to Contiki- Practical demo*	*Security in IoT Protocols: Application Layer*

Learning Resources	1. *Uckelmann, D., Harrison, M., & Michahelles, F. (Eds.). Architecting the Internet of Things.doi:10.1007/978-3-642-19157-2 , 2011* 2. *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by Rob Barton, Gonzalo Salgueiro, David Hanes, Publisher: Cisco Press, Release Date: June 2017, ISBN: 9780134307091 (https://www.oreilly.com/library/view/iot-fundamentals-networking/9780134307091/)* 3. *Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014*	4. *Peter Waher, "Learning Internet of Things", PACKT publishing, BIRMINGHAM – MUMBAI* 5. *Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118- 47347-4, Willy Publications*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Vinay Solanki, Head IoT, Lenovo (APAC & MEA)	*Dr.Zayaraj, Professor / CSE, PEC, Pondicherry*	*Dr. S.Babu, SRMIST*
Dr. Paventhan Arumugum, Director (R&D), ERNET India	*Dr.Vijalakshmi Associate Professor / CSE, PEC, Pondicherry*	*Dr.Kayalvizhi Jayavel, SRMIST*
Shiv Kumar Ganesh, Full Stack Developer, Altimetrik	*Dr.P.Yogesh, Professor/IT, Anna University, Chennai.*	*Mr.V.Haribaabu, SRMIST*

Course Code	18CSE346T	Course Name	NETWORK PROGRAMMING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*18CSC302J*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1 :	*To learn different socket function and implement client server applications using sockets*
CLR-2 :	*To conduct experiments to know how different internet protocols like TCPIP works*
CLR-3 :	*To analyze various application program like TELNET, DNS, DHCP*
CLR-4 :	*Build different application like Routing, Load balancing & Security*
CLR-5 :	*To apply protocols get adapted to emerging technologies*

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Become familiar with elementary socket functions*	*3*	*80*	*70*
CLO-2 :	*Design and implement client –server applications using Sockets*	*3*	*85*	*75*
CLO-3 :	*Learn about functions that convert between names and numeric values and protocols*	*3*	*75*	*70*
CLO-4 :	*Analyze network programs*	*3*	*85*	*80*
CLO-5 :	*Build network applications*	*3*	*85*	*75*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
L	*H*	-	*H*	*L*	-	-	-	*L*	*L*	-	*H*	-	-	-
M	*H*	*L*	*M*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
M	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
M	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
H	*H*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction*	*Socket function*	*Get sock opt function*	*DNS*	*Internet Protocol*
	SLO-2	*simple daytime client*	*connect function*	*set sock opt function*	*resolvers and name servers*	
S-2	SLO-1	*protocol independence*	*bind function*	*IPV4*	*gethostbyname function*	*IPV4*
	SLO-2	*Error handling*	*listen function*	*ICMP*	*gethostbyaddr function*	
S-3	SLO-1	*simple daytime server*	*accept function*	*TCP socket options*	*getservbyname*	*IPV6 interoperability*
	SLO-2	*Roadmap to client/server.*	*Fork function*		*getservbyport function*	
S 4-5	SLO-1	*Overview of TCP/IP protocol- TCP*	*exec function*	*UDP Echo server and client*	*tcp_connect function-*	*Daemon processes*
	SLO-2	*connection establishment and termination*				
S-6	SLO-1	*TCP state transition diagram – Time-wait state*	*concurrent servers*	*recvfrom function*	*tcp_listen function*	*Daemon processes and the inetdsuperserver*
	SLO-2	*SCTP association establishment and termination*	*close function-getsockname and getpeername*	*send to function*	*udp_client*	
S-7	SLO-1	*TCP port numbers and concurrent servers*	*TCP Echo server, TCP Echo client*	*Connect function with UDP*	*udp_connect*	*Advanced I/O functions*
	SLO-2	*Buffer size and limitations*	*normal startup and termination*		*udp_server function*	
S 8-9	SLO-1	*standard internet services*	*POSIX signal handling, Wait and Waitpid functions*	*dg_cli function*	*BOOTP*	*Advanced I/O functions*
	SLO-2	*protocol usage by common,Internet applications*	*Termination of server process, Crashing and rebooting of server host*	*lack of flow control with UDP*	*DHCP*	

Learning Resources	1. *W.Richard Stevens, Bill Fenner, Andrew M. Rudoff " Unix Network programming " 3rd edition, Volume – 1, Pearson Education , 2015 R.F.Gilberg, B.A.Forouzan, Data Structures, 2nd ed., Thomson India, 2005* 2. *Douglas.E.Comer " Internetworking with TCP/IP " principles, protocols and architecture, 6th Edition , Volume 1, Pearson Education,2013*	3. *Behrouz A.Forouzan , " TCP/IP protocol suite", 4th edition, Mc Graw Hill education private limited,2010* 4. *Wendell Odom , " IP networking ", 1st edition, Pearson Education 2012*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr.Viswanadham, Teken BIM Technologies Pvt. Ltd, 9962514477, Viswanathan_alladi@yahoo.com	*Dr. Latha, Prof & Head, CSE dept, SAIRAM engg college,latha.cse@sairam.edu.in, 8754502224*	*1. MrsT.Manoranjitham, SRMIST*
		2. Mr. Godwin , SRMIST
		3. Ms. Vinoth, SRMIST

Course Code	18CSE445T	Course Name	INTERNET OF THINGS SECURITY	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the fundamentals, various attacks and importance of Security aspects in IoT*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Understand the techniques, protocols and some idea on security towards Gaming models*			
CLR-3 :	*Understand the relevance of Blockchain, its techniques towards IoT*			
CLR-4 :	*Understand the operations of Bitcoin blockchain, crypto-currency as application of blockchain technology*			
CLR-5 :	*Understand the essential components of IoT*			
CLR-6 :	*Understand security and privacy challenges of IoT*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Incorporate the best practices learnt to identify the attacks and mitigate the same*	*3*	*80*	*70*
CLO-2 :	*Adopt the right security techniques and protocols during the design of IoT products*	*3*	*85*	*75*
CLO-3 :	*Apply the skills learnt towards gaming designs*	*3*	*75*	*70*
CLO-4 :	*Assimilate and apply the skills learnt on cipers and blockchains when appropriate*	*3*	*85*	*80*
CLO-5 :	*Describe the essential components of IoT*	*3*	*85*	*75*
CLO-6 :	*Find appropriate security / privacy solutions for IoT*	*3*	*80*	*70*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*L*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-2 :	*L*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-3 :	*L*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-4 :	*L*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-5 :	*L*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-
CLO-6 :	*L*	*H*	*M*	*H*	*M*	-	-	-	*M*	*L*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Fundamentals of IoT and Security and its need*	*Prevent Unauthorized Access to Sensor Data*	*Block ciphers*	*Introduction to Blockchain*	*Introduction of IoT devices*
	SLO-2	*IoT Security Requirements*	*,M2M Security,*	*Message integrity*	*Modeling faults and adversaries*	*Difference among IoT devices, computers, and embedded devices.*
S-2	SLO-1	*IoT and cyber-physical systems*	*RFIDSecurity,*	*Authenticated encryption*	*Byzantine Generals problem*	*sensors and actuators in IoT*
	SLO-2	*IoT security (vulnerabilities, attacks, and countermeasures),*	*Cyber Physical Object Security, ,*	*Hash functions*	*Consensus algorithms and their scalability problems*	*Accelerometer, photoresistor, buttons*
S-3	SLO-1	*Security engineering for IoT development*	*Hardware Security,*	*Merkle trees and Elliptic curves*	*digital signatures, verifiable random functions, Zero-knowledge systems*	*motor, LED, vibrator,*
	SLO-2	*IoT security lifecycle*	*Front-end System Privacy Protection, Management,Secure IoT Databases*	*Public-key crypto (PKI),*	*blockchain, the challenges, and solutions,*	*analog signal vs. digital signal*
S-4	SLO-1	*Data Privacy*	*Networking Function Security*	*Trees signature algorithms*	*proof of work, Proof of stake,*	*Networking in IoT*
	SLO-2	*Device/User Authentication in IoT*	*IoT Networking Protocols,*	*Crypto-currencies,*	*alternatives to Bitcoin consensus, Bitcoin scripting language and their use*	*Real-time communication*
S-5	SLO-1	*Introduction to Authentication Techniques*	*SecureIoT Lower Layers,*	*Bitcoin P2P network,*	*Ethereum and Smart Contracts,*	*Bandwidth efficiency*
	SLO-2	*Data Trustworthiness in IoT*	*SecureIoT Higher Layers,*	*Distributed consensus, , ,*	*Smart Contract Languages and verification*	*data analytics in IoT - simple data*

					challenges	analyzing methods
S-6	SLO-1	Human IoT Trust Relationship	Secure Communication	Incentives and proof-of-work	comparing Bitcoin scripting vs. Ethereum Smart Contracts	IoT architecture, component and technology
	SLO-2	Trust and Reputation Systems	Links in IoTs,Back-end Security - Secure Resource	Mining, scripts and smart contracts	Hyperledger fabric	Case study: discussion on specific IoT applications and their design considerations
S-7	SLO-1	Trust Negotiation	Game Theory Foundation	Wallets: hot and cold storage ,anonymity, altcoins	Mechanisms in permissioned blockchain	cybersecurity overview in IoT
	SLO-2	IoT Privacy Preservation Issues	Mixed-strategy, ,	Credential management for connected devices: Security credential management system (SCMS),	Pseudo-anonymity vs. anonymity	General cybersecurity concepts in IoT
S-8	SLO-1	Attack Models - Attacks to Sensors in IoTs,	Nash equilibrium	VehicleBased Security System (VBSS),	Zcash and Zk-SNARKS for anonymity preservation	security threats in IoT
	SLO-2	Attacks to RFIDs in IoTs,	Repeated games	PKI design, Certification provisioning	Attacks on Blockchains	data privacy in IoT
S-9	SLO-1	Attacks to Network Functions in IoTs,	Bayesian games	Pseudonyms (privacy-by design),	Sybil attacks, selfish mining	device/User authentication in IoT
	SLO-2	Attacks to Back-end Systems and security in Front end Systems	Coalitional games.	Misbehavior detection and Revocation,	51% attacks	data trustworthiness problem in IoT

Learning Resources	1. B.RusellandD.VanDuren,"PracticalInternetofThingsSecurity,"PacktPublishing,2016. 2. FeiHU,"SecurityandPrivacyinInternetofThings(IoTs):Models,Algorithms,and Implementations", CRCPress,2016 3. Narayanan et al., "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction," Princeton University Press,2016. 4. A.Antonopoulos,"MasteringBitcoin:UnlockingDigitalCryptocurrencies,"O'Reilly,2014	5. T. Alpcan and T. Basar, "Network Security: A Decision and Game-theoretic Approach," Cambridge University Press,2011. 6. SecurityandtheIoTecosystem,KPMGInternational,2015 7. InternetofThings:IoTGovernance,PrivacyandSecurityIssues"byEuropeanResearchCluster 8. Ollie Whitehouse, "Security of Things: An Implementers' Guide to Cyber-Security forInternet of Things Devices and Beyond", NCC Group,2014 9. JoshThompson,'Blockchain:TheBlockchainforBeginnings,GuildtoBlockchainTechnologyand BlockchainProgramming',CreateSpaceIndependentPublishingPlatform,2017.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Understand										
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-	40%	-
	Analyze										
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-	30%	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	Dr.A.Amuthan, Associate Dean, Dept. of CSE, Pondicherry Engg. College, Pondicherry	Dr.M.Murali Dr.Kayalvizhi Jayavel Mr. H.Karthikeyan

Course Code	18CSE446T	Course Name	ADVANCED DATABASE SYSTEMS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Familiarize with the various query processing, join and optimization techniques*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Improve their ability to choose the appropriate techniques for any parallel and distributed database systems*			
CLR-3 :	*Familiarize with the various object based databases techniques*			
CLR-4 :	*Familiarize with the various Motivation, Structure, Storage, Application and Evaluation of XML Queries*			
CLR-5 :	*Expose to the concepts of Performance Tuning, Temporal, Spatial, Multimedia and Mobile data bases*			
CLR-6 :	*Expose to the latest Spatial and Geographic data, R Trees and Multimedia databases*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Acquire the knowledge on query processing, join and optimization on a database*	*2*	*80*	*85*
CLO-2 :	*Acquire the ability to identify & design a parralel and distributed database*	*2*	*75*	*80*
CLO-3 :	*Understand the basic ideas about various object based databases*	*2*	*85*	*80*
CLO-4 :	*Apply the knowledge of XML on various applications*	*2*	*80*	*75*
CLO-5 :	*Appreciate the concepts of Performance Tuning, Temporal, Spatial, Multimedia and Mobile data bases*	*2*	*75*	*85*
CLO-6 :	*Appreciate the concepts of latest Spatial and Geographic data, R Trees and Multimedia databases*	*2*	*80*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	*H*	*L*	*M*	*L*	-	-	-	*M*	*M*	*M*	-	-	-	-
H	*H*	*L*	*M*	*L*	-	-	-	*M*	*M*	*M*	-	-	-	-
H	*M*	*L*	*M*	*L*	-	-	-	*M*	*M*	*M*	-	-	-	-
H	*H*	*L*	*M*	*L*	-	-	-	*M*	*M*	*M*	-	-	-	-
H	*M*	*L*	*M*	*L*	-	-	-	*M*	*M*	*M*	-	-	-	-
H	*M*	-	*M*	*L*	-	-	-	*M*	*M*	*M*	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Overview of query processing*	*Introduction to Parallel Databases*	*Overview of object based databases*	*Introduction to XML*	*Performance Tuning*
	SLO-2	*Measures of query cost*	*I/O parallelism*	*Complex data types*		*Improving set orientation*
S-2	SLO-1	*Selection Operation*	*Interquery Parallelis*	*Structured types in SQL*	*Motivation*	*Tuning of bulk loads and updates*
	SLO-2	*Sorting*	*Intraquery Parallelism*	*Inheritance in SQL*		*Location of bottlenecks*
S-3	SLO-1	*Join Operation-Nested loop join*	*Intraoperation Parallelism*	*Table inheritance*	*Structure of XML data*	*Tunable parameters*
	SLO-2	*Merge join and Hash join*	*Interoperation Parallelism*			*Tuning of hardware*
S-4	SLO-1	*Projection, set operation, Outer join and Aggregation*	*Query Optimization*	*Array and multiset Types in SQL*	*XML document scheme*	*Tuning of the schema and Indices*
	SLO-2	*Evaluation of Expressions*	*Design of Parallel Systems*			*Tuning of Physical design*
S-5	SLO-1	*Overview of query optimization*	*Homogeneous and heterogeneous database*	*Object –identity and reference Types in SQL*	*Querying and transformation*	*Tuning of concurrent transactions*
	SLO-2	*Transformation of relational expressions - Equivalence Rules*	*Distributed data Storage*			*Introduction to Temporal, Spatial, Multimedia and Mobile data bases*
S-6	SLO-1	*Join Ordering*	*Distributed transactions*	*Implementing O-R features*	*Application program interface to XML*	*Performance benchmarks*
	SLO-2	*Enumeration of Equivalent Expression*	*Commit protocols*			*Time in databases*
S-7	SLO-1	*Estimating statistics of expression results Cataloq Information*	*Concurrency control in distributed databases*	*Persistent programming languages – Persistence of objects*	*Storage of XML data*	*Spatial and Geographic data*
	SLO-2	*Selection Size and Join size Estimation*	*Distributed query processing*	*Object identity and pointers*		*Representation of Geographic data*

S-8	SLO-1	*Size Estimation for other Operation,Estimation of Number of Distinct Values*	*Availability*	*Persistent C++ systems*	*XML applications.*	*Spatial Queries*
	SLO-2	*Choice of evaluation plans-Cost based join order Selection*		*Persistent Java systems*		*Indexing of Spatial Data*
S-9	SLO-1	*Cost based optimization with equivalence rules*	*Heterogeneous distributed databases.*	*Object-relational mapping*	*Evaluation of XML Queries*	*R Trees*
	SLO-2	*Heuristics in optimization, Optimizing Nested Sub queries*		*Object-oriented versus object-relational.*		*Multimedia databases*

Learning Resources	1. Abraham Silberscatz, Henry F Korth, S Sudarshan, "Database System Concepts", McGraw Hill Education –2013 2. RaghuRamakrisgnan,"DatabaseManagementSystems",-McGrawHillEducation-2014	3. Elmasri Navathe, Somayajulu, Gupta, "Fundamentals of Database Systems, Pearson Education, 4th Edition, 2006 4. CJDate,AKannan,SSwamynathan,"AnIntroductiontoDatabaseSystems",PearsonEducation,8th Edition, 2006

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.Mariappan Vaithilingam, Engineering Leader Amazon, dr.v.m@ieee.org		*1. Mr. Elizer, SRMIST*
2. Mr. Badinath, SDET, Amzon, sbadhrinath@gmail.com		*2. Mrs. Sasi Rekha Sankar, SRMIST*
		3. Ms. Hemavathy, SRMIST

Course Code	18CSE447T	Course Name	EDGE COMPUTING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the concepts of IoT*
CLR-2 :	*Understand the IoT and M2M Communication*
CLR-3 :	*Understand the protocols and standards of IoT*
CLR-4 :	*Understand the Fog computing Architecture and its components*
CLR-5 :	*Understand the integration of Fog and Cloud Computing*
CLR-6 :	*Understand the concepts of IoT*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning 1: Level of Thinking (Bloom)	Learning 2: Expected Proficiency (%)	Learning 3: Expected Attainment (%)	PLO 1: Engineering Knowledge	PLO 2: Problem Analysis	PLO 3: Design & Development	PLO 4: Analysis, Design, Research	PLO 5: Modern Tool Usage	PLO 6: Society & Culture	PLO 7: Environment & Sustainability	PLO 8: Ethics	PLO 9: Individual & Team Work	PLO 10: Communication	PLO 11: Project Mgt. & Finance	PLO 12: Life Long Learning	PLO 13: PSO - 1	PLO 14: PSO - 2	PLO 15: PSO – 3
CLO-1 :	*Apply concepts of IoT*	3	80	70	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H
CLO-2 :	*Apply the M2M protocol in IoT.*	3	85	75	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H
CLO-3 :	*Equip themselves familiar with Fog computing in IoT*	3	75	70	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H
CLO-4 :	*Familiarize with IoT standard and protocols*	3	85	80	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H
CLO-5 :	*Acquaint with Fog and Cloud computing in IoT*	3	85	75	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H
CLO-6 :	*Apply concepts of IoT*	3	80	70	H	L	H	M	H	H	H	H	H	H	M	H	H	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to IoT*	*IoT Architecture*	*Fog Computational Model*	*BIG DATA*	*Case Study-1: Edge analytics in Irrigation System*
	SLO-2	*Technologies in IoT*	*Data Acquisition, Data Aggregation and Data Analysis*	*Fog Simulators*	*Data Types in Big data*	*Machine Learning in Edge for automation in Irrigation system*
S-2	SLO-1	*IoT Applications- Smart Home, Wearable, Connected Cars, Industrial IoT*	*IoT Protocols- COAP, MQTT*	*iFogSim*	*Characteristics of BIG DATA*	*Case study 2: Edge analytics for Water Quality Monitoring*
	SLO-2	*Smart Cities, Agriculture, Smart Retail, smart Grid, Healthcare*	*XMPP, AMQP, Low power Lossy Network routing*	*FogTorch*	*Benefits of Big Data*	*Machine Learning in Edge for automation in water quality monitoring*
S-3	SLO-1	*Challenges in IoT- Delivering Value to Customers, Hardware Compatibility Issues, Data Connectivity Issues*	*Communication Methods- Bluetooth, Zigbee Z-wave, 6LowPAN*	*Cisco IoX and Fog Application*	*Big Data Application-*	*Case Study 3: IoT- Edge system for Hydroponics system*
	SLO-2	*Incorrect Data Capture Capabilities, Analytic Challenges, Data Security challenges,*	*Wireless Fidelity*	*Contiki/Cooja*	*Layered Big Data Architecture- Data Ingestion, Data collection, Data Processing Layer*	*Deep Learning in Edge for automation in hydroponics system*
S 4-5	SLO-1 SLO-2	*Introduction to Edge Computing*	*4G*	*NS3*	*Data storage, Data Query and Visualization Layer*	*Case Study 4: IoT-Edge for Smart Energy Management*
S-6,7	SLO-1	*Need for Edge Computing- Improved Performance , Compliance, Data Privacy, And Data Security*	*Sigfox, NeUL*	*Software Defined Multi-Tier Fog Architecture*	*Big Data Implementation- Hortonworks, Cloudera, MAP R*	*Case Study 5: IoT- Edge for water demand forecasting*

	SLO-2	*Reduced Operational Cost*	*LoRaWAN*	*PVFOg simulator*	*Apache Projects for Big Data*	*Demand forecasting at Edge*
S-8,9	SLO-1	*Challenges in Edge/Fog Computing*	*5G*	*System Model analysis*	*Edge Computing for Big Data*	

Learning Resources	1. *Ashton Kevin, (2009), "That Internet of Things Thing," RFID Journal, pp. 4986.* 2. *Maria Rita Palattella et al., (2013), "Standardized protocol stack for the internet of (important) things," IEEE Communications Surveys and Tutorials, 15(3), pp. 1389–1406.* 3. *D. Airehrour, J. Gutierrez and S. K. Ray, (2016), "Secure routing for internet of things: A survey," Journal of Network and Computer Applications, 66, pp. 198–213.* 4. *Reem Abdul Rahman and Babar Shah, (2016), "Security analysis of IoT protocols: A focus in CoAP," 2016 3rd MEC International Conference on Big Data and Smart City, ICBDSC 2016, pp. 172–178..* 5. *Flavio Bonomi, Rodolfo Milito, Jiang Zhu and Sateesh Addepalli, (2012), "Fog Computing and Its Role in the Internet of Things," Proceedings of the first edition of the MCC workshop on Mobile cloud computing, pp. 13–16.* 6. *Weisong Shi, Jie Cao, Quan Zhang, Youhuizi Li and Lanyu Xu, (2016), "Edge Computing: Vision and Challenges," IEEE Internet of Things Journal, 3(5), pp. 637–646.* 7. *M. Mukherjee et al., (2017), "Security and Privacy in Fog Computing: Challenges," IEEE Access, 5, pp. 19293–19304.* 8. *Jie Cao, Quan Zhang and Weisong Shi, (2018), "Challenges and opportunities in edge computing," SpringerBriefs in Computer Science, pp. 59–70.* 9. *Martina Marjanovic, Aleksandar Antonic and Ivana Podnar Zarko, (2018), "Edge computing architecture for mobile crowd sensing," IEEE Access, 6, pp. 10662–10674.* 10. *Hesham El-Sayed et al., (2017), "Edge of Things: The Big Picture on the Integration of Edge, IoT and the Cloud in a Distributed Computing Environment," IEEE Access, 6, pp. 1706–1717* 11. *Huaqing Zhang, Yong Xiao, Shengrong Bu, Dusit Niyato, F. Richard Yu and Zhu Han, (2017), "Computing Resource Allocation in Three-Tier IoT Fog Networks: A Joint Optimization Approach Combining Stackelberg Game and Matching," IEEE Internet of Things Journal, 4(5), pp. 1204–1215* 12. *Veeramanikandan M. and Suresh Sankaranarayanan, (2019), "Publish/subscribe based multi-tier edge computational model in Internet of Things for latency reduction," Journal of Parallel and Distributed Computing, 127, pp. 18–27.* 13. *Ashfaq Farooqui, Kristofer Bengtsson, Petter Falkman and Martin Fabian, (2019), "From factory floor to process models: A data gathering approach to generate, transform, and visualize manufacturing processes," CIRP Journal of Manufacturing Science and Technology, 24, pp. 6–16.* 14. *Hongbing Wang, Chao Yu, Lei Wang and Qi Yu, (2018), "Effective BigDataspace service selection over trust and heterogeneous QoS preferences," IEEE Transactions on Services Computing, 11(4), pp. 644–657.* 15. *Pekka Pääkkönen and Daniel Pakkala, (2015), "Reference Architecture and Classification of Technologies, Products and Services for Big Data Systems," Big Data Research, 2(4), pp. 166–186* 16. *Tom White, (2015), "Hadoop: The Definitive Guide, 4th Edition," O'Reilly Media, Inc., (2015).* 17. *Team Hortonworks, "Hortonworks," [Online]. Available: https://hortonworks.com/.* 18. *Cloudera, "Cloudera," [Online]. Available: https://www.cloudera.com/about.html.* 19. *The Apache Software Foundation, "Apache Ni-Fi," [Online]. Available: https://nifi.apache.org/.* 20. *The Apache Software Foundation, "Apache Kafka," [Online]. Available: https://kafka.apache.org/.* 21. *The Apache Software Foundation, "Kafka Use cases," [Online]. Available: https://kafka.apache.org/uses.* 22. *The Apache Software Foundation, "Apache Storm," [Online]. Available: https://storm.apache.org/.* 23. *The Apache Software Foundation, "Apache Hive," Apache. [Online]. Available: https://hive.apache.org/.* 24. *The Apache Software Foundation, "Apache Pig." [Online]. Available: https://pig.apache.org/.* 25. *Alan Gates and Daniel Dai, (2016),"Programming Pig: Dataflow Scripting with Hadoop," Shroff/O'Reilly.* 26. *The Apache Software Foundation, "Zookeeper," [Online]. Available: https://zookeeper.apache.org/* 27. *Shangguang Wang, Yali Zhao, Jinlinag Xu, Jie Yuan and Ching Hsien Hsu, (2019), "Edge server placement in mobile edge computing," Journal of Parallel and Distributed Computing, 127, pp. 160–168.* 28. *Yuthika, S, Ekta Dagur, Sourabh Mishra, Rijo Jackson Tom, Veeramanikandan,M and Suresh,S, "Intelligent IoT Based Automated Irrigation System", International Journal of Applied Engineering and Research, Vol.12(18), pp.7306-7320, 2017* 29. *Soundarya, P, Parthyusha, V, Niharika, A .V, Karthick, T and Suresh,S, "Intelligent IoT Based Water Quality Monitoring System", International Journal of Applied Engineering and Research, Vol.12(16), pp.5447-5454, 2017* 30. *Manav,M, Sameer,S, Suresh,S, Tom, R J and Veeramanikandan,M, "IoT Based Hydroponics System using Deep Neural Networks", Journal of Computers and Electronics in Agriculture, Vol.155,pp.473-486, 2018, Elsvier Publishing* 31. *Vignesh, M , Lavanya, V, Abhilasha,K, Gunasekhar,A and Suresh, S, "IoT Based Smart Energy Management System", International Journal of Applied Engineering and Research, Vol.12(16), pp.5455-5462, 2017*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr.Madan Lakshmanan	*Dr.Subra Ganesan*	*Dr.S.Suresh*
Senior Scientist	*Professor, Department of Electrical and Computer Engineering*	*Dr.J. Sujithra*
CEERI, CSIR, Chennai (R&D Industry)	*Oakalnd University, USA*	

Course Code	18CSE448T	Course Name	ENERGY MANAGEMENT FOR INTERNET OF THINGS DEVICES	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the rudiments of energy conservation and IoT*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Gain the knowledge on various energy conservation schemes in IoT*			
CLR-3 :	*Utilize the conventional and optimization algorithms for conserving energy in IoT devices*			
CLR-4 :	*Understand the various techniques of green IoT and impact of conventional techniques of IoT*			
CLR-5 :	*Gain the knowledge on existing energy efficient architecture for energy conservation and harvesting*			
CLR-6 :	*Gain the knowledge on low energy Bluetooth devices and its importance*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)													
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge on IoT and energy conservation approaches in IoT*	*2*	*80*	*85*	*H*	*M*	*M*	*M*	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Identify and choose appropriate energy conservation component for real world problems*	*2*	*75*	*80*	*H*	*M*	*M*	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Design and develop energy conservation algorithms for improving the lifetime of IoT devices*	*2*	*85*	*80*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Compare and contrast of various green IoT techniques and able to design green IoT for real world problems*	*2*	*80*	*75*	*H*	*M*	*H*	*H*	-	-	-	-	-	-	-	*M*	-	-	-
CLO-5 :	*Design and develop energy efficient architecture for real world problems*	*2*	*75*	*85*	*H*	*H*	*H*	*H*	-	-	-	-	-	-	-	*M*	-	-	-
CLO-6 :	*Design and develop energy efficient architecture for real world problems using low energy Bluetooth devices*	*2*	*80*	*85*	*H*	*M*	*M*	*M*	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to IoT*	*Energy conservation schemes*	*Static energy efficient algorithms*	*Green IoT an Overview*	*Designing energy efficient IoT based Intelligent Transport System*
	SLO-2	*Architecture of IoT*	*Sleep/wakeup scheme*	*Exact allocation algorithm*	*Smart Homes, Smart Cities*	*Intelligent Transport System*
S-2	SLO-1	*Components of IoT*	*Data driven scheme*	*Best Fit Heuristic Algorithm*	*Energy Efficient smart health care*	*Motivations for IoT in Transportation*
	SLO-2	*Applications of IoT*	*Mobility based scheme*	*Dynamic energy efficient algorithms*	*Importance of Green IOT*	*Communication Technology and Related Power Issues*
S-3	SLO-1	*Challenges in IOT*	*Load balancing*	*Hardware Level Solution*	*Taxonomy of green IoT techniques*	*Information Extraction and Underlying Power Issues*
	SLO-2	*Energy Management in IoT*	*Working of load balancing*	*Dynamic Voltage Frequency Scaling (DVFS)*	*Various Approaches to Achieve Green IoT*	*Energy Efficiency Challenges and Corresponding Solutions, Further Challenges and Opportunities*
S-4	SLO-1	*Energy harvesting*	*Hardware based load balancing*	*Software Level Solution*	*software based green IoT techniques*	*Capacity Estimation of Electric Vehicle Aggregator for Ancillary Services*
	SLO-2	*Block diagram of energy harvesting*	*Software Based Load Balancing*	*First Fit Decreasing algorithm (FFD)*	*Hardware based green IoT techniques*	*Development of Electric Vehicles*
S-5	SLO-1	*Various ambient energies*	*Compare hardware and software based load balancing techniques*	*Modified Best Fit Decreasing algorithm (MBFD)*	*Policy based techniques*	*Motivation for Vehicle to Everything (V2X) and V2G Technology*
	SLO-2	*Energy harvesting schemes*	*Load balancing algorithms*	*Genetic Algorithm (GA)*	*Awareness based Approach - Toward Green IoT, Energy Awareness*	*Electric Vehicles and Solar Power Plants in Smart Grid Environment*

S-6	SLO-1	*Harvesting modules*		*Particle Swarm Optimization (PSO)*	*IoT Based Smart Metering*	*Potential of EV to Grid Connection, Capacity Estimation of Aggregator*
	SLO-2	*Rectenna Model*	*Static Algorithms, Dynamic Algorithms*	*Ant Colony Optimization (ACO)*	*Communication Technology Creating Awareness About Green Information, PromotingRecycling*	*Battery Management System, Grid Connection and Performance Testing of V2G*
S-7	SLO-1	*Sensing antenna*	*Issues of energy conservation in IoT*	*Simulated Annealing (SA)*	*Habitual Based Techniques*	*Weather monitoring using Bluetooth Low Energy (BLE) in warehouses*
	SLO-2	*DC-DC Converter*		*Cat Swarm Optimization(CSO)*	*Comparative analysis of different green IoT approaches*	*BLE Introduction*
S-8	SLO-1	*Wireless energy harvesting*	*Basic model of smart home system*	*Hybrid Genetic Algorithm and Cat Swarm Optimization (HGACSO)*	*Case study: impact of smart phones on the environment in present and future trends*	*BLE importance*
	SLO-2	*Near Field Communication, Inductive coupling*	*Energy Conservation in Smart Home and IoT*	*Hybrid Genetic Algorithm, Particle Swarm Optimization and Simulated annealing(HGAPSOSA)*	*Reduce the environmental impact life cycle assesment of smatphones, smart phone emission and selling rate*	
S-9	SLO-1	*Paradigmatic view of energy efficient IoT*	*Automation and Sensors in Smart Home*	*Comparison of dynamic energy efficient algorithms*	*Promoting the Usage of Sensor Cloud: a step toward green IoT.*	*Design weather monitoring using BLE*
	SLO-2	*Pragmatic energy efficient IoT system architecture*	*Case study: energy conservation component for smart home.*	*Compare and contrast static and dynamic energy efficient algorithms*	*Creating Awareness Through Prototyping: A Green IoT-Based Smart*	

Learning Resources	1. *."EnergyConservationforIoTDevicesConcepts,ParadigmsandSolutions",MamtaMittal,Sudeep Tanwar,BasantAgarwal,LalitMohanGoyal,StudiesinSystems,DecisionandControl 206,2019.* 2. *"IOTprojectswithBluetoothLowEnergy-Harnessthepowerofconnectedthings",Madhur*	3. *1Green IoT: An Investigation on Energy Saving Practices for 2020 and Beyond, Rushan Arshad, Saman Zahoor, Munam Ali Shah , Abdul Wahid, and Hongnian Yu, special section on future networks: architectures,protocols,andapplications,2017.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mr.Anantha Velavan , Principal Validation Engineer, Micro chip	*Dr. Divya Udayan J, PhD(S.Korea)| MIEEE | MACM | MIDF, Associate Professor, VIT University, Vellore*	*Dr.T.Sujithra,SRMIST*
2.Mr.GaneshSKandha, Senior Applications Engineer, Micro chip	*Dr.Masoodhu Banu, Professor/Head of Bio Medical, Veltech University,*	*Dr.Kayalvizhi Jayavel, SRMIST*
		Mrs.Anitha,SRMIST

Course Code	18CSE367T	Course Name	REQUIREMENTS ENGINEERING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Identify the sources, collect, organize and classify the requirements*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Improve their ability to choose the appropriate Elicitation Techniques for any systems*			
CLR-3 :	*Familiarize with the various requirements documentation and validation techniques*			
CLR-4 :	*Familiarize with the various requirements quality drivers, Traceability models and requirements change control techniques*			
CLR-5 :	*Expose to the Conflits, Escalation model , Settlements and Analytics of Cost Benefit analysis*			
CLR-6 :	*Expose to the latest requirements engineering tools*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge on identifying the Source, organising and classifying requirements*	*2*	*80*	*85*	*H*	*H*	*L*	*M*	*-*	*L*	*L*	*M*	*H*	*H*	*M*	*L*	*-*	*-*	*-*
CLO-2 :	*Acquire the ability to identify and Apply the appropriate Elicitation Techniques for any systems*	*2*	*75*	*80*	*H*	*H*	*H*	*L*	*-*	*L*	*-*	*L*	*H*	*H*	*H*	*L*	*-*	*-*	*-*
CLO-3 :	*Understand the basic ideas about various requirements documentation and validation techniques*	*2*	*85*	*80*	*H*	*L*	*L*	*L*	*M*	*-*	*-*	*M*	*M*	*M*	*M*	*-*	*-*	*-*	*-*
CLO-4 :	*Apply the knowledge on various requirements quality drivers, Traceability models and requirements change control techniques for any system*	*2*	*80*	*75*	*H*	*H*	*L*	*M*	*H*	*M*	*-*	*M*	*M*	*L*	*L*	*M*	*-*	*-*	*-*
CLO-5 :	*Appreciate the concepts of Conflict, Escalation model , Settlements and Analytics of Cost Benefit analysis*	*2*	*75*	*85*	*H*	*H*	*-*	*H*	*H-*	*-*	*-*	*M*	*L*	*M*	*M*	*-*	*-*	*-*	*-*
CLO-6 :	*Appreciate the concepts of latest requirements engineering tools*	*2*	*70*	*70*	*H*	*L*	*L*	*M*	*H*	*-*	*L*	*L*	*L*	*L*	*M*	*M*	*-*	*-*	*-*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Requirements and Requirements Engineering*	*Requirement Inception*	*Introduction to Requirement Document, Structure of Document*	*Business drivers of Quality-components of Integrated Quality approach*	*Conflict types*
	SLO-2	*Requirements Types*	*sources of requirements*			
S-2	SLO-1	*Classification of Requirements*	*Introduction to requirement Elicitation*	*Vision, Scope and Elicitation notes*	*Quality improvement techniques, Requirements Quality Assurance*	*Mastering and using detection of the 5conflicts types on the basis of indication in project*
	SLO-2	*Requirements Gathering relevant to Software Life Cycle Models*				
S-3	SLO-1	*Stakeholders in the requirements process*	*Classical Elicitation Techniques-Interview, Questionnaire, Social analysis*	*Requirement Specification techniques*	*PDCA Cycle*	*Glasl's conflicts escalation model*
	SLO-2					
S-4	SLO-1	*Requirements Engineering Process Framework, Requirements Engineering Maturity Model*	*Modern Elicitation Techniques-Brainstorming,*	*Introduction to requirement validation-Classical Requirement Validation techniques-Inspection, Simple Check*	*Introduction to Requirement Management-Requirement Identification-Requirements traceability*	*Conflicts Settlement techniques*
	SLO-2	*Generic Process for requirements Engineering*				

S-5	SLO-1	*Levels of Requirements Engineering*	*Modern Elicitation Techniques- Prototyping, Use Centered Design,*	*. Introduction to requirement validation- Classical Requirement Validation techniques-Desk Check, Walkthrough*	*Requirement Tracebility models, Traceability Matrix- Traceability List & Tree*	*Conflicts Settlement techniques*
	SLO-2	*System Model for Requirements Engineering*				
S-6	SLO-1	*Representation of Requirements-Data Flow, ER Diagram*	*Modern Elicitation Techniques- Walkthrough, Use case Joint Application Development*	*Format review*	*Introduction to RequirementTraceability- Requirement traceability methods*	*Analytic Methods – Mastering and using Consider All Facts (CAF)*
	SLO-2	*View Point Controlled Requirements*				
S-7	SLO-1	*Structured Analysis and Design Technique, Viewpoint Oriented Requirements Definition*	*Requirement reuse*	*Prototype & Enactments, Functional test Design*		*Analytic Methods – Plus –Minus-Intresting(PMI)*
	SLO-2					
S-8	SLO-1	*0bject Oriented Methods of Requirements Engineering*	*Feature Oriented Domain Analysis*	*Development of User manual*	*Advance Traceability*	*Analytic Methods – Cost Benefit Analysis*
	SLO-2					
S-9	SLO-1	*Case Study : For the given application identify the stakeholders, gather and classify the requirements according to the types*	*Case Study: For the given application apply various techniques and Elicitation the requirements*	*Case study. For the given application validate and document the specifications*	*Requirement Change Control*	*Case study : Requirement Engineering Tools*
	SLO-2					

Learning Resources	1. *ElizabethHull,KenJackson,JeremyDick,RequirementsEngineering,Springer,2013* 2. *RalphR.Young,"TheRequirmentsENgineeringHandbook",2004*	3. *AxelvanLamsweerde,"RequirementsEngineering:FromSystemGoalstoUMLModelstoSoftware Specifications" , Wiley,2014* 4. *KarlWiegers,JoyBeatty,SoftwareRequirements(DeveloperBestPractices),(3rdEdition),MicrosoftPress, 2014.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.Mariappan Vaithilingam, Engineering Leader Amazon, dr.v.m@ieee.org		*1. Mrs. Sasi Rekha Sankar, SRMIST*
2. Mr. Badinath, SDET, Amzon, sbadhrinath@gmail.com		*2. Mrs. Geetha.G, SRMIST*
		3 Dr. S.Thenmalar, SRMIST

Course Code	18CSE368T	Course Name	SOFTWARE ARCHITECTURE AND DESIGN	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Classify the essential elements of software architecture*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Understand the issues related to architecting a large-scale software system*			
CLR-3 :	*Understand different software architectures views and styles*			
CLR-4 :	*Able to use the four-views approach for developing and documenting a software architectures*			
CLR-5 :	*Understand the implications of different design patterns*			
CLR-6 :	*working as part of a team, develop, analyze and critique an architecture of a software system*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1 Engineering Knowledge	2 Problem Analysis	3 Design & Development	4 Analysis, Design, Research	5 Modern Tool Usage	6 Society & Culture	7 Environment & Sustainability	8 Ethics	9 Individual & Team Work	10 Communication	11 Project Mgt. & Finance	12 Life Long Learning	13 PSO - 1	14 PSO - 2	15 PSO – 3
CLO-1 :	*Describe different approaches to design software application*	*3*	*80*	*75*	*H*	*H*	*-*	*-*	*L*	*-*	*-*	*-*	*-*	*L*	*-*	*H*	*-*	*-*	*-*
CLO-2 :	*Analyze specifications and identify appropriate design strategies.*	*3*	*85*	*80*	*M*	*H*	*H*	*H*	*-*	*-*	*-*	*-*	*M*	*M*	*M*	*H*	*-*	*-*	*-*
CLO-3 :	*Develop an appropriate design for a given set of requirements*	*3*	*75*	*75*	*M*	*H*	*H*	*H*	*-*	*-*	*-*	*-*	*-*	*M*	*M*	*H*	*-*	*-*	*-*
CLO-4 :	*Identify applicable design patterns for the solution*	*3*	*85*	*80*	*H*	*H*	*H*	*H*	*-*	*-*	*-*	*-*	*-*	*L*	*L*	*H*	*-*	*-*	*-*
CLO-5 :	*Abstract and document reusable design patterns*	*3*	*80*	*70*	*M*	*H*	*H*	*-*	*L*	*-*	*-*	*-*	*M*	*M*	*M*	*H*	*-*	*-*	*-*
CLO-6 :	*Evaluate a given design against the specifications*	*3*	*80*	*70*	*M*	*H*	*-*	*-*	*-*	*-*	*-*	*-*	*M*	*M*	*M*	*H*	*-*	*-*	*-*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Software Architecture –Software Design*	*Software Architectural Patterns & Styles*	*Evaluating a Software Architecture*	*Introduction to Design Process*	*Introduction to Design Pattern*
	SLO-2	*Importance and Need of Software Architecture*	*Types of Architectural Styles*	*Why- When -Who evaluate Architecture*	*Design Strategy*	*Component of Design Pattern - Types*
S-2	SLO-1	*4 +1 View Model*	*Layered pattern*	*What Qualities Can We Evaluate an Architecture?*	*Describing the design process the D-Matrix*	*Creational Design Patten - Abstract Factory Pattern*
	SLO-2	*Activities in Software Architecture*	*Merits and Demerits of Layered Pattern*		*Views associated with D-matrix*	*Factory Method*
S-3	SLO-1	*Fundamental design issues*	*Pipe-Filter pattern*	*Outputs of an Architecture Evaluation*	*Design by top-down decomposition*	*Singleton Pattern*
	SLO-2		*Merits and Demerits of Pipe and Filter*			*Structural design Pattern - Types*
S-4	SLO-1	*Understanding quality attributes -*	*Shared Data Pattern*	*Evaluating the Architecture - ATAM*	*Design by composition*	*Adaptor pattern*
	SLO-2	*Six parts of Quality Scenario*	*Merits and Demerits of Shared Data Pattern*	*Participants and Outputs of ATAM*		*Decorator Pattern*
S-5	SLO-1	*Design for quality attributes - Availability (General Scenario, Tactics)*	*Client Server pattern*	*Phases of ATAM*	*Function-oriented design*	*Proxy Pattern*
	SLO-2		*Merits and Demerits of Client Server*	*CASE Study for ATAM*		*Behavioral Design Pattern - Types*
S-6	SLO-1	*Design for quality attributes - Modifiability (General Scenario,*	*Blackboard Architectural Pattern*	*Evaluating the Architecture - CBAM*	*Object-oriented design*	*Observer Pattern*

		Tactics)				
	SLO-2		*Merits and Demerits*	*Decision-Making Context*		*Strategy Pattern*
S-7	SLO-1	*Design for quality attributes - Security (General Scenario, Tactics)*	*Flight Simulation: A Case Study in an Architecture for Integrability*	*Basis for the CBAM - Case Study*	*Aspect Oriented Design*	*Iterator pattern*
	SLO-2		*Relationship to the Architecture Business Cycle*			*Introduction to ADL*
S-8	SLO-1	*Design for quality attributes - Usability (General Scenario, Tactics)*	*Requirements and Qualities related to flight simulation*	*Evaluating Software Architecture - SAAM*	*Design Metrics - Need for Metrics*	*Components of ADL- Example*
	SLO-2			*SAAM Evaluation Process*	*WMC -DIT*	
S-9	SLO-1	*Design for quality attributes - Testability (General Scenario, Tactics)*	*Architectural Solution for flight simulation*	*Evaluating Software Architecture - ARID*	*NOC - CBC*	*Future Directions in Architecture*
	SLO-2			*ARID Evaluation Process*	*RFC- LCOM*	

Learning Resources	1. *Len Bass, Paul Clements, & Rick Kazman. Software Architecture in Practice (Third Edition). Addison- Wesley,2013* 2. *Humberto Cervantes, Rick Kazman ,Designing Software Architectures: A Practical Approach. Pearson Education,2016* 3. *CarlosOtero,"SoftwareEngineeringDesign:TheoryandPractice",CRCPress,2012*	4. *Paul Clements , Rick Kazman , Mark Klein, Evaluating Software Architectures: Methods and Case Studies. Addison Wesley; 1 edition (22 October2001)* 5. *Jason McC. Smith, "Elemental design Patterns",. Addison Wesley,2012* 6. *VasudevaVarma,SoftwareArchitecture:ACaseBasedApproach.PearsonEducation,2009.*

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		Mr.C.Arun, SRMIST

Course Code	18CSE369T	Course Name	SOFTWARE MODELING AND ANALYSIS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Select a suitable modeling method according to problem area and assignment, and can justify their choice.*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Formulate models of a system to describe the system on different levels of abstraction and from different viewpoints.*			
CLR-3 :	*Identify the Formal models used in software development*			
CLR-4 :	*Define model checking concepts using tools*			
CLR-5 :	*Model the software system and analyze its characteristics and correctness.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*			
CLO-1 :	*Implement the appropriate modeling method for the given problem*	*2*	*80*	*85*
CLO-2 :	*Explain the system abstraction in different levels*	*2*	*75*	*80*
CLO-3 :	*Apply the Formal models in the software development*	*2*	*85*	*80*
CLO-4 :	*Apply tools to check model checking properties of a system*	*2*	*80*	*75*
CLO-5 :	*Analyze the characteristics and correctness of software system*	*2*	*75*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to software modelling*	*Representing domain concepts by conceptual objects*	*Modeling system agents, Characterizing agents.*	*Correctness of Object Oriented Programs Design by Contract, The Class Invariant*	*Introduction to Kripke Structures*
S-2	SLO-1	*Modeling principles*	*Entities, Association, Attributes*	*Representing agent models,Refinement of abstract agents*	*Example - correctness of stack application*	*Modeling System Design as Kripke Structure*
S-3	SLO-1	*Goal features as model annotations,Goal refinement*	*Built–in associations for structuring object models*	*Building Agent models*	*A real–time temporal logic for specifying model annotations*	*Exercise on Kripke Modelling, Recap to Kripke Structures*
S-4	SLO-1	*Representing conflicts among goals,Connecting the goal model with other system views.*	*Class Diagrams, Heuristic rules for building object models*	*Modelling system operations, Characterizing system operations*	*Specifying goals in the goal model.*	*Exercises on system modeling using kripke structures, Introduction to LTL*
S-5	SLO-1	*Modelling alternative options, Goal diagrams as AND/OR graphs.*	*Object or Attribute Entity, association, agent or event?*	*Goal Operationalization, Goals, agents, objects and operations*	*Specifying descriptive properties in the object model*	*Properties of a system, Liveness and Safety properties , Exercise on specifying properties as LTL formula*
S-6	SLO-1	*Documenting goal refinements and assignments with annotations*	*Attribute of a linked object or of the linking association Specialization and generalizing concepts Avoiding common pitfalls*	*Representing object models, Building operation models*	*Specifying operationalization's in the operation model*	*Introduction to NuSMV tool, Model Checking using NuSMV,Introduction to SPIN CHECKER tool*
S-7	SLO-1	*Building goal models: Heuristic rules and reusable patterns*	*Aggregation or association? Avoiding common pitfalls*	*Modelling System behaviour, Modelling instance behaviours*	*Checking goal refinements deriving goal operations*	*Model Checking using SPIN checker tool*
S-8	SLO-1	*Goal obstruction by obstacles*	*Specialization and generalizing concepts Avoiding common pitfalls*	*Modelling class behaviours*	*Generating obstacles for risk analysis Generating anti goals for security analysis*	*System Property as first order logic formula Proof of correctness using theorem prover*

S-9	SLO-1	*Modelling obstacles, Obstacle ananlysis for a more robust goal model*	*Case Study*	*Building behaviour models*	*Formal conflict analysis. Synthesizing behaviour models for animation and model checking.*	*Introduction Isabelle tool, Theorem proving using Isabelle*

Learning Resources	1. *AxelvanLamsweerde"RequirementsEngineering:FromSystemGoalstoUMLModelstoSoftware Specifications"ISBN:978-0-470-01270-3February9,2009Wiley* 2. *http://www.bowdoin.edu/~allen/courses/cs260/readings/ch12.pdf*	3. *Gerard J. Holzmann, "The SPIN Model Checker: Primer and Reference Manual" ISBN-13: 978-0321773715 , AT&T Bell Labs Murray Hill New Jersey ©2004 | Addison-Wesley Professional*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Ms T Vijayalakshmi Priyadharsini, Senior Manager, Cognizant Technology Solutions, Chennai	*1. Dr.Kumudha Padmanaban, Associate Professor, Coimbatore Institute of Technology, kumudha@cit.edu.in*	*1. Mr Ramraj S, SRMIST*
	2. Dr M Sangeetha, Coimbatore Institute of Technology, citcsesangi@gmail.com	*2. Ms A NithyaKalyani, SRMIST*

Course Code	18CSE370T	Course Name	DESIGN PATTERNS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Conceive the importance of reuse of solution for common problems in software development.*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Identify the appropriate patterns for design problems.*			
CLR-3 :	*Implement the various design pattern solution for appropriate scenarios*			
CLR-4 :	*Refactoring the badly designed program properly using patterns.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*To create software designs that are scalable and easily maintainable*	*2*	*80*	*85*
CLO-2 :	*Use creational design patterns in software design for class instantiation*	*2*	*75*	*80*
CLO-3 :	*Use structural design patterns for better class and object composition*	*2*	*85*	*80*
CLO-4 :	*Use behavioral patterns for better organization and Communication between the objects*	*2*	*80*	*75*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Basics of UML Class Diagram, Interaction Diagram*	*Strategy pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Strategy pattern- Implementation and sample code*	*Abstract factory- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Abstract factory- Implementation and sample code*	*Adapter- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Adapter- Implementation and sample code*	*What to Expect from Design Patterns The Pattern Community An Invitation*
	SLO-2					
S-2	SLO-1	*Object design, Reuse Concepts, Solution Objects Inheritance & Design Patterns*	*Mediator - Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Mediator- Implementation and sample code*	*Singleton pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Singleton pattern Implementation and sample code*	*Bridge- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Bridge- Implementation and sample code*	*A Parting Thought A Case Study : Designing a Document Editor : Design Problems, Document Structure*
	SLO-2					
S-3	SLO-1	*Principle and Strategies Open/Closed principle Designing from context, Encapusulating Variation*	*Template Method- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Template Method- Implementation*	*Factory method pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences Factory method pattern Implementation*	*Decorator, Facade- Intent, Motivation, Applicability, Participants, collaborations, consequences Structure Decorator, Facade- Implementation*	*A Case Study : Designing a Document Editor : Design Problems, Document Structure Formatting, Embellishing the User Interface*
	SLO-2					
S-4	SLO-1	*Abstract classes and Interfaces Design patterns and Architecture*	*Template Method- sample code Case study: Identify which pattern is applicable for the given case study and justify*	*Factory method pattern sample code Case study: Identify which pattern is applicable for the given case study and justify*	*Decorator, Facade- Sample Code Case study: Identify which pattern is applicable for the given case study and justify*	*Supporting Multiple Look-and-Feel Standards Supporting Multiple Window Systems*
	SLO-2					
S-5	SLO-1	*Gand of Four Patterns Basics of UML*	*Case study: Identify which pattern is applicable for the given case study and justifyStrategy pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences*	*Case study: Identify which pattern is applicable for the given case study and justify Abstract factory- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences*	*Case study: Identify which pattern is applicable for the given case study and justify Adapter- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences*	*User Operations Spelling Checking and Hyphenation What to Expect from Design Patterns*
	SLO-2					

S-6	SLO-1 SLO-2	*Class Diagram, Interaction Diagram Object design, Reuse Concepts, Solution Objects*	*Strategy pattern- Implementation and sample code Mediator - Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences*	*Abstract factory- Implementation and sample code Singleton pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences*	*Adapter- Implementation and sample code Bridge- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences*	*The Pattern Community An Invitation A Parting Thought*
S-7	SLO-1 SLO-2	*Inheritance & Design Patterns Principle and Strategies Open/Closed principle*	*Mediator- Implementation and sample code Template Method- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences*	*Singleton pattern Implementation and sample code Factory method pattern- Intent, Motivation, Applicability, Structure, Participants, collaborations, consequences*	*Bridge- Implementation and sample code Decorator, Facade- Intent, Motivation, Applicability, Participants, collaborations, consequences Structure*	*A Case Study : Designing a Document Editor : Design Problems, Document Structure A Case Study : Designing a Document Editor : Design Problems, Document Structure*
S-8	SLO-1 SLO-2	*Designing from context, Encapusulating Variation Abstract classes and Interfaces*	*Template Method- Implementation Template Method- sample code*	*Factory method pattern Implementation Factory method pattern sample code*	*Decorator, Facade- Implementation Decorator, Facade- Sample Code*	*Formatting, Embellishing the User Interface Supporting Multiple Look-and-Feel Standards*
S-9	SLO-1 SLO-2	*Design patterns and Architecture*	*Case study: Identify which pattern is applicable for the given case study and justify*	*Case study: Identify which pattern is applicable for the given case study and justify*	*Case study: Identify which pattern is applicable for the given case study and justify*	*Supporting Multiple Window Systems*

Learning Resources	1. Bruegge,BerndandAllenH.Dutoit.“Object-OrientedSoftwareEngineering:UsingUML,Patternsand Java”,Pearson: Prentice Hall Publishers2004 2. ErichGamma,RichardHelm,“DesignPatterns:Elementsofreusablesoftware development”, Pearson Education,2005	3. Alan Shalloway, James R Trott "Design pattern explained", Pearson Education,2005. 4. EricFreeman,ElisabethRobson,BertBates,andKathySierra,“HeadFirstDesignPatterns”, O’reilly Publications,2004.

Learning Assessment											
	Bloom’s Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Ms T Vijayalakshmi Priyadharsini, Senior Manager, Cognizant Technology Solutions, Chennai	*1. Dr.Kumudha Padmanaban, Associate Professor, Coimbatore Institute of Technology, kumudha@cit.edu.in*	*1. Dr S Sridar SRMIST*
	2. Dr M Sangeetha, Coimbatore Institute of Technology, citcsesangi@gmail.com	*2. Ramraj S SRMIST*

Course Code	18CSE371T	Course Name	USER INTERFACE DESIGN	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Understand the concepts of design; Utilize by learing various color models*
CLR-2 :	*Gain knowledge on the basics of various law in UX*
CLR-3 :	*Construct the task for requirement gathering*
CLR-4 :	*Gain knowledge on how to Design for various domains or applications*
CLR-5 :	*Introducetools for designing various applications*
CLR-6 :	*Utilisedifferent types of design for real-time programming applications*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Identify various color models for design*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Create the design as per the design law*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Construct the task for requirement gathering*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Create wire frames and prototypes*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Create the usability constraints and accebility*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Construct real-time applications using real-time programming applications*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*What is typography-type properties, baseline, cap height*	*Laws of UX designing*	*Introduction to Interaction Design*	*Culture in usability*	*Importance of case studies and guidelines*
	SLO-2	*X-height, ascenders*	*Hicks law*	*Task analysis*	*Universal usability*	*Tracking APP Introduction*
S-2	SLO-1	*Descenders and weight*	*example of hicks law with an application*	*Data collection for gathering user*	*Inclusive interaction*	*Tracking APP Design guidelines*
	SLO-2	*Type classification-Serif*	*Jakob's law*	*Data for task requirements*	*Importance of accessibility*	*Tracking APP demo*
S-3	SLO-1	*sans serif fonts*	*example of jakob's law with an application*	*Requirements gathering*	*principles of accessibility*	*Designing UI*
	SLO-2	*monospace*	*Fitts's Law*	*Eliciting Qualitative data*	*Universal design*	*Redesigning Gmail and making it flash*
S-4	SLO-1	*handwriting and Display*	*example of Fitts's law with an application*	*analyzing qualitative data*	*Accessibility design*	*Design principles*
	SLO-2	*Readability, letter spacing*	*Ockham's Razor*	*Qualitative metrics*	*Font weight, color*	*Redesigning Gmail and making it flash Demo*
S-5	SLO-1	*line height with an example*	*example of Ockham's law with an application*	*User narratives*	*Contrast, Screen readers*	*Introduction of how to Design a new UX concept to reduce driver distraction*
	SLO-2	*Paragraph spacing, power of alignment*	*Pareto Principle*	*Scenario implementation and its challenges*	*Alt text using a tool*	*Designing concepts of Driver distraction*
S-6	SLO-1	*Leading and Kerning*	*example of Pareto principle with an application*	*Wireframes*	*Introduction to Multifaceted Users*	*Demo*
	SLO-2	*Fundamentals of color*	*Weber's law*	*Example on wireframes*	*Designing for Multifaceted Users*	*Importance of User data in UX designing*
S-7	SLO-1	*Color Models Introduction*	*example of Weber's law with an application*	*Prototypes*	*Design guidelines*	*Approach to design without user data*
	SLO-2	*RGB, CMYK*	*Tesler's law*	*Implementation of Prototypes*	*Guidelines for helping adults*	*Designing concept*

S-8	SLO-1	*Color harmony: monochromatic, analogous*	*example of Tesler's law with an application*	*UX design for mobile application*	*Application example*	*Implementation problems without data*
	SLO-2	*Complementary, triadic, double-complementary*	*Law of proximity*	*Application design example*	*Virtual third eye simulator introduction*	*Dynamic webpages*
S-9	SLO-1	*Meaning of colors*	*example of proximity*	*Responsive Design*	*Web accessibility guide*	*Demo*
	SLO-2	*The power of Contrast*	*Law of similarity and human eye*	*Adaptive design and difference with Responsive design*	*Virtual third eye simulator web accessibility*	*Perform UI Case study*

Learning Resources	1. *Jeff Johnson, Kate Finn- "Designing user Interfaces for an aging population towards Universal design- Morgan Kauffman publishers – Elseiver-2017* 2. *ElvisCanziba-"Hands-onUXDesignforDevelopers"–PacktBirminiham,mumbai-2018*	3. *AndrewRogerson-"UserExperienceDesign"–Smashinmedia2012-Freiburg,Germany* 4. *BarbaraBallard,"Designingthemobileuserexperience"Wileypublicatoins2007* 5. *https://uxdesign.cc/tagged/case-study*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. Mr.S.Karthick, SRMIST
		2.Mrs.Akilandeswari, SRMIST

Course Code	18CSE372T	Course Name	VISUAL PROGRAMMING	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Gain knowledge about basics of C# and .NET framework*			
CLR-2 :	*Utilize object-oriented aspects of C# to develop applications*			
CLR-3 :	*Utilize forms, menus etc. to design Windows applications*			
CLR-4 :	*Utilize ActiveX Data Objects to create Database applications*			
CLR-5 :	*Utilize web forms to develop Web based applications*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Understand the basics of C# and .NET framework*	*2*	*80*	*85*
CLO-2 :	*Develop applications using object-oriented aspects of C#*	*2*	*75*	*80*
CLO-3 :	*Design Windows applications*	*2*	*85*	*80*
CLO-4 :	*Create Database applications using ActiveX Data Objects*	*2*	*80*	*75*
CLO-5 :	*Develop Web based applications*	*2*	*75*	*85*

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Understand the basics of C# and .NET framework*	-	-	-	-	*H*	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Develop applications using object-oriented aspects of C#*	*H*	-	*M*	-	*H*	-	-	-	-	-	-	*H*	-	-	-
CLO-3 :	*Design Windows applications*	*H*	-	*M*	*M*	*H*	*L*	*L*	-	*H*	-	-	*H*	-	-	-
CLO-4 :	*Create Database applications using ActiveX Data Objects*	*H*	*H*	*M*	-	*H*	*L*	*L*	-	*H*	-	-	*H*	-	-	-
CLO-5 :	*Develop Web based applications*	*H*	-	*M*	*M*	*H*	*L*	*L*	*M*	*H*	*M*	*L*	*H*	*M*	*H*	*H*

Duration (hour)		10	10	9	8	8
S-1	SLO-1	*Introducing C# - Understanding .NET Framework*	*Class – Objects*	*Building Windows Application*	*Accessing data with ADO.NET: DataSet*	*Programming Web Application with Web Forms*
	SLO-2					
S-2	SLO-1	*Overview of C# - Literals – Variables Data Types – Operators – Constants - Expressions*	*Constructors – Types of Constructors*	*Examples: Windows Applications*	*Accessing data with ADO.NET: Typed Dataset*	*Introduction to ASP.NET,*
	SLO-2					
S-3	SLO-1	*Program Control Statements: Branching*	*Inheritance and its types*	*Creating Window Forms with Events and Controls*	*Data Adapter*	*Working with XML and .NET*
	SLO-2					
S-4	SLO-1	*Program Control Statements: Looping*	*Examples - Inheritance*	*Examples: Window Forms with Events and Controls*	*Updating Database using Stored Procedures*	*Creating Virtual Directory and Web Application*
	SLO-2					
S-5	SLO-1	*Casting - Methods*	*Indexers and Properties*	*Menu and Toolbar*	*SQL Server with ADO.NET*	*Session Management*
	SLO-2					
S-6	SLO-1	*Arrays: Array Class*	*Polymorphism – Operator Overloading*	*Delegates - Inheriting Window Forms*	*Handling Exceptions*	*Web Services – web.config*
	SLO-2					
S-7	SLO-1	*Array List*	*Polymorphism – Method Overloading*	*SDI Application*	*Validating Controls*	*Web Services – Passing Datasets and Returning Datasets from Web Services*
	SLO-2					
S-8	SLO-1	*String*	*Interfaces, Abstract Class*	*MDI Application*	*Windows Application Configuration*	*Transaction Handling, Exception Handling – Returning Exceptions from SQL Server*
	SLO-2					
S-9	SLO-1	*String Builder*	*Event Handling*	*Dialog Box: Modal and Modeless*		
	SLO-2					
S-10	SLO-1	*Structures - Enumerations*	*Errors and Exception Handling*			
	SLO-2					

Learning Resources	1. *Herbert Schildt, "The Complete Reference: C# 4.0", Tata McGraw Hill, 2012.* 2. *Andrew Troelsen, Philip Japikse, "C# 6.0 and the .NET 4.6 Framework", Seventh Edition, Apress, 2015*	3. *Christian Nagel et al. "Professional C# 2012 with .NET 4.5", Wiley India, 2012.* 4. *Andrew Troelsen, Philip Japikse , "Pro C# 7 with .NET and .NET Core", Eigth Edition, Apress, 2017* 5. *Stephen C. Perry, "Core C# and .NET", Prentice Hall, 2005*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Prakas, Associate Consultant, Virtusa, Chennai	*1.*	*1. Dr. M.S. Abirami, SRMIST*
2. Mr. S. Padmanabhan, Associate Vice President, Intellect, Chennai	*2.*	*2, Ms. Nagadevi SRMIST* *3. Mr. K. Navin*

Course Code	18CSE373T	Course Name	PROGRAMMING IN JAVASCRIPT	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand scripting language basics for web development*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Develop familiarity with the JavaScript language – Arrays, Objects, Functions*			
CLR-3 :	*Understand concepts like HTML, CSS , DOM,*			
CLR-4 :	*Acquire knowledge of jQuery , DOM events etc.*			
CLR-5 :	*Apply in AJAX and learn the usage of Closures*			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:			
CLO-1 :	*Learn the basics of Scripting language*	*2*	*80*	*85*
CLO-2 :	*Ability to use Javascript in applications*	*2*	*75*	*80*
CLO-3 :	*Ability to apply HTML, CSS and DOM*	*2*	*85*	*80*
CLO-4 :	*Ability to Apply jQuery concepts in applications*	*2*	*80*	*75*
CLO-5 :	*Understand the AJAX environment and Closure concept*	*2*	*75*	*85*

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
H	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	
S-1	SLO-1	*Learn concept of Scripting languages*	*Arrays. Array insertion and deletion*	*HTML and CSS and*	*jQuery , Overview of jQuery*	*AJAX.*
	SLO-2	*Compiled vs interpreter a comparison*	*. Array length*	*The Document Object Model , Tags*	*Examples*	*Asynchronous Communication*
S-2	SLO-1	*Understand Web development basics*	*Sparse arrays*	*Document structure.*	*Cross-browser compatibility*	*Callback functions.*
	SLO-2	*Acquire basic knowledge on Server side programming*	*Multidimensional arrays*	*Elements. Text, forms, images,blocks and frames.*	*The $ function object*	*The get and post formats.*
S-3	SLO-1	*Understand concept of dynamic interactive web pages.*	*Objects as unordered maps. Object creation,*	*Selectors*	*Element selectors.*	*Same-origin policy.*
	SLO-2	*Overview of JavaScript , Brief history*	*modification and lookup syntax. Nested objects. Object methods.*	*Cascading and inheritence*	*Tree traversal.*	*Cross-origin requests with JSONP*
S-4	SLO-1	*Common use-cases. Runtime environments, Overview of language features.*	*The delete keyword.*	*Text and color tyles.*	*Node creation, insertion, modification and deletion.*	*AJAX polling.*
	SLO-2	*Running JavaScriptDebugging JavaScript in the browser. The console and REPL in the browser and at the command line*	*The for... in statement, and the hasOwnProperty method.*	*The box model.*	*Getting and setting attributes,*	*Context Object method invocation as method passing*
S-5	SLO-1	*Values and literals. Primitive types. Numbers. Integer and floating point as a single type Rounding errors.*	*The global window object. Object references*	*Layout.*	*styles and class.*	*The this variable as an implicit parameter variable.*
	SLO-2	*. Special floating point numbers.*	*Aliasing. Pass-by-reference-copy*	*The DOM as an document API. Browser*	*Wrapping and unwrapping DOM raw*	*Problems with methods in event handlers*

			semantics.	*information*	*objects.*	*and callbacks*
S-6	SLO-1	*The Math library. Strings. Immutability of strings.*	*Functions :Function declaration and invocation syntax.*	*The setTimer and setTimeout*		*Usage of call and apply*
	SLO-2	*+ and [] operatorsCommon string utilities*	*Anonymous functions.*	*Element lookup*	*The chaining pattern*	*Binding context.*
S-7	SLO-1	*Booleans. Ternary operator.*	*Functions as data.*	*Tree traversal.*	*Event handling.*	*The new keyword.*
	SLO-2	*Regular expressions. Truth-y and False-y values. null and undefined.*	*The arguments object.*	*Attribute getting and setting*	*bind and unbind.*	*Closures Lexical scope. Inner functions*
S-8	SLO-1	*Dynamic typing. Weak typing. The typeof operator.*	*Variadic functions. Optional parameters.*	*Creating and deleting nodes.*	*Keyboard and mouse events.*	*Closure scope. Examining closure scope in the debugger*
	SLO-2	*The === and !== operators.*	*Named parameters. Function overloading.*	*Events.*	*Event delegation and bubbling.*	*Functors.*
S-9	SLO-1	*Control statements.*	*Duck typing.*	*Case studies*	*Animation.*	*Simulation of private object properties.*
	SLO-2	*Examples*	*Examples*	*Case Studies*	*Examples*	*Simulation of namespaces.*

Learning Resources	*1. Don Gosselin , JavaScript Fifth Edition, Thomson Learning., Web Technology Series* *2. Nicholas C Zakas, Professional JavaScript for Web Developers , Wrox Professional Guide, 2012*	*3. Laura Lemay, Rafe Colburn, Jennifer Kyrnin, "Mastering HTML, CSS & Javascript", Web Publishing, 2016*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
	1.	*1. Prof.S.S.Sridhar, SRMIST*

Course Code	18CSE374T	Course Name	SOFTWARE ENGINEERING TOOLS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the software engineering process and the tools used to support this process to deliver the quality software product*			
CLR-2 :	*Know the process, tools and methods used for software requirements modeling and the designing process*			
CLR-3 :	*Study the various software development approaches, tools and to install and use some software development tools*			
CLR-4 :	*Know about different web application development technologies and tools used to support the quick development process*			
CLR-5 :	*Understand the software testing process used in the industry and various test related tools used for the different task in the testing*			
CLR-6 :	*Study the functionalities of different testing tools used in the software maintenance and engineering process*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Use automated tools to develop the quality software product in by following engineering process*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Design the specification of software using various techniques and tools*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Create application using latest tools, code generators and IDEs*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Apply the various web technologies and tools to develop the web application*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Know the various testing tools and apply it during the software testing process*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Use the tools for process management and to gain the knowledge of various tools used for different task in maintenance activities*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to Software Engineering Process*	*Software Construction Tools*	*Web Application Development Tools*	*Software Testing Process*	*Software Engineering Process Tools*
	SLO-2	*Need of Tools in the Software Engineering Process*	*Program editors*	*Tools for Front End Developers*	*Software Testing Tools*	*Process modeling tools*
S-2	SLO-1	*Requirement Engineering Process*	*Compilers*	*TypeScript*	*Need for Automated Testing Tools*	*Process management tools*
	SLO-2	*Software Requirements Tools*	*Compiler types*	*Installing TypeScript*	*Taxonomy of Testing Tools*	*Integrated CASE environments*
S-3	SLO-1	*Requirements modeling tools*	*code generators*	*AngularJS*	*Functional/Regression Testing Tools*	*Process-centered software engineering environments*
	SLO-2	*Traceability tools*	*Tools for JAVA code generator*	*AngularJS Architecture and Features*	*Performance Testing Tools*	*Software Configuration Management Tools*
S-4	SLO-1	*Desirable Features of Requirement Management Tools*	*Comparison of code generation tools*	*Tools for Back End Developers*	*Testing Management Tools*	*Defect, enhancement, issue and problem tracking tools*
	SLO-2	*Some Requirement Management Tools Available*	*Interpreters*	*PHP*	*Source Code Testing Tools*	*Version management tools*

S-5	SLO-1	*Tools Description*	*Difference between Compiler and Interpreters*	*Ruby on Rails*	*How to Select a Testing Tool?*	*Software Engineering Management Tools*
	SLO-2	*Software Design Process*	*Debuggers*	*Laravel*	*Test execution frameworks*	*Project planning and tracking tools*
S-6	SLO-1	*Steps in Software Design*	*Integrated Development Environment*	*Overview of Content Management System (CMS)*	*Re-engineering tools*	*Risk management tools*
	SLO-2	*Software Modeling Languages*	*Comparison of IDE*	*WordPress*	*WinRunner*	*Infrastructure Support Tools*
S-7	SLO-1	*Unified Modeling Language*	*ATOM Tool*	*WordPress - Features*	*Overview of WinRunner*	*Interpersonal Communication tools*
	SLO-2	*Behavior Trees*	*Features of ATOM Tool*	*WordPress – Installation*	*LoadRunne - Overview*	*Information retrieval tools*
S-8	SLO-1	*C-K theory*	*Installing Atom*	*Joomla - Overview*	*QTP - Overview*	*System administration and support tools*
	SLO-2	*IDEF, Object-Role Modeling*	*NetBeans*	*Joomla – Features*	*Junit - Overview*	*Miscellaneous Tool Issues*
S-9	SLO-1	*Petri nets*	*Features of NetBeans*	*Joomla – Installation*	*Testing Java Code using Junit*	*Tool integration techniques*
	SLO-2	*Software Design Tools*	*Cloud Based Development tools*	*Drupal – Overview and Architecture*	*Examples*	*Tool evaluation*

Learning Resources	1. *RogerSPressman,"SoftwareEngineering–APractitioner'sApproach",7thedition,TataMcGrawHill Education,2014.* 2. *IanSomerville"SoftwareEngineering",9thedition,PearsonEducation,2010.https://atom.io/*	4. *SwapnaKishoreandRajeshNaik,"SoftwareRequirementsandEstimation",TataMcGrawHill,2003* 5. *K.V.K.K.Prasad,"SoftwareTestingTools",DreamtechPress,2010 https://www.w3schools.com https://www.joomla.org/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. R.Tamilanban, Senior Software Engineer, Altimetrik India Pvt. Ltd.	*1.*	*1. S.KALIRAJ, SRMIST*
2.	*2.*	*2. R.ANITA, SRMIST*

Course Code	18CSE466T	Course Name	SOFTWARE VERIFICATION AND VALIDATION	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1 :	*Provide an understanding of concepts and techniques for testing software*	1
CLR-2 :	*Prepare test plan based on the requirement document ,design test plans and document test plans*	
CLR-3 :	*Design test cases suitable for a software development in various domains*	
CLR-4 :	*Validate and document test cases, assuring software component or system satisfies its requirements and meets stakeholder expectations*	
CLR-5 :	*Use of automation testing tools*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Identify, design different types of test cases for software development in any domain*	*2*	*80*	*85*
CLO-2 :	*Design, develop, implement, validate and document test plans at various levels*	*3*	*80*	*80*
CLO-3 :	*Develop Test cases for a given Software/System Specification*	*2*	*90*	*85*
CLO-4 :	*Validate Test Cases with the Requirement Specifications*	*2*	*80*	*80*
CLO-5 :	*Use various automation tools to implement test cases*	*3*	*75*	*80*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1	*H*	*H*	*H*	*H*	*H*	*M*	*M*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-2	*H*	*H*	*H*	*H*	*M*	*M*	*M*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-3	*H*	*H*	*H*	*H*	*M*	-	*M*	*H*	*H*	*M*	*M*	*H*	*H*	*H*	*H*
CLO-4	*H*	*H*	*H*	*M*	*M*	-	*M*	*H*	*H*	*H*	*M*	*H*	*H*	*H*	*H*
CLO-5	*H*	*M*	*H*	*H*	*H*	*M*	*M*	*H*	*H*	*M*	*H*	*H*	*H*	*H*	*H*

Duration (hour)		8	10	8	9	10
S-1	SLO-1	*Fundamentals of Testing: Necessity of Testing-Case Studies on "Impact of Software bugs"*	*Test Case Design Strategies: Introduction to basic design strategies*	*The need for levels of testing, Unit Testing: Planning, Test Harness*	*Test Management: Choice of Standards*	*Software Test Automation: Skills and Scope Design*
	SLO-2	*Objectives of Testing, Basics Definitions*		*Running the tests Recording Results*	*Infrastructure Management, Test People Management*	
S-2	SLO-1	*Testing Principles-Illustrations*	*White Box Strategies - Peer Reviews, Inspections, Walkthrough*	*Integration Testing: Goals, Design and Plan*	*Test Plan Components*	*Architecture for Automation*
	SLO-2		*Comparative Analysis*		*Test Plan Attachments*	
S-3	SLO-1	*Fundamental Test Process, The tester's role in a software development organization*	*Static Analysis Tools: Coding Standards, Code Metrics, Code Structure*	*System Testing goals, Types of System Testing: Functional Testing*	*Locating Test Items, Managing Issues*	*Requirements for a test tool, Process Model for Automation, Selecting the test tool*
	SLO-2	*Test planning*	*Activity: Static Analysis of a source code*	*Performance Testing, Stress Testing*	*Addressing Perception, Taking team together*	
S-4	SLO-1	*Establishing Test Policy, Structured approach to testing Test Factors*	*Coverage and Control Flow Graphs*	*Configuration Testing*	*Documentation uses*	*Demonstration of a Functional Testing Tool*
	SLO-2	*Eleven Step software testing process*	*Activity: Calculate Complexity for a given source code*	*Security Testing*	*Documentation Types*	
S-5	SLO-1	*Origin of Defects, Defect Repository and Test Design*	*Paths Code Complexity*	*Recovery Testing, Reliability Testing*	*Test Analysis report Documentation,*	*Demonstration of a Web Testing Tool*

	SLO-2	*Developer/Tester support of developing a defect repository*	*Activity: Calculate Path Code Complexity for a given source code*	*Usability Testing*	*Analyze reports and Problem tracking,*	
S-6	SLO-1	*Defect Examples, Case Studies – "Identify the defect"*	*Evaluating test adequacy criteria, Case Studies- "Applying the suitable White Box Strategy"*	*Regression Testing*	*Controlling and Monitoring Test Progress*	*Démonstration of an Unit Testing Tool*
	SLO-2			*Alpha, Beta and Acceptance Testing*	*Test Metrics and measurements: Role, need and types*	
S-7	SLO-1	*Defect Analysis and Prevention Strategies*	*Black Box Testing Strategies: Requirements Based Testing, Random Testing*	*Role of use cases in testing*	*Project Metrics with Practice*	*Demonstration of an Defect Tracking Tool*
	SLO-2			*Applying Testing Skills: Compatibility testing, Internationalization testing*		
S-8	SLO-1	*Developing adhoc test cases for a case study*	*Black Box Testing Strategies: Boundary Value Analysis, Equivalence Class Partitioning,*	*Testing Documentation plan*	*Progress Metrics with Practice*	*Demonstration of an Test Management Tool*
	SLO-2		*Activity: Designing test cases for the given requirement specification using Boundary value analysis and Equivalence Class Partitioning*	*Recording test cases, Reporting and Measurement of Success*		
S-9	SLO-1		*Black Box Testing Strategies: Cause Effect graphing*		*Productivity Metrics with Practice*	*Challenges in Automation*
	SLO-2		*Activity: Designing test cases for the given requirement specification using cause effect graphing and developing decision tables*			
S-10	SLO1 SLO2		*Evaluating test adequacy criteria, Case Studies- "Applying the suitable Black Box Strategy"*			*The Future: Software Quality Assurance*

Learning Resources	1. *Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, 2006* 2. *Ron Patton, "Software Testing", Second Edition, Sams Publishing, Pearson Education, 2007.*	3. *Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003.* 4. *Aditya P. Mathur, "Foundations of Software Testing _ Fundamental Algorithms and Techniques", Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008* 5. *RenuRajani, Pradeep Oak, "Software Testing-Effective Methods, Tools and Techniques", Tata McGraw Hill Education, 2011.*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. ShrikantSatyanarayan, Technical Manager LDRA Technology PVT LTD	*1. Dr. N. Bhalaji, Associate Professor, SSN Institutions*	*1. Mrs. Anupama.C.G, SRMIST*
2. Mr. Girish Raghavan, Senior DMTS Manager, Wipro Technologies		*2. Mr. Selvin Paul Peter, SRMIST*

Course Code	18CSE467T	Course Name	SOFTWARE QUALITY ASSURANCE	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CSE*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the importance of software quality*			
CLR-2 :	*Gain knowledge about the components of software quality assurance system*			
CLR-3 :	*Gain knowledge on conducting reviews walk through and inspection*			
CLR-4 :	*Understand the importance of SCM, procedures, policies in SQA*			
CLR-5 :	*Recognize the significance of human components*			
CLR-6 :	*Gain Knowledge on measurements and standards*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Acquire the knowledge on software quality*	*2*	*80*	*85*
CLO-2 :	*Acquire the ability to identify the dimension of a software project*	*2*	*75*	*80*
CLO-3 :	*Apply different quality component in different phase of life cycle*	*2*	*85*	*80*
CLO-4 :	*Follow procedures, processes, policies and work instructions in software development*	*2*	*80*	*75*
CLO-5 :	*Manage risks and handle human components effectively*	*2*	*75*	*85*
CLO-6 :	*Apply different measurements and follow standards*	*2*	*80*	*85*

	Program Learning Outcomes (PLO)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :		-	-	-	-	-	-		-	-	*M*	-	*H*	-	-
CLO-2 :	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	*H*	*H*
CLO-4 :		-	-	-	-	-	*M*	*H*	-	-	-	-	-	-	-
CLO-5 :	*H*	-	-	*H*	-	*M*	-	-	-	*H*	-	-	-	-	-
CLO-6 :		-	*H*	-	*H*	-	-	-	*H*	-	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to software Quality*	*Software Quality Assurance System Architecture*	*Check lists*	*Introduction to Risk management*	*Importance of Measurement*
	SLO-2	*Defining software quality and software quality Assurance*	*Components of Software Quality Assurance System*	*Verification and validation*	*Risk management according to the standards and models*	*Measurement according to ISO 9001*
S-2	SLO-1	*Software error, defects and failures*	*Contract Review process and its stages Contract Review objectives*	*Verification and validation*	*Risk management according to the standards and models*	*The practical software and systems measurement method*
	SLO-2	*Software error, defects and failures*	*Implementation of Contract Review, Contract review for internal projects*	*Basics of Software Configuration Management , Benefits of Good configuration Management*	*Risk management according to the standards and models*	*The practical software and systems measurement method*
S-3	SLO-1	*Cost of quality*	*Development plan*	*Activity: Test the functionalities of the given project using any functional testing toot*	*Roles, Measurements*	*Measurement According to the CMMI Model*
	SLO-2	*Cost of quality*	*Quality Plan*	*Activity: Test the functionalities of the given project using any functional testing toot*	*Human factors and risk management*	*Measurement According to the CMMI Model*
S-4	SLO-1	*Quality culture*	*Reviews,Personal review and desk check review*	*SCM Activities, Baselines*	*Introduction to supplier management, Supplier requirements*	*Survey as a measurement tool*
	SLO-2	*Five dimensions of a software project*	*Walk through*	*Software Repository and its branches,*	*Agreement Processes, Supplier*	*Survey as a measurement tool*

				Configuration Control	*agreement management according to the CMMI*	
S-5	SLO-1	*Software Engineering code of Ethics*	*Review standards and Models*	*Configuration Status Accounting*	*Managing suppliers*	*Implementing a measurement program*
	SLO-2	*Software Engineering code of Ethics*	*Review standards and Models*	*Software Configuration Audit, Implementing SCM in very small entities with ISO/IEC29110*	*Software Acquisition life cycle*	*Standards, cost of quality and business models*
S-6	SLO-1	*Software quality models- McCall*	*Inspection*	*Policies*	*Software Contract Types*	*ISO 9000 family*
	SLO-2	*Software quality models- McCall*	*Project Launch reviews and project assessments*	*Process*	*Software Contract Reviews*	*IEEE 730 standard for SQA processes*
S-7	SLO-1	*Software quality models -IEEE 1061*	*Agile Meetings*	*Procedures and work instructions*	*Case Study: Prepare Contract Review Document for a project*	*IEEE 730 standard for SQA processes*
	SLO-2	*Software quality models -EEE 1061*	*Measures*	*Organizational standards*	*Case Study: Prepare Contract Review Document for a project*	*Process Maturity models of the SEI*
S-8	SLO-1	*Software quality models -ISO-25000 set of standards*	*Selecting the type of review,Tools*	*Graphical representation of process and procedures*	*Staff Training and Certification*	*Software Quality Assurance Plan*
	SLO-2	*Software quality models -ISO-25000 set of standards*	*Audits, Types, Audits according to the IEEE 1028 standard*	*Graphical representation of process and procedures*	*Staff Training and Certifications*	*Software Quality Assurance Plan*
S-9	SLO-1	*Case Study: Analyzing quality factors involved in a project*	*Case Study: Prepare a development plan for a project.*	*Preventive and corrective actions*	*Management and its Role in Quality Assurance*	*Case study: Prepare a Software Quality Assurance Plan for –interested project*
	SLO-2	*Case Study: Analyzing quality factors involved in a project.*	*Case Study: Prepare a development plan for a project*	*Document control*	*Management and its Role in Quality Assurance*	*Case study: Prepare a Software Quality Assurance Plan for –interested project*

Learning Resources	1. Claude Y.Laporte, Alain April, Software quality Assurance, First edition , IEEE computer Society and Wiley,2018. 2. DanielGalin,"SoftwareQualityAssurancefromtheorytoimplementation",Pearson,2016	3. G.GordonSchulmeyer, "Hand book of Software Quality Assurance", 4th edition, ARTECH HOUSE INC,2008 4. Allen Gilles, "Software quality: Theory and management" - International Thomson - Computer press, 2011

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1.Mr. Benet Zacharias, Senior Consultant, Wipro Consulting Services, Chennai	*1. Dr. A. Amuthan, Professor, Dept. of CSE, Pondicherry Engg. College, Pondicherry.*	*1. Dr. T.S.Shiny Angel, Assistant Professor, SRMIST*
		2. Dr. A. Jeyasekar, Associate Professor, SRMIST

Course Code	18CSE468T	Course Name	SOFTWARE MEASUREMENTS AND METRICS	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*18CSE466T*	Co-requisite Courses	*Nil*	Progressive Courses	*NIL*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Familiarize with different metrics used in different process levels*			
CLR-2 :	*Apply metrics knowledge to measure Engineering problems.*			
CLR-3 :	*Improve their ability in making decisions via continuous practice like assessment and usage of metrics.*			
CLR-4 :	*Design, implement and change metrics based on industry practice*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Understand and measure the software features*	*3*		
CLO-2 :	*Understand the need of software quality*	*3*		
CLO-3 :	*Will be able to understand the software development tools*	*3*		
CLO-4 :	*Evalaute the stages of process improvement and its necessities in Development Life Cycle*	*3*		

Program Learning Outcomes (PLO)														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
L	*H*	-	*H*	*L*	-	-	-	*L*	*L*	-	*H*	-	-	-
M	*M*	*L*	*M*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
M	*M*	*M*	*H*	*L*	-	-	-	*M*	*L*	-	*H*	-	-	-
M	*H*	*M*	*H*	*L*	-	-	*M*	*M*	*L*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Software Sizing Metrics*	*Complexity Metrics and Models*	*Customer Satisfaction Surveys: Methods of survey data collection*	*Software Quality - Five steps to software quality control*	*Conducting In-Process Quality Assessments*
	SLO-2	*Fundamentals in Measurement*		*Sampling Methods*	*Product Quality Metrics with practice*	*The Preparation Phase*
S-2	SLO-1	*Basic Measures*	*Lines of Code*	*Analyzig Satisfaction with practise*	*In-Process Quality Metrics*	*The Evaluation Phase*
	SLO-2	*Reliability and Validity*	*Halstead's Software Science*			*The Summarization Phase*
S-3	SLO-1	*Measurement Errors*	*Cyclomatic Complexity*	*Satisfaction with Company terms*	*Metrics for Software Maintenance*	*Recommendations and Risk Mitigation*
	SLO-2	*Assessing Reliability*	*Syntactic Constructs*			*Conducting Software Project Assessments*
S-4	SLO-1	*Evolution in software Metrics*	*Structure Metrics*	*Metrics for Object-Oriented Projects with tools*	*Ishikawa's Seven Basic Tools with practice*	*Audit and Assessment*
	SLO-2					*Software Process Maturity Assessment and Software Project Assessment*
S-5	SLO-1	*Functional Size Measurements*	*Case Study for the usage of complexity metrics with tools*	*Concepts and Constructs*	*Defect removal Effectiveness*	*Software Process Assessment Cycle*
	SLO-2			*Design and Complexity Metrics*		*Measures and metrics of industry leaders*
S-6	SLO-1	*Cost of counting function point metrics*	*Testing Metrics :Test Progress S Curve*	*Lorenz Metrics and Rules of Thumb*	*The Rayleigh Model*	*Measures and metrics of industry leaders*
	SLO-2					
S-7	SLO-1	*Software measures and metrics not based on function points*	*Testing Defect Arrivals Over Time*	*CK OO Metrics Suite*	*Reliability Growth Models - Jelinski-Moranda Model*	*Measures,Metrics,Innovation*
	SLO-2		*Product Size Over Time*			*Measurements,Metrics and outsource Litigation*
S-8	SLO-1	*Future Technical Developments in Functional Metrics*	*CPU Utilization*	*Productivity Metrics*	*Goel-Okumoto Model*	*Measurements,Metrics and outsource and Behavioral changes*
	SLO-2		*Effort/Outcome Model*			*Software Process Improvement*

						Sequences
S-9	SLO-1	*Case Study to Measure software size using various size Metrics*	*Case Study to apply Testing metrics*	*Case Study for the usage of Object oriented metrics with tools*	*Musa-Okumoto Model*	*Measuring Process Maturity*
	SLO-2					*Measuring Proess Capability*

Learning Resources	1. *Stephen H. Kan, "Metrics and Models in Software Quality Engineering", Addison Wesley,Second Edition,2017.* 2. *CaperJones,"AppliedSoftwareMeasurement:GlobalAnalysisofProductivityandQuality",Third Edition, McGraw Hill Companies,2008*	3. *MarkLorenz,JeffKidd,"Object-OrientedSoftwareMetrics",PrenticeHall,2000* 4. *NareshChauhan,"SoftwareTestingPrinciplesandPractices",OxfordUniversityPress,2010.* 5. *RavindranathPandianC,"SoftwareMetricsAGuidetoplanning,Analysis,andApplication",Auerbach,First Indian Reprint,2011*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Bijoymon Soman Sr. Test Analyst UST Global,Philadelphia,PA, USA	*1.Dr.Arun kumar M N, FISAT, Kerala, amrakmar.mn11@gmail.com*	*1. Mrs.B.Jothi, SRMIST*
		2.Ms Aswathy, SRMIST

Course Code	18CSE469T	Course Name	SOFTWARE PROCESS AND AGILE PRACTICES	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

re-requisite Courses	*Nil*	o-requisite Courses	*Nil*	rogressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the basic concepts of Software process and Agile manifesto*			
CLR-2 :	*Comprehend various Agile principles*			
CLR-3 :	*Gain knowledge on Agile Methodologies*			
CLR-4 :	*Acquire Knowledge on Agile project management and Environment*			
CLR-5 :	*Understand the concepts of Test driven development and Feature driven development*			
CLR-6 :	*Understand the Agile approach to Quality assurance*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Acquire the knowledge of best practices involved in Software process*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Acquire the ability to identify the agile principles for software development*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Understand work products, roles and practices of Scrum, XP, UP and EVO*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Apply the knowledge of Agile methodologies in various projects*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Apply the knowledge of Agile project management and practices*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Acquire the knowledge of Agile quality assurance*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*The nature of Software*	*Agile And Its Significance*	*Agile methodology*	*Agile Project management*	*Agile Quality assurance*
	SLO-2	*Defining Software*	*Agile Story*	*Extreme Programming: Method Overview*	*Multi-team and multi-site development*	*Feature Driven Development*
S-2	SLO-1	*The Software Process*	*Evolutionary delivery, Scrum Demo*	*Life cycle phases*	*Pipelining activities across Iterations*	*Feature Driven Development roles*
	SLO-2	*Software Engineering practice*	*Planning game, Sprint back log, adaptive planning and retrospective*	*Work products*	*Rolling Wave adaptive and predictive planning*	*Feature Driven Development process*
S-3	SLO-1	*Agile Development*	*Agile Motivation*	*Roles and practices*	*Benefits of rolling wave adaptive planning*	*Class Ownership*
	SLO-2	*Agility and the cost of change*	*Challenges With The Waterfall*	*Core practices*	*Agile requirements*	*Reporting*
S-4	SLO-1	*Agile Process*	*Research Evidence*	*Process mixtures*	*Agile modeling*	*Test Driven Development (TDD)*
	SLO-2	*Agile Manifesto & Principles*	*Scrum: Method Overview*	*Strengths of XP*	*Defining and keeping the vision*	*Test Driven Development roles*
S-5	SLO-1	*Software is new product development*	*Life cycle phases*	*Unified process: Method Overview*	*Evolutionary Requirements workshop*	*TDD benefits*
	SLO-2	*Predictable vs. Inventive Projects*	*Work products*	*Work products*	*Gathering requirements*	*TDD Limitations*
S-6	SLO-1	*Iterative and Evolutionary methods*	*Roles and practices*	*Roles and practices*	*Tracking requirement across iterations, Direct user involvement*	*Agile approach to Quality Assurance*
	SLO-2	*Risk driven and client driven planning*	*Core practices*	*Core practices*	*Brainstorming and Brain writing*	*Unscheduled and Scheduled project reviews*
S-7	SLO-1	*Time boxed Iterative development*	*Values of Scrum meeting*	*EVO: Method Overview*	*Mind maps, Team rotation writing*	*Status meeting*
	SLO-2	*Evolutionary and Adaptive development*	*Other practices and values*	*Life cycle phases*	*Agile environment*	*Automated unit tests and Acceptance tests*
S-8	SLO-1	*Adaptive Development*	*Common mistakes and*	*Work products*	*Continuous Integration*	*Exploratory Testing*

			misunderstandings			
	SLO-2	*Incremental Delivery, Evolutionary delivery*	*Sample projects*	*Roles and practices*	*Project Wiki webs, Case tools*	*Code review and code metrics*
S-9	SLO-1	*Specific Iterative methods*	*Process mixtures*	*Core practices*	*Caves and common rooms*	*Continuous Integration*
	SLO-2	*Evolutionary methods*	*Strengths and Weakness of Scrum*	*Process mixtures*	*Reverse engineering*	*Informative Workspaces*

Learning Resources	1. *Bruce R. Maxim Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill Education; Eighth edition,2019* 2. *CraigLarman,"AgileandIterativeDevelopment–AManager'sGuide",PearsonEducation–2010*	3. *ElisabethHendricksonQualityTreeSoftwareInc,"AgileTesting"2008* 4. *Chetankumar Patel, Muthu Ramachandran, Story Card Maturity Model (SMM): A Process ImprovementFrameworkforAgileRequirementsEngineeringPractices,JournalofSoftware, Academy Publishers, Vol 4, No 5 (2009), 422-435, Jul2009.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr.Harihara prasath venkatraman ,Agile Coach,Renault Nissan Technology & Business Centre India , Hariharaprasath.Venkataraman@rntbci.com	*Dr.N.Prakash ,Associate professor , B.S.A. Crescent Institute of Science and Technology*	*Mr.G.Senthil Kumar, Asst.prof (S.G),SRMIST*
	Dr.K.Kumar,Associate professor,Vellore Institute of technology	*Mr.Gouthaman, Asst.Prof., SRMIST*

Course Code	18CSE470T	Course Name	SOTWARE SECURITY	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand the need for Software Security and the threats to software security*			
CLR-2 :	*Incorporate security principles to software development lifecycle*			
CLR-3 :	*Understand Secure software architecture design and coding*			
CLR-4 :	*Gain basic knowledge on web security principles*			
CLR-5 :	*Learn risk management and mitigation of risk in software development*			
CLR-6 :	*Learn testing types and strategies for secure software*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Identify security threats and issues in software*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Gather security related requirements during requirement elicitation*	*2*	*75*	*80*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Design software by incorporating security principles*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Understand the issues in web and database security*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Apply risk management strategies and risk mitigation strategies in software development*	*2*	*75*	*85*	*H*	-	-	*H*	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Apply testing strategies for secure software development*	*2*	*80*	*85*	*H*	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to software Security*	*Secure software architecture and design*	*Browser Security Principles*	*Risk Management Framework*	*Software security testing*
	SLO-2	*Software assurance and software security*	*Software security practices for architecture and design*	*Defining the same-origin policy*	*Five stages of activity*	*Contrasting software testing and software security testing*
S-2	SLO-1	*Threats to Software security*	*Software security knowledge for architecture and design*	*Client-side vs. server-side*	*Applying the RMF*	*Functional testing*
	SLO-2	*Sources of Software Insecurity*	*Software characterization*	*Exceptions to the same origin policy*	*Understanding the business context*	*Risk-based testing*
S-3	SLO-1	*Benefits of detecting software security defects early*	*Threat analysis*	*Cross-site scripting*	*Gathering the artifacts, conducting project research*	*Penetration Testing*
	SLO-2	*Managing Secure software development*	*Architectural vulnerability assessment*	*Reflected, POST-based reflected, stored and local XSS*	*Identifying the business and technical risk*	*Security testing consideration throughout the SDLC*
S-4	SLO-1	*Risk Management framework for Software security*	*Risk likelihood determination*	*XSS defense*	*Developing risk questionnaires, interviewing the target project team*	*Unit testing*
	SLO-2	*Software security practices in the development lifecycle*	*Risk Impact Determination*	*Cross-site request forgery*	*Analyzing the research and interview data*	*Testing Libraries*
S-5	SLO-1	*Properties of secure software*	*Risk Mitigation Planning*	*CSRF defense*	*Uncovering technical risks*	*Testing Executable files*
	SLO-2	*Influencing security properties of software*	*Security principles*	*Prevent XSS*	*Analyzing software artifacts*	*Integration testing*
S-6	SLO-1	*Building a security assurance case*	*Security guidelines and attack patterns*	*SQL Injection*	*Synthesizing and ranking the risk*	*System Testing*
	SLO-2	*Incorporating assurance cases into SDLC*	*Secure coding and testing*	*SQL Injection effects*	*Reviewing the risk data*	*Security Failures*

S-7	SLO-1	*Importance of requirements engineering*	*Code analysis*	*Blind SQL Injection*	*Conducting the business and technical peer review*	*Categories of Errors*
	SLO-2	*Security Requirements Engineering*	*common software code vulnerabilities*	*Setting Database Permissions*	*Defining the risk mitigation strategy*	*Attacker Behaviour*
S-8	SLO-1	*The SQUARE Process model*	*Source code review*	*Stored Procedure Security*	*The importance of measurement*	*Functional and attacker perspectives for Security Analysis*
	SLO-2	*SQUARE sample outputs*	*Coding practices*	*SQL Injection in stored procedures*	*Measurement and metrics in the RMF*	*Identity Management and Software development*
S-9	SLO-1	*Requirements elicitation*	*Sources of additional information on secure coding*	*Insecure direct object references*	*The Cigital Workbench*	*System Complexity drivers and security*
	SLO-2	*Requirements prioritization*	*Best practices for secure coding*	*Pre and post authorization checks*	*Risk Management is a framework for Software security*	*Deep Technical Problem Complexity*

Learning Resources	1. GaryMcGraw,SoftwareSecurity–AGuideforProjectManagers,Addison-Wesley Professional, 2008, ISBN-13:978-0321509178	2. JamesM.Helfrich,SecurityforSoftwareEngineers,CRCPress,TaylorandFrancisGroup2019 3. JamesRansome,Anmol Misra, Core Software Security, CRC Press,Taylorand Francis Group 2014.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2.Mr.Mithun, Cognizant,Mithun.SS@cognizant.com	*2.Dr.KunvarSingh,NITTrichy,kunwar@nitt.edu*	*2.Dr.Usha Krithikka,SRMIST*

Course Code	18CSE471T	Course Name	SOFTWARE MAINTENANCE AND ADMINISTRATION	Course Category	E	*Professional Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	
Course Offering Department	*Computer Science and Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Understand the factors that make change of existing systems both technically challenging and risky, and the processes required to control change.*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Acquire a knowledge and understanding of the specific problems inherent in the reengineering and evolution of legacy software systems, and be able to apply some of the techniques that can be of use in comprehending and changing them*			
CLR-3 :	*Identify the specific challenges that inherent in the reengineering and evolution of data-intensive systems that are able to apply some of the techniques that can be of use in comprehending and changing them*			
CLR-4 :	*Evaluate and understand the specific problems inherent in the reengineering and evolution of package-based software systems, and be able to apply techniques for designing change-resistant systems from pre-packaged code.*			
CLR-5 :	*Analyze and apply numerous administration tools and technical concepts that relate to software administration*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Explaintermsusedinmakechangeofexistingsystemsbothtechnicallychallengingandrisky,andtheprocesses*	*3*	*80*	*70*
CLO-2 :	*Incorporateaknowledgeandunderstandingofthespecificproblemsinherentinthereengineeringandevolutionof*	*3*	*85*	*75*
CLO-3 :	*Identify challenges that inherent in the reengineering and evolution of data-intensive systems that are able to apply some of the techniques*	*3*	*75*	*70*
CLO-4 :	*Apply techniques for designing change-resistant systems from pre-packaged code.*	*3*	*85*	*80*
CLO-5 :	*Apply numerous administration tools and technical concepts that relate to software administration*	*3*	*85*	*75*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	*H*	-	*H*	-	-	-
CLO-2 :	*M*	*H*	*H*	*M*	*H*	-	-	-	*M*	*H*	-	*H*	-	-	-
CLO-3 :	*M*	*H*	*M*	*H*	*H*	-	-	-	*M*	*H*	-	*H*	-	-	-
CLO-4 :	*M*	*H*	*M*	*H*	*H*	-	-	-	*M*	*H*	-	*H*	-	-	-
CLO-5 :	*H*	*H*	*M*	*H*	*H*	-	-	-	*M*	*H*	-	*H*	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Meaning of software maintenance, software change, ongoing support, economic implications of modifying software, the nomenclature and image problem*	*Definition, purposes and objectives*	*Definition for configuration management,*	*Quality Assurance,*	*Analyzing system logs,*
	SLO-2			*change control,*		*operating system updates,*
S-2	SLO-1	*Software maintenance framework,*	*levels of reverse Engineering,*	*documentation*	*fourth generation languages,*	*patches,*
	SLO-2					*configuration changes*
S-3	SLO-1	*Potential solutions to maintenance problem.*	*supports techniques,*	*Management and organizational issues*	*object oriented paradigms*	*Performing backups. Installing*
	SLO-2		*benefits*			*Configuring new hardware and software.*
S-4	SLO-1	*Maintenance process models*	*Reuse and reusability: Definitions,*	*Management responsibilities*	*Maintenance tools*	*Adding,*
	SLO-2	*Definition of critical appraisal of traditional process models,*				*removing,*
S-5	SLO-1	*Maintenance process models.*	*objective and benefit of reuse*	*Enhancing maintenance productivity*	*Criteria for selecting tools,*	*resetting passwords,*
	SLO-2					*System performance tuning*
S-6	SLO-1	*Program understanding: Aims of program comprehension,*	*approach to reuse,*	*maintenance teams*	*taxonomy of tools,*	*updating user account information,*
	SLO-2					

S-7	SLO-1 SLO-2	*maintainers and their information needs comprehension process models*	*Domain Analysis,* *Components engineering,*	*Personnel Education and Training*	*Program understanding and reverse engineering testing,*	*Performing routine audits of systems and software*
S-8	SLO-1 SLO-2	*Mental models, program comprehension strategies, factors that affect understanding,*	*reuse process model,* *Factors that impact upon reuse.*	*Personnel Education and Training*	*Configuration management, and other tasks.*	*Performing routine audits of software*
S-9	SLO-1 SLO-2	*implications of comprehension theories and studies*	*Maintenance measures, Definitions, objectives of software measurement, example measures, guidelines for selecting maintenance measures*	*Organization modes*	*Past, present and future of software maintenance*	*Performing routine audits of systems and software*

Learning Resources	*1. Armstrong A Takang and Penny A.Grubb, "Software Maintenance: concepts and Practice", International Thomson Computer press, London,2015*	*2. Roger S Pressman, "Software Engineering", 6th edition, Tata McGraw-Hill, 2004*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
		1. MrS.Selvakumara Samy., SRMIST
		2., Ms.D.Hema,SRMIST

ACADEMIC CURRICULA

Open Elective Courses

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18ASO101T	Course Name	ELEMENTS OF AERONAUTICS	Course Category	O	*Open Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Aerospace Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning
CLR-1 :	*Understand the art of flying*	1
CLR-2 :	*Understand variation of pressure, temperature, density in the layers of atmosphere and their effect on the flying objects*	2
CLR-3 :	*Identify the types of construction of aircrafts and the working of Engines*	3
CLR-4 :	*Know functions of various components of flying objects and the operating mechanisms*	
CLR-5 :	*Know the working of various types of rockets and satellites*	
CLR-6 :	*Get a bird's eye view of Aerospace Engineering*	

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Describe the evolution of aircrafts and their types*	2	85	75	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	*Describe about the atmosphere and variation in properties, aircraft flight and different speed regimes*	2	85	75	H	H	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	*Explain the basics of aircraft structures, power plants*	2	85	75	H	-	H	H	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	*Explain the basics of aircraft controls and instruments*	2	85	75	H	H	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-5 :	*Describe the basic Space Technology concepts*	2	85	75	H	-	H	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	*Identify the various components and systems in aircraft and describe its working mechanism*	2	85	75	H	H	H	H	-	-	-	-	-	-	-	-	-	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*History of Aviation*	*International Standard Atmosphere*	*Introduction to aircraft construction*	*Aircraft controls*	*Basic principle of rocket propulsion*
	SLO-2	*Imitation of birds, Ornithopters*	*Hydrostatic equation*	*History of Aircraft Construction*	*Functions of aileron, elevator and rudder.*	*Applications of Rockets*
S-2	SLO-1	*Lighter than air vehicles*	*Temperature, pressure and altitude relationships*	*Truss and Monocoque construction*	*Secondary flight controls*	*Types of Rockets*
	SLO-2	*Hot air balloons*	*Gradient and isothermal region*	*Semi-monocoque construction.*	*High lift devices*	*Solid propulsion rockets*
S-3	SLO-1	*George Cayley's contribution*	*Bernoulli's equation for incompressible flow*	*Typical wing Structures*	*Types of control systems*	*Liquid propulsion rockets Working*
	SLO-2	*Otto Lilienthal Contribution*	*Application*	*Fuselage Structures*	*History of Control system evolution*	*Liquid propulsion rockets Advantages and Disadvantages*
S-4	SLO-1	*Wright Brothers contribution*	*Forces acting on aircraft*	*Materials used in Aircraft*	*Mechanical control systems*	*Hybrid and cryogenic rockets*
	SLO-2	*History*	*Moments acting on aircraft*	*Explanation with examples*	*Powered control systems*	*Hybrid and cryogenic rockets Advantages and Disadvantages*
S-5	SLO-1	*Effects of 1st world war*	*How does an aircraft wing generate lift?*	*Types of power plants*	*Fly by wire control systems*	*History of ISRO*
	SLO-2	*Effect of 2nd world war*	*Preliminary explanation*	*Fundamental Classification*	*Basic Operation*	*Establishment of ISRO*

S-6	SLO-1	*Classification of airplanes*	*Basic characteristics of airfoils*	*An insight into air breathing engines*	*Basic instruments for flying*	*Launch vehicles designed and developed by ISRO*
	SLO-2	*Detailed classification*	*NACA nomenclature*	*Piston Engines*	*Pitot static instruments*	*Examples explanation*
S-7	SLO-1	*Components of a simple conventional aircraft*	*Introduction to high speed flight*	*Gas turbine engines*	*Altimeter*	*Principle of Satellite Operation*
	SLO-2	*Functions of each component of a simple conventional aircraft*	*propagation of sound, Mach number*	*Types of Gas turbine engines*	*ASI, VSI*	*Types of Satellites*
S-8	SLO-1	*Introduction to Unmanned aerial vehicles*	*Subsonic and transonic flows*	*Relative merits of piston-prop, turboprop, and jet engines*	*Gyroscopic instruments*	*Satellite applications*
	SLO-2	*Applications of UAV*	*Supersonic and hypersonic flows*	*Comparison based on performance characteristics*	*Turn and slip indicator Artificial horizon.*	*Space Debris*
S-9	SLO-1	*Aviation for society*	*Supersonic flows*	*Relative merits of jet engine*	*Turn and slip indicator*	*Case study-I on successful launches*
	SLO-2	*Aviation for socio economic development*	*Hypersonic flows*	*Comparison based on performance characteristics*	*Artificial horizon*	*Case study-2 on launch failures*

Learning Resources	1. *Charles Harrington Kermode,A.C., Flight Without Formulae, 5th ed., Pearson Education,1970* 2. *Anderson, J.D., Introduction to Flight, 8th ed., Tata McGraw Hill,1996* **3.** *Clancy L.J.., Aerodynamics, 2nd ed., Sterling book house 1975*	4. *Shevell R.S., Fundamentals of flights, 2nd ed., Pearson education 2004* 5. *Kermode.A.C., Mechanics of Flight, 12th ed. Pearson Education 1972* 6. *McKinley, J.L., R.D. Bent, Aircraft Power Plants, McGraw Hill 1993*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	18ASO102T	Course Name	CREATIVITY, INNOVATION AND NEW PRODUCT DEVELOPMENT	Course Category	O	*Open Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Aerospace Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Improve creativity and problem solving methods*			
CLR-2 :	*Improve the knowledge in finding innovative approach to issues*			
CLR-3 :	*Equip students the skills of project selection*			
CLR-4 :	*Understand patent laws and international practices*			
CLR-5 :	*Have expose to design, testing of an engineering product*			
CLR-6 :	*Set the quality standards in developing a prototype of any engineering product*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Understand the importance of thinking ability in the field of engineering*	*2*	*85*	*80*	*H*	*H*	*-*	*-*	*-*	*H*	*H*	*H*	*-*	*H*	*-*	*H*	*-*	*-*	*-*
CLO-2 :	*Update the skills to solve engineering problems*	*2*	*85*	*80*	*H*	*H*	*-*	*-*	*-*	*H*	*H*	*H*	*-*	*-*	*-*	*H*	*-*	*-*	*-*
CLO-3 :	*Undertake better projects which will be helpful for nation development*	*2*	*85*	*80*	*H*	*-*	*-*	*H*	*-*	*H*	*H*	*H*	*H*	*-*	*-*	*H*	*-*	*-*	*-*
CLO-4 :	*Perform better research*	*2*	*85*	*80*	*H*	*H*	*-*	*-*	*-*	*H*	*H*	*H*	*-*	*-*	*H*	*H*	*-*	*-*	*-*
CLO-5 :	*Study and analyze the case studies in the technical way*	*2*	*85*	*80*	*H*	*-*	*H*	*-*	*-*	*H*	*H*	*H*	*H*	*-*	*-*	*H*	*-*	*-*	*-*
CLO-6 :	*Support for the design of quality products and services*	*2*	*85*	*80*	*H*	*H*	*H*	*H*	*-*	*H*	*H*	*H*	*-*	*-*	*H*	*H*	*-*	*-*	*-*

Duration (hour)		**9**	**9**	**9**	**9**	**9**
S-1	SLO-1	*Introduction*	*Collection of ideas*	*Introduction to project evaluation*	*Evaluation of IPR*	*Design of product prototype*
	SLO-2	*The process of technological innovation*	*Categories of ideas*	*Preliminary methods*	*4 traditional forms*	*Factors of design*
S-2	SLO-1	*Factors contributing to successful technological innovation*	*Different routes for collecting ideas*	*Screening methods*	*Definition of IPR*	*Requirement of design*
	SLO-2	*Examples for the factors*	*Examples*	*Examples*	*Development of 7 types of IPR*	*Design process*
S-3	SLO-1	*Technological milestones*	*Taking different views, Combining the unusual*	*Product life cycle*	*Need for IPR in India*	*Functional design*
	SLO-2	*Technological evolution*	*Examples*	*Different organizations*	*Patentable innovation*	*Functional margins*
S-4	SLO-1	*The need for creativity for individual and nation*	*Adapt, adopt & improve*	*Product Evaluation profile*	*Obligations*	*Test and Qualification*
	SLO-2	*The need for innovation for individual and nation*	*Breaking the rules.*	*Stability factors*	*Enforcement measures*	*Types of tests and their significance*
S-5	SLO-1	*Creativity -Obstacles*	*Challenge the assumptions*	*Growth factors*	*Patent search and its advantages*	*Test plan*

	SLO-2	*Problem solving-Obstacles*	*Asking searching questions*	*Marketability factors*	*IP Council*	*Issues in concluding a test*
S-6	SLO-1	*Creativity -keys and questions*	*Increasing the yield*	*Research factors*	*International Treaties*	*Quality standards*
	SLO-2	*Problem solving-keys and questions*	*Implementation methods*	*Development factors*	*Conventions*	*Product Strategy*
S-7	SLO-1	*Brain Storming*	*Purpose and types, Indian National Technology Missions*	*Position factors*	*WIPO*	*Six-sigma Practice Procedure*
	SLO-2	*Examples*	*Detailed explanation*	*Production factors*	*TRIPS*	*Implementation*
S-8	SLO-1	*Different techniques for creative intelligence*	*Project selection criteria*	*Value Engineering*	*WTO*	*Marketing- methods*
	SLO-2	*Detailed explanation with examples*	*Analysis methods*	*Need for value engineering*	*PCT*	*Marketing- research*
S-9	SLO-1	*Case Study-1on technology innovation*	*Case Study-2 on project selection*	*Case Study-3 on project evaluation*	*Case Study-4 on IPR*	*Case Study -5 on product development*
	SLO-2	*Example*	*Example*	*Example*	*Example*	*Example*

Learning Resources	1. *Keleen A.L., New Product Planning and Development, International Correspondence Schools Division, Scraton, Pennsyvania, 1969* 2. *Paul Sloane, The Leader's Guide to Lateral Thinking Skills, 2nd ed., Kogan Page India, New Delhi, 2008* 3. *Department of Space: IPR Manual, Bangalore, 2007* **4.** *Osho, Creativity – Unleashing the Forces Within, St Martin's Griffin, New York, March, 2007*	5. *Abdul Kalam.A.P.J., Arun Tiwari, "Wings of Fire", Universities Press, Hyderabad,1999* 6. *Edward de Bono, How to have a beautiful mind, Vermilon, London, 2004* 7. *Khandwalla, R.N., Fourth Eye (Excellence through creativity), Wheeler Publishing, Allahabad, 1992.* 8. *Rajiv.V.Dharaskar, Innovation-Growth Engine for Nation. Nice Buzzword but often Misunderstood, www.dharaskar.com* **9.** *Annamalai.N., www.creativitysphere*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Dr. A. Sakthivel, CEMILAC, Bangalore, asakthironika@gmail.com	*2. Dr.A.P.Haran, Park College of Engineering & Technology, email: ap_haran@rediffmail.com*	*2. Mr. S. Chandra Sekhar, SRMIST*

Course Code	18ASO103T	Course Name	AVIATION AND AIRLINE MAINTENANCE MANAGEMENT	Course Category	O	*Open Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Aerospace Engineering*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Create insights to the concepts of Air transportation and Airline management*			
CLR-2 :	*Familiarize the concept of Airline forecasting and fleet planning*			
CLR-3 :	*Identify the significance of airline scheduling and equipment maintenance*			
CLR-4 :	*Create insights to the concepts of Aircraft reliability and aging aircraft maintenance*			
CLR-5 :	*Familiarize the aviation supporting organization and state regulatory*			
CLR-6 :	*Familiarize with aviation maintenance and management*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Identify and understand the organization details in air-transportation*	*2*	*85*	*75*	*H*	-	*L*	*L*	*M*	*M*	*M*	*H*	*M*	*M*	*L*	*L*	*M*	*M*	*H*
CLO-2 :	*Identify the forecasting methods in airline*	*2*	*85*	*75*	*H*	-	*L*	*L*	*M*	*L*	*L*	*L*	*M*	*M*	*L*	*L*	*M*	*M*	*H*
CLO-3 :	*Understand the scheduling process and maintenance of aircraft*	*2*	*85*	*75*	*M*	-	-	-	*L*	*M*	*M*	*M*	*M*	*M*	*L*	*L*	*H*	*M*	*M*
CLO-4 :	*Understand the aging aircraft maintenance*	*2*	*85*	*75*	*H*	-	*L*	*M*	*M*	*M*	*L*	*M*	*M*	*M*	*M*	*M*	*M*	*M*	*H*
CLO-5 :	*Understand the aviation supporting organizations and state regulatory*	*2*	*85*	*75*	*H*	-	*L*	*L*	*H*	*M*	*M*	*M*	*M*	*M*	*H*	*M*	*M*	*M*	*M*
CLO-6 :	*Understand the concept of aviation maintenance and management*	*2*	*85*	*75*	*H*	-	*L*	*L*	*M*	*M*	*M*	*M*	*M*	*M*	*L*	*L*	*M*	*M*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Air Transportation*	*Airline Economics*	*Introduction to airline scheduling*	*Aircraft reliability*	*Aviation supporting organisations*
	SLO-2	*Development of Air Transportation*	*Airline Forecasting*	*Mission of Airline scheduling*	*Parameters to monitor*	*World trade organisation*
S-2	SLO-1	*Comparison of Air Transportation with other Modes of Transport*	*Fleet Planning*	*Equipment maintenance*	*Maintenance schedule*	*World tourism organisation*
	SLO-2	*International Aviation Association*	*Aircraft Selection Process*	*Maintenance system of a jet aircraft*	*Maintenance program*	*State regulatory*
S-3	SLO-1	*ICAO*	*Operating Cost*	*Flight operations and crew scheduling*	*Schedule determination*	*Responsibilities and functions of CAA*
	SLO-2	*IATA*	*Passenger Capacity*	*Objective of ground service*	*Condition monitoring maintenance*	*Responsibilities and functions of FAA*
S-4	SLO-1	*Aviation Classification*	*Load Factor*	*Ground operations and facility limitations*	*ETOPS and EROPS*	*DGCA*
	SLO-2	*Factors Affecting General Aviation Industry*	*Passenger Fare and Tariffs*	*Schedule planning and coordination*	*Aircraft depressurization*	*functions of DGCA*
S-5	SLO-1	*Aircraft Uses*	*Influence of Geographical, Economic and Political Factors*	*Traffic flow*	*Aging Aircraft*	*Turbine engine monitoring*
	SLO-2	*airport classification*	*On Routes And Route Selection*	*Schedule salability*	*Maintenance in aging aircraft*	*Turbine engine vibration monitoring*

S-6	SLO-1	*Airline Management*	*Fleet Commonality*	*Schedule Adjustment*	*Operating cost associated with maintenance*	*Onboard maintenance system*
	SLO-2	*Levels of Management*	*Factors Affecting Fleet Choice*	*Chain reaction effect*	*Helicopter maintenance*	*Life usage monitoring*
S-7	SLO-1	*Functions of management*	*Valuation and Depreciation*	*Load factor leverage*	*Maintenance schedule*	*Technology in aircraft maintenance*
	SLO-2	*Management by Objective*	*Budgeting*	*Equipment's and types of schedule*	*Current Capabilities of NDT*	*Airline financing*
S-8	SLO-1	*Principle of organization planning*	*Cost planning*	*Preparing flight plans*	*Applications of NDT in maintenance*	*Sources of fund*
	SLO-2	*Organizational Chart*	*Aircrew Analysis*	*Aircraft scheduling in line with aircraft maintenance practice*	*Equipment and tools for maintenance*	*Globalization*
S-9	SLO-1	*Line management*	*Route Analysis*	*Hub and spoke scheduling*	*Spare maintenance*	*Globalization of airlines*
	SLO-2	*Staff Management*	*Aircraft evaluation*	*Advantages and Disadvantages*	*Future aircraft maintenance*	*Future Challenges*

Learning Resources	1. *John G Wensveen, Air Transportation – A Management Prespective, Ashgate Publications, 8th ed., 2015* **2.** *Friend C.H., Aircraft Maintenance Management, Longman aviation technology. 2nd ed., 1992*	3. *Indian Aircraft Manual, DGCA, sterling book House, Mumbai, reprint 2014* **4.** *PS Senguttuvan, Fundamentals of air transport management, excel books, reprint 2010*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Wg .Cdr K. Manoharan (Retd), Blue Dart Aviation Ltd., manoharank@bluedart.com	*1. Mr. D. Balaji, Professor, KPRIET, Coimbatore, dbalajideva@gmail.com*	*1. K.lynthezhuthon, SRMIST*
2. Dr. Raja S, CSIR-NAL, Bangalore, raja@nal.res.in	*2. Dr. K. M. Parammasivam, Madras Institute of Technology, Chennai, mparams@mitindia.edu*	*2. Mr .G. Mahendra Perumal, SRMIST*

Course Code	18ASO104T	Course Name	AIRCRAFT GENERAL ENGINEERING AND MAINTENANCE PRACTICES	Course Category	O	*Open Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Aerospace Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Identify ground handling tools and equipments to perform ground handling operation of aircraft*			
CLR-2 :	*Maintain the aircraft ground servicing units*			
CLR-3 :	*Upkeep the safety aspects and improve the human relations in working environment.*			
CLR-4 :	*Work in the planning process environment of maintenance industry.*			
CLR-5 :	*Maintain the tools, accessories, components ,minor & major assemblies*			
CLR-6 :	*Utilize the knowledge acquired to work as an efficient maintenance engineer.*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Understand the operation of various ground handling equipments & procedures*	*2*	*85*	*75*	*H*	-	*L*	*L*	*M*	*M*	*M*	*M*	*M*	*M*	*L*	*L*	*M*	*M*	*H*
CLO-2 :	*Acquire knowledge on utility of aircraft ground servicing units and their maintenance*	*2*	*85*	*75*	*H*	-	*L*	*L*	*M*	*L*	*L*	*L*	*M*	*M*	*L*	*L*	*M*	*M*	*H*
CLO-3 :	*Know the safety aspects of usage of fluids & the human performance factors*	*2*	*85*	*75*	*M*	-	-	-	*L*	*M*	*M*	*M*	*M*	*M*	*L*	*L*	*H*	*M*	*M*
CLO-4 :	*Acquire knowledge on different maintenance operational procedures*	*2*	*85*	*75*	*H*	*L*	*L*	*M*	*M*	*M*	*L*	*M*	*M*	*M*	*M*	*M*	*M*	*M*	*H*
CLO-5 :	*Acquire knowledge on various maintenance practices.*	*2*	*85*	*75*	*H*	*L*	*L*	*L*	*H*	*M*	*M*	*M*	*M*	*M*	*H*	*M*	*M*	*M*	*M*
CLO-6 :	*Acquire comprehensive knowledge about ground handling & operational procedure of aircraft & its servicing units.*	*2*	*85*	*75*	*H*	*L*	*L*	*L*	*M*	*M*	*M*	*M*	*M*	*M*	*L*	*L*	*M*	*M*	*H*

Duration (hour)		**9**	**9**	**9**	**9**	**9**
S-1	SLO-1	*Introduction to Aircraft Ground Handling Procédures.*	*Introduction to Maintenance and handling of ground equipment*	*Safety aspects when working with electricity*	*Introduction to Maintenance Procedure*	*Hand Tools*
	SLO-2	*Aircraft Taxing Procedure*	*Maintenance and handling of Compressor*	*Safety aspects when working with oil, gases, oxygen and chemicals*	*Maintenance Planning*	*Care of Tools*
S-2	SLO-1	*Aircraft Towing Operations*	*Maintenance of Portable Hydraulic Test Stand.*	*Remedial action during an incident*	*Modification Procedure*	*Calibration of tools and equipment*
	SLO-2	*Safety Precautions during Towing Operations*	*Handling of Portable Hydraulic Test Stand*	*Remedial action during an accident.*	*Stores Procedure*	*Calibration standards*
S-3	SLO-1	*Aircraft Jacking Procedure*	*Maintenance of Electric power supply equipment*	*Human Factors*	*Certification Procedure*	*Control Cables*
	SLO-2	*Safety Precautions during Jacking Procedure*	*Handling of Electric power supply equipment*	*Human Error, Murphy's Law*	*Release Procedure*	*Pipes and Unions*
S-4	SLO-1	*Chocking & Mooring Operations*	*Maintenance of Charging Trolley*	*Human performance and limitations – Vision& Hearing*	*Interface with aircraft operation*	*Transmissions*
	SLO-2	*Safety Precautions during Chocking & Mooring Operations*	*Handling of Charging Trolley*	*Information Processing*	*Maintenance, Inspection*	*Bearing & Hoses*
S-5	SLO-1	*Aircraft Storage Methods*	*Maintenance of Air-conditioning and Heating Unit*	*Attention & Perception*	*Quality control*	*Springs*

	SLO-2	*Storage of Rotables*	*Handling of Air-conditioning and Heating Unit*	*Memory & Physical Access*	*Quality assurance*	*NDT Techniques*
S-6	SLO-1	*Refueling Procedures*	*Maintenance of Ground Support Air Starter Unit*	*Claustrophobia*	*Publications*	*Engineering drawing diagrams*
	SLO-2	*Defueling Procedures*	*Handling of Ground Support Air Starter Unit*	*Factors affecting human performance – Workload*	*Bulletins*	*Standards*
S-7	SLO-1	*Aircraft Deicing Procedures*	*Maintenance of Oil Pressure Unit*	*Stress*	*Airworthiness Directives*	*Fits and Clearance*
	SLO-2	*Aircraft Anti-icing Procedures*	*Handling of Oil Pressure Unit*	*Time Pressure & Deadlines*	*Structural Repair Manual*	*Welding & Swaging*
S-8	SLO-1	*Effect of environmental condition on aircraft handling and operation*	*Maintenance of Fire extinguishers*	*Medication*	*Overhaul Manual*	*Brazing & Soldering*
	SLO-2	*Aircraft cleaning and Maintaining*	*Handling of Fire extinguishers*	*Noise & Fumes*	*Log Books*	*Bondings*
S-9	SLO-1	*Ground signaling, Marshaling of aircraft in day time*	*Maintenance of Jacks, Cranes, Ladders, Platforms, Trestles & Chocks*	*Climate & Temperature*	*Introduction to ATA*	*Corrosion and its removal*
	SLO-2	*Ground signaling, Marshaling of aircraft in night time.*	*Handling of Jacks, Cranes, Ladders, Platforms, Trestles & Chocks*	*Working Environment*	*ATA Specifications*	*Trouble shooting techniques.*

Learning Resources	1. *Airframe and Power plant Mechanics, General Hand Book, Federal Aviation Administration, AC65 – 9A* 2. *Airframe and Power plant Mechanics, Airframe Hand Book, Federal Aviation Administration, AC65 – 15A* 3. *Civil Aviation Inspection(CAP 459) Part – II* **4.** *Acceptable Methods, Techniques & Practices (FAA) – EA-AC43.13-1A & 2A*	5. *Michael J.Kroes, William A.Watkins ad Frank Delp, Aircraft Maintenance and Repair, 7th ed., Tata McGraw Hill, New Delhi, 2013* **6.** *CAP 715 – An Introduction to Aircraft Maintenance Engineering Human Factors for JAR 66, Civil Aviation Authority, UK*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply / Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate / Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Wg .Cdr K. Manoharan (Retd), Blue Dart Aviation Ltd., manoharank@bluedart.com	*1. Dr.A.P.Haran, Park College of Engineering & Technology, email: ap_haran@rediffmail.com*	*1. Dr. S. Sivakumar, SRMIST*
2. Dr. Raja S, CSIR-NAL, Bangalore, raja@nal.res.in	*2. Dr. K. M. Parammasivam, Madras Institute of Technology, Chennai, mparams@mitindia.edu*	*2. Mr .G. Mahendra Perumal, SRMIST*

Course Code	18ASO105T	Course Name	FLOW VISUALIZATION TECHNIQUES	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Aerospace Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	Identify the type of flow visualization used in air flow																		
CLR-2 :	Identify the type of flow visualization used in water flow																		
CLR-3 :	Identify the type of flow visualization for compressible flow																		
CLR-4 :	Assess the need of image-based measurement like Particle Image Velocimetry																		
CLR-5 :	Understand the operation of various other flow visualization techniques																		
CLR-6 :	Utilize the knowledge acquired about various flow visualization for improving the aerodynamics																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Understand Flow Visualization requirements and applications	2	80	70	H	-	H	L	-	-	M	-	-	-	-	-	-	M	L
CLO-2 :	Acquire knowledge on Flow Visualization using air and water	2	80	70	H	-	H	L	-	-	-	-	-	-	-	-	H	M	M
CLO-3 :	Learn the working principles of compressible flow visualization techniques	2	80	70	H	-	H	L	-	-	-	-	-	-	-	-	-	M	M
CLO-4 :	Appreciate the usefulness of Particle Image Velocimetry, setup, working and its applications	2	80	70	H	-	H	L	H	-	-	-	-	-	-	-	H	H	H
CLO-5 :	Gain knowledge on various other visualization techniques	2	80	70	H	-	H	L	M	-	-	-	-	-	-	-	M	M	M
CLO-6 :	Acquire comprehensive understanding of various flow visualization techniques and their applications	2	80	70	H	-	M	L	-	-	M	-	-	-	-	-	M	M	M

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Flow Visualization	Safety requirements	Skin Friction Visualization	Holographic Interferometer	Tracer Methods
	SLO-2	Need for Flow Visualization	Safety procedures	Requirements for Skin Friction	Applications of Holographic Interferometer	Hydrogen Bubble Method
S-2	SLO-1	Applications of Flow Visualization	Chemical Safety	Interferometer	Particle Image Velocimetry (PIV)	Dye Injection
	SLO-2	Types of Flow Visualization	Human Safety	Fringe Imaging	PIV and its Types	Types of dye
S-3	SLO-1	Flow Visualization in Water	Surface Visualization	Compressible Flow Visualization	PIV Setup	Spark Tracer Technique
	SLO-2	Laminar Flow Visualization	Need for Surface Visualization	Gladstone Dale Relation	PIV Procedure	Spark Tracer Setup
S-4	SLO-1	Hele-Shaw Apparatus	Surface Visualization versus Surface Measurements	Requirements for Optics	Pulse Signals	Molecular Tagging Velocimetry (MTV)
	SLO-2	Dye Injection Method	Advantages of Surface Visualization	Optics and Setup procedures	Synchronizer	Setup for MTV
S-5	SLO-1	Flow Visualization in Air	Wall Shear Stress	Shadowgraph	Imaging for PIV	Thermometry
	SLO-2	Usage of Tufts	Need for Wall Shear Stress Study	Shadowgraph procedure	Image Correlation	Devices for Thermometry

S-6	SLO-1	*Smoke Generators*	*Surface Pressure Visualization*	*Schlieren*	*Video Recording*	*Low density flow visualization*
	SLO-2	*Smoke Injection Methods*	*Pressure Sensitive Paints (PSP)*	*Schlieren procedure*	*Video Imaging*	*Challenges for low density flow study*
S-7	SLO-1	*Light Sources*	*Application of PSP on Surfaces*	*Mach Zehnder Interferometer*	*Postprocessing PIV data*	*Electron Beam Flow visualization*
	SLO-2	*Light Diffuser*	*Time resolved PSP*	*Mach Zehnder Interferometer Setup*	*Post processing PIV software*	*Glow Discharge visualization*
S-8	SLO-1	*Laser Sources*	*Surface Flow Visualization*	*Fresnel Equation*	*Error Sources in PIV*	*Surface Temperature Visualization*
	SLO-2	*Laser Sheet for smoke visualization*	*Shear Sensitivity*	*Applications of Mach Zehnder Interferometer*	*Applications of PIV*	*Temperature Sensitive Paints (TSP)*
S-9	SLO-1	*Photographic Equipment*	*Liquid Crystal Coating*	*Holography*	*3D PIV*	*3D Imaging*
	SLO-2	*Photographic Techniques*	*Choice of Liquid Crystals*	*Holography setup*	*Setup for 3D PIV*	*3D Image processing*

Learning Resources	1. *Alexander J Smits, TT Lim, Flow Visualization: Techniques and Examples, 2nd ed., Imperial College Press, 2012* 2. *Rathakrishnan E, Instrumentation, Measurements, and Experiments in Fluids, 1st ed., CRC Press, 2007* 3. *Settles G S, Schlieren and Shadowgraph Techniques: Visualizing Phenomena in Transparent Media, 1st ed., Springer, 2001*	4. *Merzkirch W (Ed Gersten K), Techniques of flow visualization, AGARDograph No. 302, 1984* 5. *Journal of Visualization, Springer* 6. *Journal of Visualization and Image processing, Begell House*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Dr. Raja S, CSIR-NAL, email: raja@nal.res.in	*2. Dr. Parammasivam K M, MIT, Chennai, email: mparams@mitindia.edu*	*2. Dr. Kannan B T, SRMIST*

Course Code	18ASO106T	Course Name	AIRPORT ENGINEERING	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Aerospace Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Familiarize about airports and surveys			
CLR-2 :	Understand about airport planning and forecasting			
CLR-3 :	Understand and design runway and taxiways			
CLR-4 :	Understand about air traffic control tower and terminal areas			
CLR-5 :	Understand about helipads and STOL ports			
CLR-6 :	Utilize the knowledge acquired to work as an airport engineer			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Identify airports and surveys involved	2	85	75	H	-	L	L	M	M	M	M	M	M	L	L	M	M	H
CLO-2 :	Identify airport planning and forecasting	2	85	75	H	-	L	L	M	L	L	L	M	M	L	L	M	M	H
CLO-3 :	Understand and design runway and taxiways	2	85	75	M	-	-	-	L	M	M	M	M	M	L	L	H	M	M
CLO-4 :	Understand about air traffic control tower and terminal areas	2	85	75	H	L	L	M	M	M	L	M	M	M	M	M	M	M	H
CLO-5 :	Understand about helipads and STOL ports	2	85	75	H	L	L	L	H	M	M	M	M	M	H	M	M	M	M
CLO-6 :	Acquire comprehensive knowledge about airport and the utilities.	2	85	75	H	L	L	L	M	M	M	M	M	M	L	L	M	M	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	International airport authority of India	Airport Planning	Runway design	Planning and design of terminal area	Heliport
	SLO-2	Civil aviation department	Improvement of existing Airport	Runway orientation	Terminal building	Advantages of helicopter
S-2	SLO-1	Airport Authority of India	Airport site selection	Change in direction of runway	Passenger Flow	Characteristics of helicopter
	SLO-2	Open sky policy	Factors influence location	Basic runway length	Sequence of activity	Planning of heliport
S-3	SLO-1	Airport terminology	Airport size	Corrections to basic runway length	Size of apron	Site Selection
	SLO-2	Aircraft Classification	Factors affecting size of airport	Runway patterns	Hangars	Obstruction clearance requirements
S-4	SLO-1	Components parts of Aeroplane	Aviation Forecasting	Comparison of runway patterns	Typical airport layout	Elevated heliport
	SLO-2	Aircraft Characteristics	Important aspects	Taxiway design	Air Traffic Control	Marking and lighting of heliport
S-5	SLO-1	Jet Aircraft Characteristics	Airport obstructions	Layout of taxiways	Significance of ATC	Heliport in airport
	SLO-2	Civil and military aircrafts	Imaginary surface	Geometric standards for taxiway	Flight Rules	STOL ports

S-6	SLO-1	*Classification of aerodrome*	*Objects with actual height*	*Exit taxiways*	*ATC Network*	*Characteristics of STOL Aircraft*
	SLO-2	*Classification of airports*	*Clear Zone*	*Location of exit taxiway*	*ATC Aids*	*Advantages of STOL Aircraft*
S-7	SLO-1	*Flying Activities*	*Turning zone*	*Design of exit taxiways*	*Classification*	*Planning of STOL Port*
	SLO-2	*Scheduled and non-scheduled flights*	*Zoning Laws*	*Loading aprons*	*Automation in ATC Aids*	*Aspects of the planning*
S-8	SLO-1	*Airport Survey*	*Environmental considerations*	*Holding Aprons*	*GPS ATC*	*Obstruction clearance requirements*
	SLO-2	*Objectives and types of survey*	*Factors influenced by airport activity*	*Fillets*	*Free Flight ATC*	*Runway and taxiway of STOL port*
S-9	SLO-1	*Drawings to be Prepared*	*Pollution factor*	*Separation Clearance*	*Free flight types*	*Lighting of STOL Port*
	SLO-2	*Types of plan*	*Social factor*	*Bypass or turnaround taxiway*	*Approaches of free flight*	*Marking of STOL Port*

Learning Resources	1. *Rangwala. Airport Engineering, Charotar Publishing House Pvt., 15th ed., 2015*	**2.** *Norman J. Ashford, Saleh A. Mumayiz, Paul H. Wright. Airport Engineering: Planning, Design and Development of 21St - Century Airports", 4th ed., CBS Publishers & Distributors. April 2011*

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply / Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate / Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Dr. Raja S, CSIR-NAL, Bangalore, raja@nal.res.in	*2. Dr. K. M. Parammasivam, Madras Institute of Technology, Chennai, mparams@mitindia.edu*	*2. Mr .G. Mahendra Perumal, SRMIST*

Course Code	18ASO107T	Course Name	MOLECULAR GAS DYNAMICS	Course Category	O	*Open Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Aerospace Engineering*	Data Book / Codes/Standards		*Nil*	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Understand need for molecular description of fluid flow*			
CLR-2 :	*Know the importance of binary collision and the Boltzmann equation*			
CLR-3 :	*Understand the significance of elastic and inelastic collision*			
CLR-4 :	*Demonstrate the chemical reactions and thermal radiation with respect to engineering problem*			
CLR-5 :	*Know importance of collisionless flow*			
CLR-6 :	*Understand the numerical technique for microscopic and mesoscopic method*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Explain the importance of molecular perspective fluid flow*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	*M*	*M*	*M*
CLO-2 :	*Describe the binary collision and need for Boltzmann equation*	*2*	*80*	*75*	*H*	*H*	-	-	-	-	-	-	-	-	-	-	*L*	*H*	*L*
CLO-3 :	*Explain the difference between inelastic and elastic collision and its significance*	*2*	*85*	*80*	*H*	-	-	-	-	-	-	-	-	-	-	-	*M*	*M*	*M*
CLO-4 :	*Explain the role of bimolecular reactions and termolecular reactions in chemical reaction*	*2*	*80*	*75*	*H*	*H*	-	*L*	-	-	-	-	-	-	-	-	*M*	*M*	*M*
CLO-5 :	*Describe the significance of collisionless flow*	*2*	*80*	*75*	*H*	*H*	-	*L*	-	-	-	-	-	-	-	-	*M*	*H*	*M*
CLO-6 :	*Explain the need for mesoscopic and microscopic numerical technique for fluid flow*	*2*	*80*	*75*	*H*	*H*	-	*L*	*M*	-	-	-	-	-	-	-	*L*	*H*	*L*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to kinetic theory*	*The bolzamnn equation: The evaluation of phase-space distribution function*	*Collision theory for bimolecular reactions*	*Bimodal distributions*	*Computational technique for mesoscopic method: The Direct Simulation Monte Carlo (DSMC) method, Lattice Boltzmann Method (LBM)*
	SLO-2	*Hydrostatitics, hydrodynamics*				
S-2	SLO-1	*Gas kinetic theroy*	*The Boltzmann collision intergral*	*Reaction cross-sections for given reaction rates*	*Molecular effusion and transpiration*	*DSMC algorithm*
	SLO-2		*The H-theorem*			
S-3	SLO-1	*Molecular model: need for a molecular description of fluid flow*	*BGK approximation*	*Extension to termolecular reactions*	*One dimensional steady flwos*	*DSMC working principle, advances in DSMC method*
	SLO-2		*Nonequilibrium solutions of Boltzmann equation*			
S-4	SLO-1	*The simple dilute gas, real gas effects*	*Ellastic collision: collision corss-section, collision dynamics*	*Chemical equilibrium*	*One-dimensional unsteady flows*	*Lattice gas automata (LGA)*
	SLO-2					
S-5	SLO-1	*Macroscopic properties in a simple gas*	*The inverse power law model, hard sphere model*	*The equilibrium collision theory*	*Transfer of normal, tangential momentum, transfer of translational energy*	*LGA to lattice Boltzmann equation*
	SLO-2					

S-6	SLO-1	*Distribution function, Phase space distributions*	*Variable hard sphere model*	*The dissociation reaction, recombination reaction*	*Free molecular heat transfer, recovery temperature*	*LBM algorithm, boundary and initial conditions*
	SLO-2	*The Maxwell-Boltzmann distribution*	*Variable soft sphere model*			
S-7	SLO-1	*Maxwell assumption, Distribution of molecular speeds*	*Generalized hard sphere model, Maxwell model*	*The exchange and ionization reactions*	*Stanton number and thermal recovery factor*	*Computational technique for microscopic method: Molecular Dynamics (MD)*
	SLO-2					
S-8	SLO-1	*Mixture of gases*	*Larsen-Borgnakke model in a simple gas and gas mixture*	*Classical model for rotation radiation*	*Thermophoresis, flow with multiple reaction*	*Description of MD method, the force calculation*
	SLO-2					
S-9	SLO-1	*Moments of Maxwell-Boltzmann distribution*	*Vibrational and electronic energy, gas-surface interaction*	*Bound-bound radiation*	*Test-particle Monte Carlo mehtod*	*Integrating equations of motion and solution methods.*
	SLO-2					

Learning Resources	1. *Gombosi, Tamas I., and Atmo Gombosi. Gaskinetic theory. No. 9. Cambridge University Press, 1994.* 2. *Bird, Graeme A., and J. M. Brady. Molecular gas dynamics and the direct simulation of gas flows. Vol. 5. Oxford: Clarendon press, 1994.* **3.** *Kruger, Ch H., and W. G. Vincenti. "Introduction to physical gas dynamics." John Wlley & Sons (1965).*	4. *Frenkel, Daan, et al. "Understanding molecular simulation." Computers in Physics 11.4 (1997): 351-354.* 5. *Anderson, John David. Modern compressible flow: with historical perspective. Vol. 12. New York: McGraw-Hill, 1990.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Expert
Mr. Amit Palankar, GE aviation, Bangalore, palankr.amit@gmail.com	*Dr.Arun Kumar P, Indian Institute of Technology Jammu, email: arun.perumal@iitjammu.ac.in*	*Dr. Malaikannan G, SRMIST*

Course Code	18BTO101T	Course Name	HUMAN HEALTH AND DISEASES	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	State the basic structural organization of human health system	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Summarize the etiology of human infectious diseases			
CLR-3 :	Describe immune system of human body and immune disorders			
CLR-4 :	Impart information about genetic disease			
CLR-5 :	Indicate the high risk diseases associated with modern society			
CLR-6 :	State about disease diagnosis and treatment strategies			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Recall basic human biology at the genetic, cellular, and physiological levels	2	80	70	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H
CLO-2 :	Interpret how the human body maintains a healthy balance, and how disturbances of this balance underlie diseases	2	85	75	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H
CLO-3 :	Discuss about infectious organism and understand defense mechanism of our human body	2	75	70	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H
CLO-4 :	Describe disease causing agents	2	85	80	-	-	-	L	-	M	-	-	-	H	-	H	-	L	H
CLO-5 :	Familiarize with modern biomedical scientific approaches to treat disease.	2	85	75	-	-		L	-	M	-	M	-	H	-	H	H	H	H
CLO-6 :	Demonstrates the importance of taking responsibility for one's own health	2	80	70	-	-	-	L	-	M	-	H	-	H	-	H	-	H	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to human heath	Concepts of human disease	Immune system	Mendelian genetics	Disease Diagnosis
	SLO-2	Anatomy and physiology	Disease Disorder and syndrome	Physical chemical and cellular barrier	Genetics of simple and complex traits	Treatment strategy
S-2	SLO-1	Respiratory system	Pathology of disease	Types of Immune cell	Hereditary disease	Biomedical Instruments
	SLO-2	Circulatory system	Mechanism of disease	Humoral and cell mediated immunity	Karyotype preparation and analysis Chromosome abnormality	Biosensors
S-3	SLO-1	Digestive system	Infectious disease	Cells Involved in inflammation	Thalassemia	Drug designing and development
	SLO-2	Execratory system	Causative agents Bacteria, virus and parasites	Inflammatory Process	Cystic fibrosis	Computer aided drug designing
S-4	SLO-1	Reproductive system	Bacteria: Introduction Pathogenesis	Immune disorders	Duchene Muscular dystrophy	Drug metabolism
	SLO-2	Fertilization and embryogenesis	Bacterial toxins	Abscesses, ulcer, cellulitis And Allergy	Sickle cell anemia	ADME property of a drug
S-5	SLO-1	Cell structure	virulence of bacterial infection	Autoimmunity	Indian genetic disease database	Sources of drug- plants and microbes
	SLO-2	Tissue types	Antibiotic resistance strains	Immunodeficiency	Human gene mutation database	Route of administration

S-6	SLO-1	*How body gets energy*	*Virus: An overview of replication cycle of virus*	*High risk disease of modern society*	*Principle class of metabolic disorders*	*Bulk Drugs and processing*
	SLO-2	*ATP Synthesis*	*Effect of virus infection in the host cell*	*Obesity, Hypertension and diabetics*	*Inherited Metabolic disorders*	*Active pharmaceutical ingredient*
S-7	SLO-1	*Cell metabolism*	*Epidemiology*	*Neoplasm*	*Metabolic syndrome*	*Vaccines types, Recommendation by age*
	SLO-2	*Cell cycle*	*Roots of spreading, Emerging and reemerging virus*	*Oncogenes and tumor suppressor genes*	*Risk factors*	*Vaccines – Recent advancement*
S-8	SLO-1	*Checkpoints in cell division*	*Parasitosis, common parasites of human*	*Types of cancer*	*Lysozyme storage disease: Molecular basis*	*Immunotherapy*
	SLO-2	*Cell division -Mitosis and Meiosis*	*Plasmodium – life cycle and disease*	*Stages of cancer*	*List of proteins involved in LSD*	*Immunotherapeutic approaches currently in use*
S-9	SLO-1	*Growth factors- overview*	*Fungal Infections*	*Cancer in future*	*Balanced nutrition and Malnutrition*	*Stem cell therapy*
	SLO-2	*Types and function*	*Endemic mycoses in immunocompromised patients*	*Life style and cancer risk*	*Deficiency disease*	*Gene therapy*

Learning Resources	1. *Goodenough and McGuire, Biology of Humans: Concepts, Applications and issues, 4th ed., Benjamin Cummins/Pearson Publisher, 2011*	2. *Marianne Neighbors, Ruth Tannehil, Human Diseases, 4th ed.,Jones Cengage learning, 2015*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences Pvt Ltd, Chennai, ramchand@saksinlife.com	*1. Prof. K Subramaniam, IITM, Chennai, subbu@iitm.ac.in*	*1. Dr. Lilly M Saleena, SRMIST*
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	*2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in*	*2. Dr.Priya Swaminathan, SRMIST*

Course Code	18BTO102T	Course Name	MODELLING OF BIOMOLECULES	Course Category	O	*Open Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Biotechnology*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*State the basic structural organization of human health system*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Summarize the etiology of human infectious diseases*			
CLR-3 :	*Describe immune system of human body and immune disorders*			
CLR-4 :	*Impart information about genetic disease*			
CLR-5 :	*Indicate the high risk diseases associated with modern society*			
CLR-6 :	*State about disease diagnosis and treatment strategies*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Recall basic human biology at the genetic, cellular, and physiological levels*	2	80	70
CLO-2 :	*Interpret how the human body maintains a healthy balance, and how disturbances of this balance underlie diseases*	2	85	75
CLO-3 :	*Discuss about infectious organism and understand defense mechanism of our human body*	2	75	70
CLO-4 :	*Describe disease causing agents*	2	85	80
CLO-5 :	*Familiarize with modern biomedical scientific approaches to treat disease.*	2	85	75
CLO-6 :	*Demonstrates the importance of taking responsibility for one's own health*	2	80	70

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Recall basic human biology at the genetic, cellular, and physiological levels*	-	-	-	*L*	-	*M*	-	-	-	*H*	-	*H*	-	*L*	*H*
CLO-2 :	*Interpret how the human body maintains a healthy balance, and how disturbances of this balance underlie diseases*	-	-	-	*L*	-	*M*	-	-	-	*H*	-	*H*	-	*L*	*H*
CLO-3 :	*Discuss about infectious organism and understand defense mechanism of our human body*	-	-	-	*L*	-	*M*	-	-	-	*H*	-	*H*	-	*L*	*H*
CLO-4 :	*Describe disease causing agents*	-	-	-	*L*	-	*M*	-	-	-	*H*	-	*H*	-	*L*	*H*
CLO-5 :	*Familiarize with modern biomedical scientific approaches to treat disease.*	-	-		*L*	-	*M*	-	*M*	-	*H*	-	*H*	*H*	*H*	*H*
CLO-6 :	*Demonstrates the importance of taking responsibility for one's own health*	-	-	-	*L*	-	*M*	-	*H*	-	*H*	-	*H*	-	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to human heath*	*Concepts of human disease*	*Immune system*	*Mendelian genetics*	*Disease Diagnosis*
	SLO-2	*Anatomy and physiology*	*Disease Disorder and syndrome*	*Physical chemical and cellular barrier*	*Genetics of simple and complex traits*	*Treatment strategy*
S-2	SLO-1	*Respiratory system*	*Pathology of disease*	*Types of Immune cell*	*Hereditary disease*	*Biomedical Instruments*
	SLO-2	*Circulatory system*	*Mechanism of disease*	*Humoral and cell mediated immunity*	*Karyotype preparation and analysis Chromosome abnormality*	*Biosensors*
S-3	SLO-1	*Digestive system*	*Infectious disease*	*Cells Involved in inflammation*	*Thalassemia*	*Drug designing and development*
	SLO-2	*Execratory system*	*Causative agents Bacteria, virus and parasites*	*Inflammatory Process*	*Cystic fibrosis*	*Computer aided drug designing*
S-4	SLO-1	*Reproductive system*	*Bacteria: Introduction Pathogenesis*	*Immune disorders*	*Duchene Muscular dystrophy*	*Drug metabolism*
	SLO-2	*Fertilization and embryogenesis*	*Bacterial toxins*	*Abscesses, ulcer, cellulitis And Allergy*	*Sickle cell anemia*	*ADME property of a drug*
S-5	SLO-1	*Cell structure*	*virulence of bacterial infection*	*Autoimmunity*	*Indian genetic disease database*	*Sources of drug- plants and microbes*
	SLO-2	*Tissue types*	*Antibiotic resistance strains*	*Immunodeficiency*	*Human gene mutation database*	*Route of administration*

S-6	SLO-1	*How body gets energy*	*Virus: An overview of replication cycle of virus*	*High risk disease of modern society*	*Principle class of metabolic disorders*	*Bulk Drugs and processing*
	SLO-2	*ATP Synthesis*	*Effect of virus infection in the host cell*	*Obesity, Hypertension and diabetics*	*Inherited Metabolic disorders*	*Active pharmaceutical ingredient*
S-7	SLO-1	*Cell metabolism*	*Epidemiology*	*Neoplasm*	*Metabolic syndrome*	*Vaccines types, Recommendation by age*
	SLO-2	*Cell cycle*	*Roots of spreading, Emerging and reemerging virus*	*Oncogenes and tumor suppressor genes*	*Risk factors*	*Vaccines – Recent advancement*
S-8	SLO-1	*Checkpoints in cell division*	*Parasitosis, common parasites of human*	*Types of cancer*	*Lysozyme storage disease: Molecular basis*	*Immunotherapy*
	SLO-2	*Cell division -Mitosis and Meiosis*	*Plasmodium – life cycle and disease*	*Stages of cancer*	*List of proteins involved in LSD*	*Immunotherapeutic approaches currently in use*
S-9	SLO-1	*Growth factors- overview*	*Fungal Infections*	*Cancer in future*	*Balanced nutrition and Malnutrition*	*Stem cell therapy*
	SLO-2	*Types and function*	*Endemic mycoses in immunocompromised patients*	*Life style and cancer risk*	*Deficiency disease*	*Gene therapy*

Learning Resources	1. *Goodenough and McGuire, Biology of Humans: Concepts, Applications and issues, 4th ed., Benjamin Cummins/Pearson Publisher, 2011*	2. *Marianne Neighbors, Ruth Tannehil, Human Diseases, 4th ed.,Jones Cengage learning, 2015*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences Pvt Ltd, Chennai, ramchand@saksinlife.com	*1. Prof. K Subramaniam, IITM, Chennai, subbu@iitm.ac.in*	*1. Dr. Lilly M Saleena, SRMIST*
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	*2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in*	*2. Dr.Priya Swaminathan, SRMIST*

Course Code	18BTO103T	Course Name	ACTIVATED CARBON TECHNOLOGY	Course Category	O	*Open Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Biotechnology*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*State a basic understanding of activated carbon and its industrial applications.*			
CLR-2 :	*Demonstrate the preparation of the material from different sources of waste*			
CLR-3 :	*Apply the engineering aspects of the adsorbents*			
CLR-4 :	*Prepare the adsorbents for the waste water treatment plants*			
CLR-5 :	*Analyze the problems of the industrial effluents that are hazardous to the environment*			
CLR-6 :	*Apply a solution to solve the industrial effluent problems*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Discuss about the activated carbon from different sources and subsequent knowledge to apply industrially*	*1*	*80*	*80*	*H*	*H*	*H*	*H*	*-*	*M*	*L*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-2 :	*Prepare the activated carbon from different sources*	*2*	*85*	*75*	*H*	*H*	*H*	*H*	*-*	*-*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-3 :	*Explain the kinetics on the adsorption of heavy metals, dyes and toxic substances*	*2*	*75*	*80*	*M*	*H*	*M*	*H*	*M*	*M*	*-*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-4 :	*Evaluate mechanism of activated carbon that is ultimately responsible for removing the toxic substance from the effluent*	*2*	*85*	*80*	*H*	*H*	*H*	*H*	*-*	*-*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-5 :	*Design an alternative adsorption process and present the solution to adsorption problems.*	*3*	*85*	*75*	*H*	*H*	*H*	*H*	*-*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*
CLO-6 :	*Formulate the activated carbon for better environment*	*2*	*80*	*80*	*H*	*H*	*H*	*H*	*L*	*M*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Activated Carbon and Its Surface Structure*	*Principle of Adsorption Kinetics*	*Activated adsorption from solutions*	*Principle of AAS and its applications*	*Application of activated adsorption technology in the waste water treatment*
	SLO-2	*Basics of activated carbon*	*Effect of contact time on the adsorption characteristics*	*Types of isotherms for solution phase*	*AAS analysis of dyes adsorption by activated carbon*	*Application of Activated Carbon in Environmental Pollution*
S-2	SLO-1	*Historical Perspective ofActivated Carbon Adsorption and its Integration with Biological Processes*	*Effect of pH on the adsorption characteristics*	*Types of adsorption isotherm sorbent selection*	*Characterizing the pore structure of the carbon by SEM*	*Integration of Activated Carbon Adsorption with Biological Processes in Wastewater and Water Treatment*
	SLO-2	*Activated carbon-crystalline structure, porous structure and chemical structure*	*Effect of agitation and adsorbent dosage on the adsorption characteristics e*	*Regeneration of activated carbon*	*Proximate analysis of activated carbon prepared from various raw materials*	*Industrial waste water treatment using natural material as an adsorbent*
S-3	SLO-1	*Types of materials from different sources*	*Thermodynamic parameters like change in free energy, enthalpy and entropy for the process of removal*	*Batch adsorption kinetics*	*Principles of FTIR analysis for the prepared activated carbon*	*AC on the removal of hazardous organic and inorganic compounds from industrial waste water*
	SLO-2	*Preparation of granulated and powder activated carbon*	*Contact Oxidation Process Followed by Activated Carbon*	*Factors influencing adsorption from binary solution*	*X-ray refractive diffraction (XRD) studies for activated carbon*	*AC on the removal of hazardous gases and vapors from industrial flue gases*
S-4	SLO-1	*Influence of carbon-oxygen surface groups of adsorption properties*	*Models, and types of adsorption*	*Transport processes in adsorption from liquid phase on activated carbon*	*X-ray photoelectron spectroscopy (XPS) studies for activated carbon*	*Application of activated adsorption technology in pharmaceutical industries*
	SLO-2	*Influence of other surface groups of adsorption properties*	*Influencing factors for adsorption properties*	*Capillary transport in adsorption from liquid phase on activated carbon*	*Interpretation of results*	*Application of activated adsorption technology in leather industries*

S-5	SLO-1	*Chemical activation using acids*	*Influencing factors for the Adsorption equilibrium*	*Adsorption behaviour of Low-Bio-degradable Organics on Activated Carbon Surfaces*	*X-ray absorption spectroscopy (XAS) studies for activated carbon*	*Application of activated adsorption technology in food industries*
	SLO-2	*Chemical activation using alkalis*	*Development of adsorption isotherms*	*Adsorption behaviour of Non-Bio-degradable Organics on Activated Carbon Surfaces*	*Interpretation of analysis*	*Application of activated adsorption technology in paint industries*
S-6	SLO-1	*Preparation of carbon from agricultural wastes*	*Linear, Freundlich, Langmuir adsorption isotherms*	*Design for packed columns*	*BET Principle and analysis*	*Adsorption for Textile Wastewater Treatment*
	SLO-2	*Preparation of activated carbon from agricultural waste using chemical agents*	*Temkin and Dubinin–Radushkevich isotherm models*	*Process design factors of fixed-bed adsorption columns*	*Interpretation of BET analysis*	*Improved Control of Pollutants through Integrated Adsorption and Biological Treatment*
S-7	SLO-1	*Preparation of activated carbon from lower cost materials*	*Adsorption Equilibria of the Light Hydrocarbon Gases on the Activated Carbon and Silica Gel*	*Phenol wastewater treatment by a two-step adsorption–oxidation process on activated carbon*	*Analysis and design of GAC and PAC Contactors*	*Application of activated adsorption technology in plating industries*
	SLO-2	*Effect of activating agents*	*Adsorption Equilibria of the heavy Hydrocarbon Gases on the Activated Carbon and Silica Gel*	*Hydrocarbon wastewater treatment process on activated carbon*	*Interpretation of results*	*Application of activated adsorption technology in dye industries*
S-8	SLO-1	*Activated carbon from e-waste such as PCB, Metallic and non-metallic components*	*Simulated Binary Isothermal Adsorption on Activated Carbon in Periodic Countercurrent Column Operation*	*Scale-up laboratory adsorption column*	*Thermal analysis of prepared activated carbon*	*Application of activated adsorption technology in drug industries*
	SLO-2	*Using physical and chemical methods for the preparation of AC from e waste*	*Solving problems*	*Criteria for scale up*	*Interpretation of results*	*Application of activated adsorption technology in brewing industries*
S-9	SLO-1	*pH, solubility and Iodine number of activated carbon*	*A Liquid-Phase Adsorption and rate of diffusion of phenol from aqueous solution into Activated Carbon*	*Adsorption of phenols onto granular activated carbon in a liquid–solid fluidized bed*	*Differential Scanning Calorimetry for the analysis of activated carbon*	*Adsorption of Normal Paraffins and Sulfur Compounds on Activated Carbon*
	SLO-2	*Different types of carbon Nano-materials: CNT, CNF, CNB, their structure*	*Solving problems*	*Desorption of phenols onto granular activated carbon in a liquid–solid fluidized bed*	*Interpretation of results*	*Application of activated adsorption technology in dairy industries*

Learning Resources	1. *Bansal, R.C. and M. Goyal, Activated Carbon Adsorption, Boca Raton, FL: CRC Press, 2013* 2. *Harry Marsh Francisco Rodríguez Reinoso, Activated Carbon, I Edition, Elsevier Science, June 2006* 3. *Douglas M. Ruthven, Principles of Adsorption and Adsorption Processes, Wiley, 1984*	4. *Jean Rouquerol, Francoise Rouquerol, Kenneth S.W.Sing, Adsorption by Powders and Porous Solids: Principles, Methodology and Applications, Academic Press, 1998* **5.** *Richard I. Masel, Principles of Adsorption and Reaction on Solid Surfaces, Wiley, 1996*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Mr.Vinod Kanth, Consultant,svkuvk71@yahoo.com	*2. Dr. R. Aravindan, CLRI, Anna Universwity, aravindhan@clri.res.in*	*2. Dr. B.Samuel Jacob, SRMIST*

Course Code	18BTO104T	Course Name	DEFENCE FORCES IN OUR BODY	Course Category	O	*Open Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Biotechnology*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Analyze the various components of the immune system*			
CLR-2 :	*Discuss the innate immune cells and their role in fighting against pathogens*			
CLR-3 :	*Demonstrate the adoptive immune system and their function*			
CLR-4 :	*Illustrate the methods and techniques used in immunology*			
CLR-5 :	*Discuss how the human body respond to pathogens*			
CLR-6 :	*Apply immunotherapy*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Explain about the basic concept of immune system*	*1*	*80*	*80*
CLO-2 :	*Describe the different type of immune cells and organs*	*2*	*85*	*75*
CLO-3 :	*Analyse how the body respond to pathogens*	*2*	*75*	*80*
CLO-4 :	*Discuss about the immunotechniques used to assess immune functions*	*2*	*85*	*80*
CLO-5 :	*Evaluate immunity to infections*	*2*	*85*	*75*
CLO-6 :	*Describe immunotherapy*	*2*	*80*	*80*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*H*	*H*	*H*	*H*		*M*	*L*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-2 :	*H*	*H*	*H*	*H*			*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-3 :	*M*	*H*	*M*	*H*	*M*	*M*		*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-4 :	*H*	*H*	*H*	*H*			*H*	*L*	*H*	*H*	*H*	*H*	*H*	*H*	*H*
CLO-5 :	*H*	*H*	*H*	*H*		*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*
CLO-6 :	*H*	*H*	*H*	*H*	*L*	*M*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Introduction to the immune system*	*Introduction to innate immune system*	*Introduction to adaptive immune system*	*Antigen –antibody interaction*	*What is an infection?*
	SLO-2	*History of modern immunology*	*Components of the innate immune system*	*Components of the adaptive immune system*	*Forces in antigen-antibody interaction*	*Human infectious agents*
S-2	SLO-1	*What is immunity?*	*Anatomical barriers- Chemical and mechanical*	*Types of adaptive response*	*Affinity and avidity*	*Bacterial diseases*
	SLO-2	*Concept of self and non-self*	*Anatomical barriers- Biological*	*Innate versus adaptive immune response*	*Cross-reactivity and specificity*	*Immunity to bacteria*
S-3	SLO-1	*Primary lymphoid organ Blood marrow*	*Humoral components-complements*	*Antibody mediated immune response*	*Antibody as Immunoassays*	*Viral diseases*
	SLO-2	*Primary lymphoid organ Thymus*	*Humoral components-coagulation factors*	*What are antibodies and antigens?*	*Agglutination*	*Immunity to viruses*
S-4	SLO-1	*Hematopoietic stem cell*	*Cytokines*	*Immunoglobulin structure*	*Blood typing*	*Fungi and human diseases*
	SLO-2	*Development of blood cell lineage*	*Properties and functions of cytokines*	*Role of antibodies*	*Immuno electrophoresis*	*Immunity to fungi*
S-5	SLO-1	*Red blood cells and platelets*	*Phagocytosis and macrophages*	*Effect of antigen-antibody binding*	*Principle of ELISA Clinical utility*	*Protozoan and worms*
	SLO-2	*White Blood cells*	*Neutrophil granules and killing*	*Types of antibodies*	*Types of ELISA*	*Immunity to protozoan*

S-6	SLO-1	*The myeloid cells- granulocytic*	*NK cell cytotoxicity*	*Cell mediated immunity- T cells*	*Western Blot and confirmation*	*Vaccination-how does it work?*
	SLO-2	*The myeloid cells- monocytic*	*Dendritic cells and its action*	*Different types of T cells and their functions*	*ELISPOT- detection of virus*	*Different types of vaccination*
S-7	SLO-1	*The lymphoid cells- T and B cells*	*Pathogen recognition*	*T cell receptor*	*Tissue sectioning*	*Immunodeficiency*
	SLO-2	*The lymphoid cells- NK cells*	*Innate immune receptors*	*How does a T cell recognize antigen?*	*Immunohistochemistry*	*Autoimmune diseases*
S-8	SLO-1	*Secondary lymphoid organs-Spleen*	*Inflammation and its process*	*Antigen presenting cells*	*Fluorescence and its utility in immunoassays*	*Introduction to cancer*
	SLO-2	*Secondary lymphoid organs-Lymph nodes*	*Signs of inflammation*	*Interaction of APC with the T cells*	*Flow cytometry*	*Immunity to cancer*
S-9	SLO-1	*The lymph*	*Mechanism of inflammation*	*Clonal selection*	*Isolation of immune cells*	*Strategies of cancer treatment*
	SLO-2	*The lymphatic system*	*Role of inflammation in diseases*	*Primary and secondary immune response*	*Activation of immune cells*	*Immunotherapy*

Learning Resources	1. *A.K. Chakravarty, Immunology and Immunotechnology,Oxford University Press, 2006* 2. *Peter Wood, Understanding Immunology,2nd ed., Pearson Education, 2006*	3. *Sudha Gangal, Shubhangi Sontakke, Textbook of basic and clinical immunology, Universities Press, 2013* **4.** *Richard Coico, Geoffrey Sunshine, Immunology: A short course, 6th ed., Wiley-Blackwell, 2009*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	*2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in*	*2. Dr.Oindrilla.M, SRMIST*

Course Code	18BTO105T	Course Name	ANIMAL MODELS FOR RESEARCH	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Learn the basics of animal experiments			
CLR-2 :	Apply the concept of living model organism and selection of appropriate model			
CLR-3 :	Use of various animal models available			
CLR-4 :	Analyze the different alternatives and ethical issues			
CLR-5 :	Use pilot experiments to evaluate their working/living environment			
CLR-6 :	Analyze animal experiment data and correlate with human case reports			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Describe about the fundamentals of animal experiments	1	85	80	L	M	H	H	H	L	M	H		M	H	H	H	H	H
CLO-2 :	Recognize the similarities between anima models and humans	2	85	70	M	M	H	H	H	M	M	H		M	H	H	M	L	M
CLO-3 :	Discuss the knowledge on different animal models available	2	80	75	M	H	M	H	H	L	L	H		L	H	H	H	M	L
CLO-4 :	Explain the functions that can be studied in animal models	2	75	80	M	H	H	H	H		H	H		L	H	H	M	M	M
CLO-5 :	Analyze the animal alternatives and ethical issues	3	85	75	H	M	H	H	H		H	H	L	H	H	H	H	L	M
CLO-6 :	Interpret pilot experiments to study animal model experiment	3	80	80	H	H	H	H	H	M	M	M	L	H	H	H	H	M	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to biology of animals	Selection of animal models	Transgenesis and transgenic animal models	Drugs and compound administration	Animals in laboratory environment
	SLO-2	Structure and organs	Mammals, bovine, aquatic, insect	Knockout, Knockin, Mutation models	Need for animal models to test new compounds prior clinical study	Light cycle, temperature and humidity
S-2	SLO-1	Classification of animals	Mammal biology – life cycle	CRISPR cas 9	Oral administration	Pathogen free environment lab
	SLO-2	Vertebrate and Invertebrate	Rats, mice, sheep and bovine	UAS gal 4 systems	Nasal dosage	Precautions and protective gear to be followed by researchers
S-3	SLO-1	Human evolution	Rats – types of rats	Animal models for cataracts and retinitis pigmentosa	Inhalation	Housing and Animal husbandry
	SLO-2	Darwinism theory	Genetic background among different sub species	Animal models for Atherosclerosis and myocardial infarction	Inhalation related experiment animal models	Animal husbandry training
S-4	SLO-1	Human diseases	Mice – types of mice	Animal models for cardiac and cardiovascular disease	Inhalation related experiment animal models and issues that can be replicated	3 R`s and Alternative for animal models
	SLO-2	Need for animal models	Genetic background among different sub species	Animal models for metabolic syndrome	Invasive administrations – intravenous	Tissue culture – cell lines
S-5	SLO-1	Experimental animal models	Sheep and cow as animal models	Animal models for diabetes and obesity	Invasive administrations – intravenous and intra-peritoneal	Primary tissue culture

	SLO-2	*Monkey, rat, rabbit - living animals models*	*Disease research on sheep and cow*	*Animal models for liver diseases*	*Invasive administrations – intraocular*	*3D cell culture reconstructing and replacing organs*
S-6	SLO-1	*Chicken, pig tissues – non living animal models*	*Aquatic animals models*	*Animal models for skin disorders and regeneration*	*Invasive administrations – intraocular and intramuscular*	*Limitation and ethical issues in research on humans*
	SLO-2	*Pig heart as cardiovascular model*	*Life cycle of zebra fish and Japanese rice fish and research*	*Animal models for stroke, olfactory and neuromuscular dysfunction*	*Invasive administrations – Subcutaneous*	*Lower order animal models*
S-7	SLO-1	*Classical animal models used – squid*	*Hydra as an aquatic animal model*	*Animal models for schizophrenia*	*Invasive administrations – Subcutaneous*	*Ethical issues in using humans samples*
	SLO-2	*Nervous system in squid and early evidences*	*Life cycle and environmental toxin researches*	*Animal models for Alzheimer`s and Huntington disease*	*Non invasive drug administration*	*Ethical issues in using experiments animals*
S-8	SLO-1	*Classical animal models used – cats*	*Non vertebrate insect models – Drosophila and C. elegans*	*Animal models for Parkinson and multiple sclerosis.*	*Skin adsorption*	*Computer science – simulations and animal models*
	SLO-2	*Visuals tracks in cats and early evidences*	*Life cycle of C. elegans and research*	*Animal models for Mood disorders*	*Selecting appropriate drug administration route*	*Heart diseases and simulation*
S-9	SLO-1	*Classical animal models – primates*	*Life cycle of Drosophila as evolution models*	*Animal disorder for mania*	*Understand route of exposure in toxicity cases*	*Computational models*
	SLO-2	*Behavioral assays in primates.*	*Drosophila genetics*	*Animal disorder for stress coping and resilience.*	*Human-animal equivalent dose calculation and problems*	*Computational models to repalce animal cognition*

Learning Resources	1. *Hau J, Van Hoosier GL Jr, Handbook of Laboratory Animal Science, Volume I: Essential Principles and Practices" 2nd ed., CRC Press: Boca Raton, FL, 2003*	2. *Micheal Conn P, Animal Models for the Study of Human Disease,2nd ed., Academic Press, 2017* **3.** *Jerome Y Yager, Animal Models of Neuro-developmental Disorders, Human Press, 2015*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. C. N. Ramchand, Saksin Life sciences Pvt Ltd, Chennai, ramchand@saksinlife.com	*1. Prof. K Subramaniam, IITM, Chennai, subbu@iitm.ac.in*	*1. Dr. S. Sahabudeen, SRMIST*
2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	*2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in*	*2. Dr.R.A. Nazeer, SRMIST*

Course Code	18BTO106T	Course Name	WASTE TO WEALTH TO WHEELS	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Biotechnology	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Identify the applications of engineering concepts for sustainable waste management			
CLR-2 :	Identify the applications of energy conversion technology			
CLR-3 :	Identify the significance of eco-friendly process			
CLR-4 :	Create insights to the concepts of zero-waste process			
CLR-5 :	Analyze the important fuel properties of wastes and biomass			
CLR-6 :	Utilize the concepts basic engineering calculations (mass and heat balances) for biomass based energy systems			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Formulate the methodology for waste segregation based on international policy	1	80	70	H	H	M	M	M	H	H	H	M	H	M	H	M	H	H
CLO-2 :	Analyze calorific parameters of wastes and biomass	2	85	75	H	M	M	M	M	H	H	H	M	L	H	H	M	H	H
CLO-3 :	Apply thermo-chemical conversion process for waste to energy conversion	2	75	70	H	H	M	M	M	H	H	H	H	M	H	H	H	M	H
CLO-4 :	Apply bioprocessing techniques to convert waste to biofuel and value added chemicals	2	85	80	H	H	M	M	M	H	H	H	H	M	H	H	H	H	H
CLO-5 :	Identify the applications of mass and energy balance for making commercially viable Waste to wealth process	2	85	75	H	H	M	M	M	H	H	H	M	H	M	H	H	H	H
CLO-6 :	Describe the National policy towards biofuel production and Energy security	1	80	70	H	M	M	M	M	H	H	H	M	H	M	H	H	M	H

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Sources of industrial wastes	Thermal processing of wastes: Combustion, Co-generation/co-firing	Catalytic depolymerization of biomass-derived oxygenated feedstocks	Treatment based on aerobic and anaerobic waste bioprocessing	Energy content estimation of wastes and products by bomb (solid and liquid)(ASTM)
	SLO-2	Sources of agro and MSW wastes	Pyrolysis and torrefecation	Biosynthetic pathway for lignin synthesis	Vermi-composting of solid wastes for bio-fertilizer; Vermi-wash	For gaseous fuel (ASTM)
S-2	SLO-1	Impact of wastes on biodiversity	Hydrolysis and plasma treatment for waste to energy conversion	Hydrolysis of cellulose from lignocellulosic wastes over novel solid acids	Production of hydrocarbons (bioalkanes) from lignocelluloses	Process calculations for energy and mass balance of waste and by product recovery
	SLO-2	Effect on food chain/food web	Catalytic conversion process	Inhibitory compounds of lignin degradation that impedes bioprocessing	Quality comparison between conventional and bio-based chemicals	Software hands on training for mass and energy balance
S-3	SLO-1	Waste segregation methodologies	Syngas production	Synthesis of polyols by hydrogenation / hydrogenolysis of cellulose and sugar	Production of biodiesel (Oil seeds/Algae)	Case : non-conventional transportation fuels and their manufacturers obtained by processing of wastes
	SLO-2	Hazardous and non-hazardous wastes	Flue gas filters and value addition from particulate matter	Role of green solvents and ionic liquids in fuel production	Whole crop biorefinery approach	Municipal leachate processing and value product development
S-4	SLO-1	Recalcitrant and non-recalcitrant wastes	Waste heat recovery	Hybrid energy system using biological routes	Oleagenous organisms (Fungi and yeast)	Management of post-energy recovery residues (bottom ash, fly ash, digestate)
	SLO-2	Xenobiotics and Rationale for bioprocessing	Hydrothermal electricity production	Clean coal technologies bioleaching and biosorption	Enzymatic transesterification Vs. Chemical methods	Bioenergy-Biochar energy cycle

S-5	SLO-1	*Waste characterization*	*Bio refinery demonstration projects on ethanol*	*Unified oils and biodiesel from oil seeds and algae by chemical catalysis*	*Biobutanol, ABE synthesis, bioalkanes*	*R& D scope in WWW* *Gas to liquids (GTL) technology*
	SLO-2	*Calorific value estimation: Bomb and Junker's calorimeter*	*Case study on India's potential on second generation bioethanol*	*Case study on India's potential on second generation biodiesel from Jatropha*	*Biopolymers and plastics (PHA, PHB and PLA)*	*CO_2 sequestration by biological modes*
S-6	SLO-1	*Point source collection and non-point source wastes collection*	*Distillation technology for bioethanol*	*Fischer–Tropsch process – Gas to liquid fuels*	*Gaseous fuels: Biomethane*	*Landill fill emission control*
	SLO-2	*Role of smart dustbins*	*Adsorption technology for ethanol fractionation*	*Comparison of fuel quality standards from FT and fossil fuel*	*Energy conversion strategies from biogas*	*Land fill and flue gas recovery for its commercial application*
S-7	SLO-1	*Energy crops – Terrestrial*	*Bio refinery demonstration projects on Biodiesel*	*3rd generation biofuel: For transportation*	*Biohydrogen and Gas to liquid fuel technologies*	*Current and Emerging Challenges to Renewable Energy Development*
	SLO-2	*Energy crops – Aquatic*	*Case study of implementation of Biodiesel project by Indian Railways*	*3rd generation biofuel: For value added hydrocarbons*	*ABE biosynthesis (Acetone Butanol and Ethanol)*	*Government policies for energy security*
S-8	SLO-1	*Potential Benefits of Replacing Fossil Fuels with Biofuel, Biomass and Biogas*	*Transesterification and distillation*	*Genetically modified (GM) organisms for improved fuel production*	*Metabolic pathway engineering for ABE biosynthesis*	*Community Participation in Renewable Energy Development*
	SLO-2	*Implication of fossil fuel on National economy, environment and energy security*	*Refining technologies for biodisesel*	*GM bioenergy crops and its implication for developing countries*	*Aircraft liquid biofuel from biomass feedstocks*	*Contract farming strategy for non-edible feedstock production*
S-9	SLO-1	*Political Drivers for Biofuel Development*	*By product processing of biodiesel production*	*Algal based technologies for biofuel and value added chemical preparation*	*Bio-alkanes and alkenes from waste biomass to be used as jet engines fuels*	*Combined industrial waste treatment for energy recovery*
	SLO-2	*Activities of MNRE, Government of India and International Energy Agency*	*Conversion of de-oiled cake into value added products*	*GM algae and its regulatory issues*	*New energy research Projects pertaining to transportation fuels in Global context*	*Urban and rural integration system for sustainable waste utilization for value added product generation*

Learning Resources	1. *David M. Mousdale, Biofuels: Biotechnology, Chemistry, and Sustainable Development, CRC Press, 2008* 2. *Roland A. Jansen, Second Generation Biofuels and Biomass, Wiley, 2013*	3. *A.H.Scragg, Biofuels, Production, Application and Development, CAB International, 2009* **4.** *Robert C. Brown, Tristan R.Brown, Biorenewable Resources: Engineering New Products from Agriculture, 2nd ed., Wiley, 2014*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
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2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	*2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in*	*2. Dr. K.Ramani, SRMIST*

Course Code	18BTO107T	Course Name	FUNDAMENTAL NEUROBIOLOGY	Course Category	O	*Open Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Biotechnology*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Recall the brain function from its organization*			
CLR-2 :	*Discuss Molecular signaling in neurons*			
CLR-3 :	*Compare Neural basis of senses*			
CLR-4 :	*Explain different methods for studying neuro-immune functions*			
CLR-5 :	*Analyze genetic variations in brain development*			
CLR-6 :	*Analyze genetic* variation and inheritance pertaining to nervous system disorders			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Describe the fundamental organization of brain and its functions*	*1*	*80*	*80*
CLO-2 :	*Explain the concepts and experiments in the neurotransmitters*	*2*	*85*	*75*
CLO-3 :	*Recognize the pattern of brain energy metabolism*	*2*	*75*	*80*
CLO-4 :	*Discuss the different methods in the neuroendocrine and immune interactions*	*2*	*85*	*80*
CLO-5 :	*Analyze the role of genes in brain development and functions*	*3*	*85*	*75*
CLO-6 :	*Explain the concepts of nervous system disorder and the diseases associated with it*	*2*	*80*	*80*

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1	*L*	*H*	*H*	*H*	-	*M*	*L*	*H*	*H*	*H*	*H*	*H*	*L*	*H*	*H*
CLO-2	*M*	*H*	*H*	*M*	-	-	*M*	*H*	*L*	*H*	*H*	*H*	*L*	*H*	*H*
CLO-3	*M*	*H*	*M*	*H*	*M*	*M*	-	*M*	*H*	*H*	*H*	*H*	*L*	*H*	*H*
CLO-4	*L*	*H*	*H*	*H*	-	-	*H*	*L*	*L*	*H*	*H*	*H*	*M*	*H*	*H*
CLO-5	*L*	*H*	*H*	*M*	-	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*
CLO-6	*M*	*H*	*H*	*H*	*L*	*H*	*M*	*M*	*H*	*H*	*H*	*H*	*H*	*H*	*H*

Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Basics of Neurobiology*	*Membrane potential*	*Brain energy metabolism at the cellular level*	*Nature of central systems*	*Disorders of the nervous system*
	SLO-2	*Understanding brain function*	*Action potential*	*Sensory systems*	*Survey methods*	*Developmental disorder:*
S-2	SLO-1	*Orientation of Central nervous system*	*Resting potential*	*Receptors to perceptions*	*Neuroendocrine circuits*	*Autism, Dyslexia, ADHD*
	SLO-2	*Peripheral nervous system*	*Electrochemical basis of nerve function*	*Chemical and somatic senses*	*Functions of neuroendocrine system*	*Mental Disorder*
S-3	SLO-1	*Levels of Neural organization*	*Electrical and Thermodynamic Forces in Passive Distribution of Ions*	*Molecular and neural basis of visual perception*	*Neuroendocrine tumors*	*Schizophrenia*
	SLO-2	*Concept of functional units*	*Hyperpolarization or Depolarization*	*Organization of autonomic nervous system and functions*	*Global epidemiology of neuroendocrine tumors*	*Degenerative disorders*
S-4	SLO-1	*Cellular basis of Neurobiology*	*Chemical basis for neuronal communication*	*Nature of motor system and its functions*	*Neuro-immune circuits*	*Alzheimer's disease*
	SLO-2	*Clinical issues in neurobiology*	*Ion pumps and Ion gradients*	*Reflexes and fixed motor responses*	*Neuro-immune functions*	*Parkinson's disease*
S-5	SLO-1	*Neuron terminology*	*Ion channels*	*Locomotion*	*Neuroendocrine-immune interactions in neurological disorders*	*Psychiatric disorder*

	SLO-2	*Cell biology of neurons and glia*	*Hyperpolarization-Activated Ionic Currents*	*Food intake and metabolism*	*Neuroendocrine-immune interactions in autoimmune diseases*	*Depression and anxiety*
S-6	SLO-1	*Differentiation of axon and dendrite*	*Neurotransmitters*	*Water intake and body fluids*	*Developmental genetics of the brain.*	*Vascular disorders*
	SLO-2	*Structural neuroscience methods: A brief history*	*Neuropeptides*	*Sleep, dreaming and wakefulness*	*Genes for human brain development*	*Stroke*
S-7	SLO-1	*Sensorimotor, autonomic and enteric divisions*	*Receptors of neurotransmitters*	*Reward and motivation*	*Genes in neurological disorders.*	*Other disorders*
	SLO-2	*Synapses and spines*	*Non-classical neurotransmitters*	*Emotion and addiction*	*Epigenetics of the brain.*	*Epilepsy*
S-8	SLO-1	*Inhibitory circuit neurons*	*Synthesis of neurotransmitters and neuropeptides*	*Cognitive development and aging*	*Epigenetics in brain disorders*	*Drug addiction*
	SLO-2	*Inhibitory projection neurons*	*Release and metabolism of neurotransmitters*	*Cognitive impairment*	*Role of Environmental factors in neurodevelopment.*	*Neural Plasticity, Goat Brain Dissection*
S-9	SLO-1	*Excitatory neurons*	*Molecular mechanisms nerve terminal*	*Learning and memory*	*Exposure of lead and methyl mercury in neurodevelopmental disorders.*	*Understanding brain by Artificial Intelligence*
	SLO-2	*Neuroglia and glial sheaths*	*Molecular signaling in neurons*	*Language, communication and consciousness*	*Neurotoxins*	*Neural network for analyzing brains network*

Learning Resources	1. *Larry Squire, Darwin Berg,Floyd E. Bloom,Sascha du Lac,Anirvan Ghosh,Nicholas C. Spitzer, Fundamental Neuroscience, 4th ed., Academic Press, 2012*	2. *Michael Aschner,* Lucio G. Costa,Environmental factors in Neurodevelopmental*and neurodegenerative disorders, Academic Press, 2015*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Dr. Karthik Periyasamy, Aurobindo Pharma Limited, Hyderabad, karthikmpk@gmail.com	*2. Prof. R. B. Narayanan, SVCE, Chennai, rbn@svce.ac.in*	*2. Dr. R. VasanthaRekha, SRMIST*

Course Code	18ECO106J	Course Name	PCB DESIGN AND MANUFACTURING	Course Category	O	Open Elective	L	T	P	C
							2	0	2	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLR-1 :	Explore the terminologies of PCB design and Electronic components	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-2 :	Design consideration involved in PCB design																		
CLR-3 :	Utilize the PCB design consideration for special application circuits																		
CLR-4 :	Design a PCB layout using CAD tool																		
CLR-5 :	Explore various PCB manufacturing techniques																		
CLR-6 :	Equip the learners to explore and understand PCB design technology, design constraints and manufacturing technique																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Identify the various types of PCB and electronics components packaging	2	80	70	H	-	-	L	-	-	-	-	-	-	-	-	-	-	-
CLO-2 :	Select suitable design and consider appropriate parameters involved in PCB design	3	80	70	M	-	L	-	-	-	-	-	-	-	-	-	-	-	-
CLO-3 :	Apply the appropriate design rules in designing PCB for special application circuits	2	80	70	M	-	-	L	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Design and develop a PCB layout using CAD tool	3	80	70	M	-	-	M	H	-	-	-	-	-	-	-	-	-	-
CLO-5 :	Identify and select the required PCB manufacturing technology	3	80	70	L	-	-		H	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Develop PCB layout using PCB design CAD (Computer Aided Design) tool and proficiency in PCB fabrication	1	80	70	H	-	L	L	H	-	-	-	-	-	-	-	-	-	-

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Nomenclature of a Printed Circuit Board	PCB Design Considerations - Important Design Elements	Design Rules for Analog Circuits	Schematic Capture - Introduction schematic capture tool	Image Transfer Techniques- Screen Printing, Pattern Transferring Techniques
	SLO-2	Classification of Printed Circuit Boards	PCB Design Considerations - Important Performance Parameters	Design Rules for Analog Circuits		
S-2	SLO-1	Manufacturing of basic PCB - Single-and Double-sided Plated Through-holes	PCB Design Considerations - Mechanical Design Considerations	Design Rules for Digital Circuits	Schematic Capture - Simulation of simple electronic circuit	Image Transfer Techniques- Printing Inks, Photo Printing, Laser Direct Imaging (LDI)
	SLO-2	Manufacturing of Multi-Layer Boards - Flexible Boards, Challenges in modern PCB Design and Manufacture, Standards	PCB Design Considerations - Mechanical Design Considerations	Design Rules for Digital Circuits	Schematic Capture - Schematic to layout transfer	Copper Clad Laminates - Properties of Laminates, Types of Laminates, Evaluation of Laminates
S 3-4	SLO-1	Study of electronic components- Passive electronic components	Design and analysis of RL and RC time constants. Schematic in CAD tool	Schematic and PCB Layout in CAD tool. Regulated power supply design. - Full wave rectifier circuit design with fixed voltage regulator	PCB Layout Design of single digit pulse counter using PCB design tool.	Mini Project - PCB Layout Design of electronic turn ON/OFF timer using IC555 using PCB design tool.
	SLO-2					
S-5	SLO-1	Types, Symbols, Packaging shapes and terminal details of Electronic Components –Resistors, Thermistors Capacitors, Inductors	PCB Design Considerations - Electrical Design Considerations	Design Rules for High Frequency Circuits	PCB Layout Design - Conception Level Introduction	Etching Techniques – wet Etching chemicals
	SLO-2	Diodes, Light Emitting Diodes (LED), Photodiode,	PCB Design Considerations - Conductor Patterns	Design Rules for Fast Pulse Circuits	PCB Layout Design - Specifying Parts, Packages and Pin Names, Libraries	Etching Techniques - Mechanical Etching

S-6	SLO-1	*Transistors, Field-effect Transistors, Insulated Gate Bipolar Transistor (IGBT), Thyristor*	*Component Placement Rules*	*Design Rules for Microwave Circuits*	*PCB Layout Design - Checking foot prints of the components, Part list, Net list, Making Net list Files*	*PCB Assembly Process*
	SLO-2	*Integrated Circuits (ICs), Three-terminal Voltage Regulator*	*Fabrication and Assembly Considerations*	*Design Rules for Microwave Circuits*	*PCB Layout Design – Placing Parts, Routing Traces, Modifying Traces*	*Through-hole*
S 7-8	SLO-1	*Study of electronic components- active devices, analog and digital integrated circuits (IC)*	*Design and analysis of RLC circuits. Schematic in CAD tool*	*Schematic and PCB Layout in CAD tool. Regulated power supply design. -Full wave rectifier circuit design with fixed voltage regulator*	*PCB Design of single digit pulse counter: Schematic and PCB layout using PCB design tool.*	*Mini Project - Manufacture the PCB for electronic turn ON/OFF timer using IC555and construct and test the designed circuit.*
	SLO-2					
S-9	SLO-1	*Digital Integrated Circuits, Random Access Memory*	*Environmental Factors*	*Design Rules for High-density Interconnection Structures*	*PCB Layout Design - Mounting Holes*	*PCB Assembly Process*
	SLO-2	*Read Only Memory*	*Cooling Requirements*	*Design Rules for High-density Interconnection Structures*	*Adding Text, PCB Layout*	*Surface Mount, Mixed Technologies*
S-10	SLO-1	*Microcontrollers, Surface Mount Devices*	*Packaging Density*	*Electromagnetic Interference (EMI)*	*PCB Layout Design - DRC,*	*PCB Assembly Process*
	SLO-2	*Transformer, Relays, Connectors*	*Layout Design*	*Electromagnetic Compatibility (EMC)*	*Pattern Transfer, Layout printing*	*Soldering*
S 11-12	SLO-1	*Study of testing and measuring Instruments: Logic analyzer, spectrum analyzer, IC tester (Analog and Digital), LCR meters*	*PCB Layout Design - of RL, RC and RLC circuits*	*Schematic and PCB Layout in CAD tool. Regulated power supply design. Full wave rectifier circuit design with fixed voltage regulator*	*Mini Project - PCB Layout Design of electronic turn ON/OFF timer using IC555 using PCB design tool.*	*Mini Project - Manufacture the PCB for electronic turn ON/OFF timer using IC555and construct and test the designed circuit.*
	SLO-2					

Learning Resources	1. *Raghbir Singh Khandpur, Printed Circuit Boards: Design, Fabrication, and Assembly, McGraw-Hill Electronic Engineering, 2006* 2. *Charles A. Harpe, High Performance Printed Circuit Boards, McGraw Hill Professional, 2000* 3. *Bruce R. Archambeault, James Drewniak, PCB Design for Real-World EMI Control, Volume 696 of The Springer International Series in Engineering and Computer Science, Springer Science & Business Media, 2013* 4. *Kraig Mitzner, Complete PCB Design Using OrCAD Capture and PCB Editor, Newnes / Elsevier, 2009* 5. *Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall PTR, 2003* 6. *Mark I. Montrose, Printed Circuit Board Design Techniques for EMC Compliance: A handbook for designers,2nd ed., Wiley, 2015* 7. *Esim open source tool: http://esim.fossee.in/* 8. *TINA/Orcad User manual*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anii@gmail.com	*1. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu*	*1. Dr. P. Eswaran, SRMIST*
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	*2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in*	*2. Dr. D. Malathi, SRMIST*

Course Code	18ECO108J	Course Name	EMBEDDED SYSTEM DESIGN USING ARDUINO	Course Category	O	*Open Elective*	L	T	P	C
							2	0	2	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Electronics and Communication*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	*Get to know about ARDUINO hardware details and environment*			
CLR-2 :	*To understand the core elements of ARDUINO programming language*			
CLR-3 :	*Create insights to the concepts of serial communication*			
CLR-4 :	*To use common input and output devices*			
CLR-5 :	*Apply the ARDUINO programming into real time applications*			
CLR-6 :	*Apply the ARDUINO programming into real time applications*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Analyze the programming skill*	*2*	*80*	*70*	*H*		-	-	-	-	-	-	-	-	-	-	-	*H*	*H*
CLO-2 :	*Apply the real time data's into digital*	*2*	*85*	*75*	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	-	*H*	-	-	*H*	*H*
CLO-3 :	*Interact with almost many devices*	*2*	*75*	*70*	*H*	-	*H*	*H*	*H*	-	-	-	*H*	-	*H*	-	*H*	*H*	-
CLO-4 :	*Learn techniques to handle timer delays and IO devices*	*2*	*85*	*80*	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	-	*H*	-	*H*	*H*	-
CLO-5 :	*Use and modifying the existing libraries*	*2*	*85*	*75*	*H*	-	*H*	*H*	*H*	-	-	-	*H*	-	*H*	-	*H*	*H*	-
CLO-6 :	*Use and modifying the existing libraries*	*2*	*85*	*80*	*H*	*H*	*H*	*H*	*H*	-	-	-	*H*	-	*H*	-	*H*	*H*	*H*

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Introduction to arduino platform*	*Introduction to Arduino C*	*Analog and Serial Communication*	*IO Programming*	*Case Studies*
	SLO-2	*Block diagram*	*Arduino C Data Types*	*Introduction to Analog Communication*	*Introduction to Timer/Counters*	*Wireless Communication Using Zigbee*
S-2	SLO-1	*AT mega 328p architecture*	*Decision Making in C*	*Pulse Width Modulation*	*Introduction to Timer/Counters*	*Bluetooth*
	SLO-2	*AT mega 328p architecture*	*Decision Making in C*	*RS232*	*Timer programming*	*Robotics -Motor and Sensor*
S 3-4	SLO-1	*Lab 1 Getting Started with Adriano*	*Lab 4 -Sensor Interfacing for Temperature Monitoring*	*Lab 7: Actuators – Stepper Motor*	*Lab10: Interrupt Programming*	*Lab 13: Mini Project*
	SLO-2	*CCS and AVR Studio 7 Blinking Led*	*Lab 4 -Sensor Interfacing for Displacement Measurement*	*Lab 7: Actuators – Stepper Motor*	*Lab10: Interrupt Programming*	*Lab 13: Mini Project*
S-5	SLO-1	*Pin function*	*Program Loops in C*	*I2C*	*Timer programming*	*Security-RFID, Infrared*
	SLO-2	*Overview of main features-I/O ports*	*Functions in C*	*I2C*	*Timer programming*	*Security-RFID, Infrared*
S-6	SLO-1	*Features-timers,interrupts*	*Introduction to Pointers*	*I2C*	*Timer programming*	*Bio medical application*
	SLO-2	*Features-timers,interrupts*	*Introduction to Pointers*	*I2C*	*Timer programming*	*Bio medical application*

S 7-8	SLO-1	*Lab 2 GPIO LED*	*Lab 5: PWM BASED SERVO MOTOR INTERFACING*	*Lab 8: DC MOTOR*	*Lab11: Watch Dog Timer*	*Lab14: Model Practical*
	SLO-2	*Switch Based Led Control*	*Lab 5: PWM Based Servo Motor Interfacing*	*Lab 8: DC MOTOR*	*Lab11: Watch Dog Timer*	*Lab14: Model Practical*
S-9	SLO-1	*Features-PWM,SERIAL PORT*	*Using Pointers Effectively*	*SPI Protocol*	*Interrupts*	*Bio medical application*
	SLO-2	*Features-ADC*	*Structures, Unions, and Data Storage*	*SPI Protocol*	*Interrupt programming*	*Bio medical application*
S-10	SLO-1	*Introduction to Arduino IDE*	*Arduino Libraries*	*Interfacing with sensors*	*External interrupt*	*GPS Navigation*
	SLO-2	*Writing ,saving,compiling with IDE.*	*Arduino Libraries*	*Interfacing with sensors*	*External interrupt*	*GPS Navigation*
S 11-12	SLO-1	*Lab 3: DISPLAY INTERFACE-7 SEGMENT*	*Lab 6: SERIAL COMMUNICATION*	*Lab 9: Repeat/Revision of Experiments*	*Lab 12 : I2C*	*Lab:15 University Practical*
	SLO-2	*LCD 16x2 Matrix*	*Lab 6: Serial Communication*	*Lab 9: Repeat/Revision of Experiments*	*Lab 12: I2C*	*Lab:15 University Practical*

Learning Resources	1. *Michael-Margolis,Arduino-Cookbook., Revised edition, O'Reilly,1st edition, 2011* 2. *D.Dale.Wheat, Arduino.Internals, TIA publication, 5th edition, 2011*	3. *James M. Fiore, Embedded Controllers Using C and Arduino, ARDUINO open source community, 2018* 4. *Jack Purdum ,Beginning C for Arduino , Apress, 2012*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

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2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	*2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in*	

Course Code	18ECO121T	Course Name	BASIC BIOMEDICAL ENGINEERING	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Analyze the scopes and roles of Biomedical Engineering			
CLR-2 :	Utilize biomedical instrumentation modules			
CLR-3 :	Utilize medical imaging principles and its applications			
CLR-4 :	Analyze the scope of biomechanics and its applications			
CLR-5 :	Utilize biomaterials and its applications			
CLR-6 :	Gain the knowledge about Biomedical Engineering			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)															
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Analyze the areas in which biomedical engineers can work	2	85	75	-	-	-	-	-	-	-	-	-	-	-	L	-	-	L
CLO-2 :	Analyze the basic biomedical instrumentation unit	3	85	75	L	-	-	-	-	-	-	-	-	-	-	-	-	-	L
CLO-3 :	Analyze basic medical imaging principles	3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Apply the concepts of biomechanics on human body	3	85	75	L	-	-	-	-	-	-	-	-	-	-	-	-	-	L
CLO-5 :	Identify domains where biomedical engineers can work	3	85	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Analyze the applications of Biomedical Engineer	3	85	75	M	-	-	-	-	-	-	-	-	-	-	L	-	-	L

		Introduction to Biomedical Engineering	Biomedical Instrumentation	Medical Imaging system	Biomechanics	Biomaterials
Duration (hour)		9	9	9	9	9
S-1	SLO-1	Evolution of the modern health care system	Introduction: Bioinstrumentation	X-Ray production	Introduction: Principal Areas of Biomechanics	Biomaterials Introduction
	SLO-2	Modern Healthcare system	Basic Bioinstrumentation System	X-Ray Imaging principle	Fundamentals of biomechanics and qualitative analysis	Classification of Biomaterials
S-2	SLO-1	What is Biomedical Engineering	Physiological Systems of the body	Application of X-ray imaging	Kinematics of Human Body Models	Properties of Biomaterials: Mechanical
	SLO-2	Roles played by the Biomedical Engineers	Sources of Biomedical Signals	CT-Imaging principle	Kinetics of Human Body Models	Properties of Biomaterials: Chemical
S-3	SLO-1	Types of Biomedical Engineering	Origin of Bioelectric Signals	CT-Imaging Applications	Modelling of Bio systems	Properties of Biomaterials: Biological
	SLO-2	Surgical instruments and medical devices	Origin of Bioelectric Signals	MRI- Introduction	Tissue Biomechanics	Biomedical alloys and its medical applications- titanium
S-4	SLO-1	Biomaterials	Various Electrodes used for picking the biomedical signals	MRI Imaging principles	Modelling in Cellular Biomechanics	Biomedical alloys and its applications- Stainless steel, Cobalt-Chromium alloys
	SLO-2	Biomechanics	Various Electrodes used for picking the biomedical signals	MRI Imaging principles	Fluid mechanics	Introduction to ceramics
S-5	SLO-1	Tissue Engineering	ECG Introduction	MRI Imaging Applications	Mechanics of the musculoskeletal system impact	Alumina, Zirconia

	SLO-2	*Neural Engineering*	*ECG system Block diagram and its uses*	*Ultrasound basics*	*Mechanics of Blood Vessels*	*Titanium, Hydroxyapatite*
S-6	SLO-1	*Telehealth*	*EEG Introduction*	*Ultrasound Imaging*	*Cardiac Biomechanics*	*Glass ceramics*
	SLO-2	*Bio signal processing*	*EEG system Block diagram and its uses*	*Ultrasound Application*	*Biomechanics of Chest and Abdomen*	*Introduction to polymers*
S-7	SLO-1	*Medical Imaging*	*EMG Introduction*	*fMRI Imaging*	*Cochlear Mechanics*	*Types of polymers*
	SLO-2	*Computational modelling*	*EMG system Block diagram and its uses*	*fMRI Imaging Application*	*Dynamics of Human Body Models*	*Biodegradable polymers and its applications*
S-8	SLO-1	*BioMEMS*	*Cardiac pacemakers and its uses*	*PET- Imaging*	*Gait analysis*	*Composites and its applications*
	SLO-2	*Mobile POCT*	*Cardiac Defibrillators and its uses*	*PET Imaging Application*	*Biomechanics in physical education*	*Wound-Healing process*
S-9	SLO-1	*Professional Status of Biomedical Engineering*	*Patient Monitoring System Introduction*	*SPECT Imaging*	*Biomechanics in strength and conditioning*	*Biomaterials for artificial valve, Ear*
	SLO-2	*Professional Societies*	*Patient Monitoring System Block diagram and its uses*	*SPECT Imaging Application*	*Biomechanics in sports medicine and rehabilitation*	*Biomaterials for artificial Skin, Eye*

Learning Resources	1. *Anthony Y. K. Chan, Biomedical Device Technology: Principles and Design, Charles C Thomas publisher, 2008* 2. *R.S Khandpur, Handbook of Biomedical Instrumentation, 3rd ed., McGraw Hill, 2014* 3. *Joseph J. Carr, John M.Brown, Introduction to Biomedical Equipment Technology, 4th ed., Pearson, 2002*	4. *John Enderle, Joseph Bronzino, Introduction to Biomedical Engineering, Academic Press, 2011* 5. *Andrew R Webb, Introduction to Biomedical Imaging, Wiley-IEEE Press, 2003* 6. *Sujata V. Bhat, Biomaterials, 2nd ed., Alpha Science International, 2005*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Sathyanarayanan J, Mindray Medical India Pvt Ltd, sathyanarayananjayagopal@mindray.com	*1. Dr. S. Poonguzhali, Anna University, poongs@annauniv.edu*	*1. Ms. Oinam Robita Chanu, SRMIST*
2. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anii@gmail.com	*2. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu*	*2. Dr. D. Kathirvelu, SRMIST*

Course Code	18ECO122T	Course Name	HOSPITAL INFORMATION SYSTEMS	Course Category	O	*Open Elective*	L	T	P	C
							3	0	0	3

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Electronics and Communication*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Utilize the planning and organizational activities of Hospitals*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Analyze the concepts in clinical and diagnostic services*			
CLR-3 :	*Utilize the policies and procedures about support services and material management*			
CLR-4 :	*Utilize the features in staff and safety management in hospital*			
CLR-5 :	*Analyze the reporting system and recent advancement in hospital administration*			
CLR-6 :	*Apply all the advanced application the field of telemedicine*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)															
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	*Analyze the role of hospitals and ensure proper healthcare delivery*	*2*	*85*	*75*	*L*	-	-	-	-	*M*	-	-	-	-	-	-	*L*	-	-
CLO-2 :	*Suggest appropriate technologies and services in clinical and diagnostic field*	*3*	*85*	*75*	*M*	-	-	-	-	-	-	-	-	-	-	-	*L*	-	-
CLO-3 :	*Analyze the supportive services and the use of proper material management*	*3*	*85*	*75*	*M*	-	-	-	-	-	*M*	*L*	-	-	-	-	*M*	-	*L*
CLO-4 :	*Identify objectives of staff management and ensure safety management in hospitals*	*3*	*85*	*75*	*M*	-	-	-	-	-	-	*L*	-	-	-	*L*	*L*	-	-
CLO-5 :	*Implement the advance technologies and effectively evaluate the healthcare information*	*3*	*85*	*75*	*L*	-	-	-	-	*M*	-	*L*	*L*	-	-	-	*L*	*L*	*L*
CLO-6 :	*Implement the various standards in hospital and healthcare services*	*3*	*85*	*75*	*L*	-	-	-	-	*M*	-	-	-	-	-	-	*L*	-	-

		Planning and designing of hospitals	Inpatient and Outpatient services	Material management services	Management services in hospitals	Patient record and advancement in healthcare services
Duration (hour)		9	9	9	9	9
S-1	SLO-1	*Hospital as a social system*	*Design and planning of emergency department*	*Pharmacy services- goals of hospital pharmacy services*	*Human resource management- Human resource development*	*Medical record management- Importance of medical record*
	SLO-2	*Primary health care and hospitals*	*Health information and counselling*	*Staff organization and divisions of hospital pharmacy services*	*Hospital staff skill development*	*Methods of record keeping*
S-2	SLO-1	*Hospital planning and design-Guiding principles in planning*	*Outpatient services –Types and functions of outpatient department*	*Benefits of formulatory system*	*Nursing management-Functions of nursing management*	*Electronic medical record-Benefits and drawbacks*
	SLO-2	*Regionalization of Hospital service*	*Physical features of outpatient department*	*Other services of hospital pharmacy*	*Nursing management- organizational structure*	*Record retention and disposal*
S-3	SLO-1	*Role of health promotion approach in hospitals*	*Ward/Indoor services-Components of the ward system*	*Transport services-Types of ambulance*	*Biomedical waste management- Types and Composition of Biomedical Waste*	*Office management -skills required by the office staff*
	SLO-2	*Health promoting hospital system*	*Design of special units*	*Communication and physical facilities of ambulance service*	*Categories of biomedical waste*	*Functions of office management*
S-4	SLO-1	*Healthy hospital environment*	*Operation theatre services-Planning and designing of Operation theatres*	*Staff transport services*	*Concept of total quality management*	*Operations research in hospitals-Phases of operation research*
	SLO-2	*Components of healthy hospital environment*	*Types of Operation theatres*	*Other transport services in hospitals*	*Types of approaches in quality management*	*Operations research in hospitals- Tools and techniques of operations research*
S-5	SLO-1	*Creating manpower services*	*Policies and procedures of operation theatres*	*Medicolegal services- Steps for Medicolegal Examination*	*Quality assessment and management tools*	*Emerging health insurance – components of health insurance*

	SLO-2	*Hospital engineering: Key to efficient healthcare services*	*Assessing operation theatre utilisation*	*Problems faced by healthcare professionals in medicolegal service*	*Clinical audit*	*Emerging health insurance-Types of health insurance*
S-6	SLO-1	*Designing disabled friendly hospitals-Barriers faced and implications in Persons with disabilities*	*Clinical laboratory services-Introduction and role of laboratory medicine*	*Food safety in hospitals-Need of food safety*	*Quality improvement-Cause and effect method*	*Advantages and common problems of health insurance schemes*
	SLO-2	*Need for disabled-friendly health services*	*Testing procedure in clinical laboratory*	*Sources of food contamination*	*Pareto analysis*	*Role of health and hospital administrators in Health insurance*
S-7	SLO-1	*Barrier-Free Environment to Universal Design*	*Radio diagnosis and imaging services-Planning and equipments of radiology department*	*Materials management- Principles of material management*	*Failure mode and effect analysis*	*Telemedicine clinic –functions and classification of telemedicine*
	SLO-2	*Overcoming the barriers*	*Advancement in radiology service*	*Concepts of Inventory control*	*Triggers of quality improvement strategy in a hospital*	*Challenges for telemedicine*
S-8	SLO-1	*Energy conservation- Classification*	*Radiation oncology service-Radiotherapy facilities*	*Modern techniques for inventory control*	*Occupational safety-Roles and responsibilities*	*Growth of mobile phones and potential of mobile health*
	SLO-2	*Types of energy streams in hospitals*	*Nuclear medicine services-Categorization and nuclear medicine department*	*Integrated concept for materials management*	*Prevention of hazards specific to health sector*	*Mobile health and its applications*
S-9	SLO-1	*Need for energy conservation*	*Planning of nuclear medicine department*	*Purchase and procurement system-Essentials for procurement process*	*Hospital security-Physical security*	*Challenges in implementing information and Communication technology in healthcare*
	SLO-2	*Energy conservation opportunities in hospitals*	*Ancillary requirements*	*Purchase system*	*Organizational chart of security wing*	*Information and communication technology applications in healthcare*

Learning Resources	*1. SonuGoel, Anil Kumar Gupta, Amarjeet Singh, Hospital administration A problem- solving approach, 1st ed., Elsevier, 2014*	*2. Sakharkar B M, Principles of hospital administration and planning, 2nd ed., Jaypee Brothers Medical Publishers, 2009* ***3.** Kunders G D, Hospitals: Facilities planning and management, 1st ed., Tata Mcgraw Hill, 2008*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Sathyanarayanan J, Mindray Medical India Pvt Ltd, sathyanarayananjayagopal@mindray.com	*1. Dr. S. Poonguzhali, Anna University, poongs@annauniv.edu*	*1. Dr. D. Ashokkumar, SRMIST*
2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	*2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in*	*2. Mr. P. Muthu, SRMIST*

Course Code	18ECO123T	Course Name	BIOMEDICAL IMAGING	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize the working principle of X-ray imaging	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Analyze the principle behind tomographic imaging and the reconstruction techniques			
CLR-3 :	Interpret the theory behind nuclear medicine and utilize the working of imaging modalities in nuclear medicine			
CLR-4 :	Analyze the physics of ultrasound and the different imaging modes using ultrasound			
CLR-5 :	Utilize the physical principle of nuclear magnetic resonance and magnetic resonance image reconstruction			
CLR-6 :	Utilize imaging modalities X-ray, computed tomography, nuclear medicine, ultrasound and magnetic resonance imaging			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Analyze the physics and principle behind the working of X-ray imaging	2	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-2 :	Identify the principle behind working of tomographic imaging and reconstruction procedures.	3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-3 :	Analyze the working principle of nuclear medicine imaging modalities	3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-4 :	Identify the physics of ultrasound and the modes of ultrasound imaging	3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-5 :	Explain the physical principle of magnetic resonance imaging and the instrumental components involved in MR imaging	3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-6 :	Understand the basic principle and working of medical Imaging systems	3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-

		X-ray	Computed Tomography	Ultrasound	Magnetic Resonance Imaging	Nuclear medicine
Duration (hour)		9	9	9	9	9
S-1	SLO-1	General principles of Imaging with X-rays	Introduction: Tomographic Imaging	Characteristics of sound: Propagation, wavelength, frequency and speed	Principles of NMR Imaging	Radionuclide decay terms and relationship
	SLO-2	X-ray Production –X-ray source	Comparison between tomographic and planar imaging	Pressure, Intensity and dB scale	Free Induction decay	Nuclear transformation
S-2	SLO-1	X-ray tube current, tube output	Basic principle: Technique of producing CT images	Interaction of ultrasound with matter: Acoustic impedance, reflection, refraction	Excitation, Emission	Radionuclide production
	SLO-2	Beam intensity, X-ray Energy Spectrum	Contrast scale	Scattering, Attenuation	Relaxation times-T1 & T2	Radiopharmaceuticals
S-3	SLO-1	Coherent and Compton scattering	System components: first generation, second generation, third generation,	Transducers: Piezoelectric materials, resonance transducers	Spin echo technique	Radiation detection and measurement: types of detectors, Gas-filled detectors
	SLO-2	Photoelectric effect	Fourth, fifth and spiral/helical CT	Damping block, matching layer, Resolution	Spin echo contrast weighting	Scintillation detectors
S-4	SLO-1	Linear and Mass attenuation coefficient of X-rays in tissue	X-ray source, types of detectors	Transducer arrays	T1 weighted image	Semiconductor detectors
	SLO-2	Instrumentation for Planar X-ray Imaging: Collimators	Gantry and slip ring technology, Collimation and filtration	Multi-element linear array scanners	T2 weighted image	Pulse height spectroscopy

S-5	SLO-1	*Antiscatter grids Intensifying screens*	*Processing system*	*Multi-linear and phased array*	*Gradient recalled sequence*	*Non-imaging detector applications*
	SLO-2	*X-ray films*	*Iterative reconstruction, back projection reconstruction*	*Generation and detection of ultrasound*	*Proton density weighted images, pulse sequence for fast imaging*	*Counting statistics*
S-6	SLO-1	*Instrumentation for computed and digital radiography*	*Filtered back projection*	*Basic pulse echo apparatus: A-scan*	*Slice selection gradient*	*Nuclear imaging*
	SLO-2	*X-ray Image characteristics: Signal to Noise ratio*	*Helical /Spiral CT: Helical pitch*	*B-Mode*	*Frequency encode gradient*	*Anger scintillation camera*
S-7	SLO-1	*Spatial resolution, Contrast to Noise ratio*	*Basic reconstruction approaches*	*M-mode*	*Phase encode gradient*	*Basic principle :Emission computed tomography*
	SLO-2	*X-ray contrast agents, X-ray angiography*	*Slice sensitivity profile*	*Echocardiograph*	*2D spin echo data acquisition*	*Single photon emission computed tomography*
S-8	SLO-1	*X-ray Fluoroscopy*	*Multislice CT*	*Duplex scanner*	*Basic NMR components: Main magnet, RF transmitter/receiver*	*Positron emission tomography*
	SLO-2	*X-ray mammography*	*Detector configuration*	*Intravascular imaging*	*Body coils, gradient coils*	*Imaging techniques and scanner instrumentation*
S-9	SLO-1	*Dual energy Imaging*	*Measurement of X-ray dosage*	*Artefacts: Refraction, shadowing and enhancement*	*fMRI : Basic principle*	*Dual modality: PET/CT*
	SLO-2	*Abdominal X-ray scans*	*Methods for dose reduction*	*Reverberation*	*BOLD concept, MR spectroscopy*	*Working and applications*

Learning Resources	*1. R.S.Khandpur, Handbook of Biomedical instrumentation, 3rd ed., Tata McGraw Hill, 2014*	**2.** *Jerrold T. Bushberg, John M. Boone, The essential physics of medical imaging, 3rd ed., Lippincott Williams & Wilkins, 2011*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply / Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate / Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Sathyanarayanan J, Mindray Medical India Pvt Ltd, sathyanarayananjayagopal@mindray.com	*1. Dr. S. Poonguzhali, Anna University, poongs@annauniv.edu*	*1. Dr. T. Jayanthi, SRMIST*
2. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anii@gmail.com	*2. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu*	*2. Dr. U. Snekhalatha, SRMIST*

Course Code	18ECO124T	Course Name	HUMAN ASSIST DEVICES	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Utilize the latest technology and device used for assisting human disability	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Analyze various devices used for mobility			
CLR-3 :	Utilize the various assist device used for hearing			
CLR-4 :	Utilize the various assist device used for vision			
CLR-5 :	Utilize the various assist device used in orthopaedic			
CLR-6 :	Analyze the working principles of cardiac assist devices and Artificial kidney			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Comprehend the assistive technology (AT) used for mobility	2	85	75
CLO-2 :	Analyze the Assist technology used for hearing	3	85	75
CLO-3 :	Evaluate the Assist technology used for sensory impairment of vision	3	85	75
CLO-4 :	Evaluate the assist device used in orthopedic	3	85	75
CLO-5 :	Analyze the latest use of assist technology in health care	3	85	75
CLO-6 :	Design the prosthetic heart valves and pacemaker	3	85	75

Program Learning Outcomes (PLO)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-2 :	M	-	-	-	-	-	-	-	-	-	-	-	-	L	-
CLO-3 :	-	-	-	-	-	-	-	-	-	-	-	-	-	L	-
CLO-4 :	M	-	-	-	-	-	-	-	-	-	-	-	M	L	-
CLO-5 :	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-
CLO-6 :	M	-	-	-	-	-	-	-	-	-	-	-	M	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Basic assessment and evaluation for mobility	Basic ear anatomy, Mechanism of hearing	Anatomy of eye	Anatomy of upper & lower extremities -	Basic Anatomy and physiology of heart.
	SLO-2	Basic assessment and evaluation for mobility	Common tests audiograms	Categories of visual impairment	Classification of amputation types	Cardiac assist devices
S-2	SLO-1	Manual wheelchairs	Air conduction, Bone conduction	Intraocular Devices	Prosthesis prescription	Intra-Aortic Balloon Pump (IABP),
	SLO-2	Electric power wheelchairs	Masking techniques,	Extraocular Devices	Hand and arm replacement	Prosthetic heart valves
S-3	SLO-1	Power assisted wheelchairs	SISI	Permanent Vision Restoration	Different types of models, externally powered limb prosthesis	Evaluation of prosthetic valve
	SLO-2	Wheel chair standards & tests -	Hearing aids principles	Non-Permanent Vision Restoration	Different types of models, externally powered limb prosthesis	Heart pacemaker
S-4	SLO-1	Wheel chair transportation	Drawbacks in the conventional unit	Voice Control Sound Control.	Foot orthosis	CABG
	SLO-2	Control systems, navigation in virtual space by wheelchairs	DSP based hearing aids	Sensor Technology Adapted for the Vision Impaired	Pediatric orthoses	Extracorporeal support
S-5	SLO-1	Wheel chair seating and pressure ulcers.	Cochlear Implants	Libraille	Wrist-hand orthosis	Vascular prosthesis

	SLO-2	*EOG based voice controlled wheelchair*	*Internal Hearing Aid*	*GRAB*	*feedback in orthotic system*	*Vascular prosthesis*
S-6	SLO-1	*BCI based wheelchair*	*External Hearing Aid*	*mathematical Braille*	*Components of upper limb prosthesis*	*Artificial heart*
	SLO-2	*Fuzzy logic expert system for automatic tuning of myoelectric prostheses*	*Permanent Hearing Restoration*	*Blind mobility aids*	*Components of lower limb prosthesis*	*Intermittent positive pressure breathing (IPPB) type assistance for lungs*
S-7	SLO-1	*Intelligent prosthesis*	*Non-Permanent Hearing Restoration*	*Reading writing & graphics access,*	*Lower extremity- and upper extremity-orthoses*	*Dialysis for kidneys*
	SLO-2	*Intelligent prosthesis*	*Touch Tactile Haptic Technology*	*Orientation & navigation Aids*	*Lower extremity- and upper extremity-orthoses*	*Artificial Kidney*
S-8	SLO-1	*Future trends in assistive technology*	*Sound Coding Translation*	*Wearable Assistive Devices for the Blind*	*functional electrical stimulation*	*Haemodialysis*
	SLO-2	*virtual reality based training system for disabled children*	*Acoustic Transducers Hearing Quality*	*Wearable tactile display for the fingertip.*	*Sensory assist devices*	*Membrane dialysis*
S-9	SLO-1	*Information technology, telecommunications,*	*Electric Electronic Stimulation*	*Cortical implants*	*Sensory assist devices*	*Portable dialysis monitoring and functional parameter*
	SLO-2	*new media in assisting healthcare*	*Hearing Enhancement*	*Retinal implants*	*Slints – materials used*	*Latest use of assistive technology for chronic heart diseases and healthcare*

Learning Resources

1. *Levine S.N. Advances in Bio-medical engineering and Medical physics, 1st ed., Vol. I, II, IV, Interuniversity publications, 1968.*
2. *Marion. A. Hersh, Michael A. Johnson, Assistive Technology for visually impaired and blind, 1st ed., Springer Science & Business Media, 2010*
3. *Kopff W.J, Artificial Organs, 1st ed., John Wiley and Sons, 1976*
4. *Daniel Goldstein, Mehmet Oz, Cardiac assist Devices, Wiley, 2000*
5. *Kenneth J. Turner, Advances in Home Care Technologies: Results of the match Project, 1st ed., Springer, 2011*
6. *Albert M.Cook, Webster J.G, Therapeutic Medical Devices, Prentice Hall Inc.,1982*
7. *Gerr .M. Craddock Assistive Technology-Shaping the future, 1st ed., IOS Press, 2003*
8. *Brownsell, Simon, et al,. A systematic review of lifestyle monitoring technologies, Journal of telemedicine and telecare 17.4 (2011): 185-189*
9. *Yadin David, Wolf W. von Maltzahn, Michael R. Neuman, Joseph.D, Bronzino, Clinical Engineering, 1st ed., CRC Press, 2010*
10. *Pascal Verdonck, Advances in Biomedical Engineering, 1st ed., Elsevier, 2009*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember / Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply / Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate / Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	*2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in*	*2. Dr. U. Snekhalatha, SRMIST*

Course Code	18ECO125T	Course Name	QUALITY CONTROL FOR BIOMEDICAL DEVICES	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Utilize Quality, Quality control measures essential for an organization			
CLR-2 :	Utilize the quality management principles and good management practices			
CLR-3 :	Utilize the various quality control tools			
CLR-4 :	Utilize the various quality management tools			
CLR-5 :	Analyze the various standards applicable to healthcare globally and nationally			
CLR-6 :	Implement the global standards in healthcare			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Analyze the underlying concepts of quality and quality control concepts of an organization	2	85	75	-	-	-	M	-	-	-	M	M	-	-	L	-	M	L
CLO-2 :	Evaluate the various quality management principles and good management practices	3	85	75	L	-	-	-	-	-	-	-	-	-	-	-	-	-	L
CLO-3 :	Evaluate various tools of quality control	3	85	75	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-4 :	Analyze the various quality management tools	3	85	75	L	-	-	-	-	-	-	-	-	-	-	-	-	-	L
CLO-5 :	Analyze the various standards applicable to healthcare globally and nationally	3	85	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CLO-6 :	Analyze the outcomes of implementing global standards	3	85	75	M	-	-	-	-	-	-	-	-	-	-	L	-	-	L

		Introduction to quality	TQM principles	Statistical process control	TQM tools	Quality systems
Duration (hour)		9	9	9	9	9
S-1	SLO-1	Definition of Quality	Customer satisfaction – Customer Perception of Quality	The seven tools of quality	Benchmarking	ISO 9000 Systems
	SLO-2	Dimensions of Quality	Customer Complaints	Cause-and-effect diagram	Reasons to Benchmark	ISO 9000 Systems
S-2	SLO-1	Quality Planning	Service Quality	Check sheet	Benchmarking Process	ISO 9000:2000 Quality System –Elements
	SLO-2	Quality Planning	Customer Retention	Check sheet	Benchmarking Process	ISO 9000:2000 Quality System –Elements
S-3	SLO-1	Quality costs	Employee Involvement	Control chart	Quality Function Deployment (QFD)	Need for Accreditation of hospitals
	SLO-2	Quality costs	Motivation	Control chart	Quality Function Deployment (QFD)	Need for Accreditation of hospitals
S-4	SLO-1	Basic concepts of Total Quality Management	Empowerment	Histogram	House of Quality	FDA Regulations
	SLO-2	Principles of TQM	Teams and Team Work	Histogram	House of Quality	FDA Regulations
S-5	SLO-1	Leadership – Concepts	Recognition and Reward	Pareto chart	QFD Process - Benefits	Joint Commission

	SLO-2	*Role of Senior Management*	*Performance Appraisal*	*Pareto chart*	*QFD Process - Benefits*	*Joint Commission*
S-6	SLO-1	*Quality Council*	*Juran Trilogy*	*Scatter diagram*	*Total Productive Maintenance (TPM) – Concept*	*Regulatory Bodies of India*
	SLO-2	*Quality Statements*	*Juran Trilogy*	*Scatter diagram*	*Total Productive Maintenance*	*Medical Council of India*
S-7	SLO-1	*Strategic Planning*	*PDSA Cycle*	*Stratification*	*Improvement Needs*	*Pharmacy Council Of India*
	SLO-2	*Strategic Planning*	*PDSA Cycle*	*Stratification*	*Improvement Needs*	*Pharmacy Council Of India*
S-8	SLO-1	*Deming Philosophy*	*Kaizen*	*Six sigma*	*FMEA*	*Indian Nursing Council*
	SLO-2	*Deming Philosophy*	*Kaizen*	*Six sigma*	*FMEA*	*Indian Nursing Council*
S-9	SLO-1	*Barriers to TQM Implementation*	*5S*	*Six sigma*	*Stages of FMEA*	*Dental Council of India*
	SLO-2	*Barriers to TQM Implementation*	*5S*	*Six sigma*	*Stages of FMEA*	*Homeopathy Central Council*

Learning Resources	1. *Rose J.E, Total Quality Management, Kogan Page Ltd., 1993* 2. *Cesar A. Cacere, Albert Zana,The Practise of clinical Engineering, Academic Press,1997* 3. *Greg Bounds, Beyond Total Quality Management-Toward the emerging paradigm, McGraw Hill, 2013*	4. *Joseph J.Carr, Elements of Electronics Instrumentation and Measurement, 2nd ed., Pearson Education, 2003* 5. *Jerrold T. Bushberg, John M. Boone, The essential physics of medical imaging, 3rd ed., Lippincott Williams & Wilkins, 2011*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
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2. Mr. Anuj Kumar, Bombardier Transportation, Ahmedabad, kumaranuj.anii@gmail.com	*2. Dr. Meenakshi, Professor of ECE, CEG, Anna University, meena68@annauniv.edu*	*2. Dr. D. Ashok Kumar, SRMIST*

Course Code	18ECO131J	Course Name	VIRTUAL INSTRUMENTATION	Course Category	O	Open Elective	L	T	P	C
							2	0	2	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	To study the concepts of Virtual instrumentation and to learn the programming concepts in VI.	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	To study about the various real time data acquisition methods.			
CLR-3 :	To study about thevarious Instrument Interfacing concepts.			
CLR-4 :	To study the programming techniques for various control techniques using VI software			
CLR-5 :	To study various analysis toolsfor Process control applications.			
CLR-6 :	To study various real time measurement systems			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	An ability to understand the purpose of virtual instrumentation and understand the construction of VI	2	80	70	H												H		
CLO-2 :	An ability to understand and apply various data acquisition methods.	2	85	75	H												H	H	
CLO-3 :	An ability to understand and implement the available interfacing instruments	2	75	70	H	H	H	H	H								H	H	H
CLO-4 :	An ability to understand and implement various control techniques using VI software	3	85	80	H	H	H	H	H								H		H
CLO-5 :	An ability to understand and develop a program foran engineering application.	3	85	75	H	H	H	H	H				H	H	H	H	H	H	
CLO-6 :	An ability to understand and implement various measurement systems	3	80	70	H	H	H	H	H				H	H	H	H	H	H	

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Historical perspective,Need of VI,Advantages of VI,Virtual Instruments versus Traditional Instruments	A/D Converters, Organization of the DAQ VI system -	Introduction to PC Buses	Introduction to Non continuous controllers in LabVIEW	PC based digital storage oscilloscope
	SLO-2	Review of software in Virtual Instrumentation ,Software environment Architecture of VI,Introduction to the block diagram and Front panel Pallets	D/A Converters, Types of D/A	Local Buses-ISA, PCI,	Introduction to continuous controllers in LabVIEW	Sensor Technology
S-2	SLO-1	Creating and saving a VI, Front Panel Tool Bar, Block diagram Tool Bar, Palettes	plug-in Analog Input/Output cards - Digital Input and Output Cards,	RS232, RS422	Design of ON/OFF controller	Applications of sensor Technology
	SLO-2	Creating sub VI, Creating an ICON, Building a connector pane, Displaying VI'S Placing and Saving Sub VI'S on block diagram Example of full adder circuit using half adder circuit	Organization of the DAQ VI system -	RS485	Proportional controller for a mathematically described processes using VI software	Signal processing Techniques
S 3-4	SLO-1	Front Panel controls and Indicator Verification of Arithmetic Operations	Measurement of diode I-V characteristics using LabVIEW	Load cell Data acquisition using RS232	On-off temperature controller using LabVIEW	Design of DSO
	SLO-2	Verification of Half Adder Verification of Full adder.	Temperature measurement using LabVIEW and DAQ hardware.	Load cell Data acquisition using RS422	Continous Control of temperature using LabVIEW	Analysis of different signal Filters using LabVIEW
S-5	SLO-1	Loops-For Loop,	Opto Isolation need	Interface Buses-USB,PXI	Modeling of level process	Spectrum Analyser
	SLO-2	While Loop	Performing analog input and analog output	VXI,	Basic control of level process in LabVIEW	Waveform Generator
S-6	SLO-1	Arrays,	Scanning multiple analog channels	SCXI	Modeling of Reactor Processes	Data visualization from multiple locations

	SLO-2	*Clusters,plotting data*	*Issues involved in selection of Data acquisition cards*	*PCMCIA*	*Basic control of Reactor process in LabVIEW*	*Distributed monitoring and control*
S 7-8	SLO-1	*Program to find Addition of First n natural numbers using for loop Program to find Addition of First n odd numbers using while loop.*	*Flow measurement in water using LabVEW and DAQ hardware.*	*DC motor control using VXI*	*On-off Level controller using LabVIEW*	*Real time spectrum analysis using LabVIEW*
	SLO-2	*Implementation of Array functions. Calculation of BMI using cluster*	*Level measurement in water using LabVEW and DAQ hardware*	*GPIB with VISA functions*	*Continuous Control of pressure controller using LabVIEW*	*Arbitratory Waveform Generator using LabVIEW*
S-9	SLO-1	*Charts*	*Data acquisition modules with serial communication*	*Instrumentation Buses - Modbus and GPIB*	*Case studies on development of HMI in VI*	*Vision and Motion Control*
	SLO-2	*Graphs*	*Design of digital voltmeters with transducer input*	*Networked busses – ISO/OSI*	*Case studies on development of HMI in VI*	Examples on Integrating Measurement with vision and motion
S-10	SLO-1	*Case and Sequence Structures*	*Timers and Counters*	*Reference model,*	*Case studies on development of SCADA in VI*	NI Motion control
	SLO-2	*Formula nodes, String and File Input/Output.*	*Timers and Counters*	*Ethernet and TCP / IP Protocols*	*Case studies on development of SCADA in VI*	Speed control system
S 11-12	SLO-1	*Monitoring of temperature using Charts and Graphs. Program for implementing Seven segment display..*	*Design of digital voltmeters with transducer input using LabVIEW*	*Online temperature control using LabVIEW using TCP/IP*	*On-off pressure controller using LabVIEW*	*Minor Project*
	SLO-2	*Program to perform Traffic light control*	*Pressure measurement usingLabVEW and DAQ hardware DAQ.*	*Online temperature control using Webpublishing tool*	*Continuous Control of pressure controller using LabVIEW*	*Minor Project*

Learning Resources	1. *Nadovich, C., Synthetic Instruments Concepts and Applications, Elsevier, 2005* 2. *Bitter, R., Mohiuddin, T. and Nawrocki, M., Labview Advanced Programming Techniques, 2nd ed., CRC Press, 2007* 3. *Gupta, S. and Gupta, J. P., PC Interfacing for Data Acquisition and Process Control", 2nd ed., Instrument Society of America, 1994*	4. *Jamal, R., Picklik, H., Labview – Applications and Solutions, National Instruments Release.* 5. *Johnson, G., Labview Graphical programming, McGraw-Hill, 1997* 6. *Wells, L.K., Travis, J., Labview for Everyone, Prentice Hall, 1997* 7. *Buchanan, W., Computer Busses, CRC Press, 2000*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand										
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze										
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. D. Karthikeyan, Controlsoft Engineering India Pvt Ltd, karthikeyan.d@controlsoftengg.in	*1. Dr. J. Prakash, MIT, Chennai, prakaiit@rediffmail.com*	*1. Dr. K. A. Sunitha, SRMIST*
2. V. Venkateswaran, Instrumentation Consultant, vvenkat99@gmail.com	*2. Dr. D. Nedumaran, Madras University, dnmaran@gmail.com*	*2. Mrs. A. Brindha, SRMIST*

Course Code	18ECO132T	Course Name	ANALYTICAL INSTRUMENTATION	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLR-1 :	Understand the principle and theory of analytical instruments																		
CLR-2 :	Understand the quantitative analysis of dissolved components																		
CLR-3 :	Study the concept of separation science and its applications																		
CLR-4 :	Study the various spectroscopic techniques and its instrumentation																		
CLR-5 :	Identify and solve engineering problems associated with Radiation Techniques																		
CLR-6 :	Understand the working of Analytical Instrument and their importance in industries																		
Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:																		
CLO-1 :	Apply the principles and theory of instrumental analysis	2	80	70	H	H	L	L	H	H	H	-	-	-	-	-	H	H	L
CLO-2 :	Apply the principles of various chemical analysis instruments in industries	2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H	L
CLO-3 :	Analyze and understand the operation of various radio chemical methods of analysis	2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H	L
CLO-4 :	To analyze and understand the operation of instruments based on optical properties	2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H	L
CLO-5 :	To identify and solve engineering problems associated with Radiation Techniques	2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H	L
CLO-6 :	To understand the working of analytical Instruments in industries	2	80	70	H	H	L	L	H	H	-	-	-	-	-	-	H	H	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to Chemical instrumental analysis	Dissolved oxygen analyzer, Importance of measuring dissolved oxygen in Industry, Principle working	Chromatography, Importance, Basic working of Chromatography	Spectral methods of analysis- Properties or parameters of electromagnetic radiation	NMR spectrometers ,Importance and basic working of NMR Spectroscopy
	SLO-2	Spectral method of analysis	Working of Dissolved oxygen analyzer	Gas chromatography Instrumentation	Electromagnetic spectrum Types of spectrometers	Magnetic assembly, Probe unit, Instrument stabilization
S-2	SLO-1	Electro analytical and seperative methods	sodium analyzer, Importance of measuring sodium in Industry, Principle working	Basic parts of a gas chromatography	Beer's law UV-visible spectrophotometers Transmittance and absorbance	Types of NMR spectrometer, Minimal type
	SLO-2	Instrumental methods of analysis-basic components and their classification	Working of sodium analyzer	Carrier gas supply Sample injection system	Beer's law Application of beer's law	Multipurpose NMR,Wideline
S-3	SLO-1	Sampling systems	Silica analyzer, Importance of measuring Silica in Industry, Principle working	Chromatographic column, Selection of column	Derivations of beer's law	Applications of NMR Spectrometer
	SLO-2	Importance of Sampling system in chemical Industries and Safety aspects	Working of Silica Analyzer	Thermal compartment Detection system Recording system	Single beam and double beam instruments	Mass Spectrometers, Basic working and Importance
S-4	SLO-1	PH Measurement, Principle of PH measurement &Importance of PH measurement in Industries	Moisture measurement Importance of Moisture measurement	Liquid chromatography-Principles, types and applications	IR spectrophotometers Instruments of IR	Components of Mass Spectrometers
	SLO-2	Types of Electrodes, Reference Electrodes and types	Types of Moisture measurement	High pressure liquid chromatography	Types of IR Components required for three types of IR	Types of Mass spectrometers Magnetic Sector analyzer ,Double focusing spectrometers
S-5	SLO-1	Secondary Electrodes and Types	Oxygen analyzer Methods of oxygen analyzers and importance	Instrumentation or basic component of HPLC	Instruments of dispersive instrument , IR Radiation Sources and types	Time of flight analyzers, Quadrupole Mass analyzers

	SLO-2	*Indicator electrodes*	*Paramagnetic oxygen analyzer Electro analytical method*	*Solvent reservoir and its treatment system*	*Importance of Monochromators and types of Monochromators*	*Application of mass spectrophotometers*
S-6	SLO-1	*pH meters direct reading type pH meter null detector type pH meter*	*CO monitor,Importance of measuring CO*	*Pumping system, Types of working systems and Importance*	*Samples And Sample Cells detectors*	*nuclear radiation detectors, importance of measurement*
	SLO-2	*ion selective electrodes Types of ion selective electrodes Glass membrane electrodes Liquid membrane electrodes Solid membrane Electrodes*	*Types of CO monitor*	*Pulse dampers*	*FTIR spectrometers Main components Advantages disadvantages*	*GM counter*
S-7	SLO-1	*Features of Biosensor Block diagram of bio sensor*	*NO2 analyzer, Importance of NO_2 measurement*	*Sample injection system and types*	*Types of sources Selection factors*	*Working setup, advantages of GM Counter*
	SLO-2	*Applications of Biosensors in industries*	*Types of NO_2 measurement*	*Liquid chromatographic column working , Types of Column thermostats*	*Types of detectors Selection factors*	*proportional counter, Basic Principle*
S-8	SLO-1	*conductivity meters ,Importance in Chemical Industries*	*H_2S analyzer, Importance of H_2 S Measurement*	*Detection system types*	*atomic absorption spectrophotometer instruments for atomic absorption spectroscopy*	*Working setup, advantages of GM Counter*
	SLO-2	*Types of Conductivity meters*	*Types of H_2S measurement*	*Types of Recording system*	*radiation source chopper*	*solid state detectors, Basic Principle*
S-9	SLO-1	*Air pollution Monitoring Instruments*	*Dust and smoke measurement- dust measurement and Importance Types of dust measurement*	*Application of HPLC, Advantages of HPLC over gas chromatography*	*production of atomic vapor by flame, Parts by flame photometer Emission system*	*Working setup, advantages of Solid state detectors*
	SLO-2	*Estimation of Air pollution*	*Thermal analyzer , Importance of Thermal analyzers, Types of Thermal analyzer*	*Detectors types, Factors Influencing the Selection of Detectors*	*Monochromators And types, Types of Detectors and recording systems and their selection criteria*	*scintillation counter, Basic principle*

Learning Resources	1. *Khandpur. R.S, "Handbook of Analytical Instruments", Tata McGraw Hill publishing Co. Ltd., 2006* 2. *Bella. G, Liptak, "Process Measurement and analysis"., CRC press LLC.,2003.* 3. *Francis Rousseau and Annick Rouesssac "Chemical analysis Modern Instrumentation Methods and Techniques", John wiley & sons Ltd.2007.*	4. *James W.Robinson,"Undergraduate Instrumental Analysis", Marcel Dekker., 2005.* 5. *Dwayne Heard, "Analytical Techniques for atmospheric measurement", Blackwell Publishing, 2006.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. D.Karthikeyan, Controlsoft Engineering India Pvt Ltd, karthikeyan.d@controlsoftengg.in	*1. Dr. J. Prakash, MIT, Chennai, prakaiit@rediffmail.com*	*1. Dr. K. A. Sunitha, SRMIST*
2. V. Venkateswaran, Instrumentation Consultant, vvenkat99@gmail.com	*2. Dr. D. Nedumaran, Madras University, dnmaran@gmail.com*	*2. Mrs. A. Brindha, SRMIST*

Course Code	18ECO133T	Course Name	SENSORS AND TRANSDUCERS	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	Gain knowledge on classification, and characteristics of transducers	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	Acquire the knowledge of different types of inductive and capacitive sensors			
CLR-3 :	Acquire the knowledge of different types of thermal and radiation sensors			
CLR-4 :	Acquire the knowledge of different types of magnetic sensors			
CLR-5 :	Acquire the knowledgeof different types of sensors measuring non-Electrical quantity			
CLR-6 :	Locate the Applications of sensors in industries and home appliances			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	To demonstrate the various types of basic sensors.	3	80	75	H	-	H	-	-	H	H	H	-	-	-	H	H	-	-
CLO-2 :	Understand the inductive and capacitive sensors which are used for measuring various parameters.	3	80	75	H	-	-	H	-	H	-	-	-	-	-	H	-	H	-
CLO-3 :	Understand the thermal and radiation sensors	3	80	75	-	-	-	-	-	H	-	-	H	H	-	-	H	-	-
CLO-4 :	Have an adequate knowledgeon the various magnetic sensors	3	80	75	-	H	H	-	-	-	-	-	-	-	-	-	-	H	-
CLO-5 :	To demonstrate the various types of basic sensors measuring non electrical quantity	3	80	75	-	-	H	-	H	-	-	-	-	-	-	H	-	-	H
CLO-6 :	Select the right transducer for the given application	3	80	75	H	-	H	-	-	H	H	H	-	-	-	H	H	-	-

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Introduction to sensors/ transducers, Principles	Introduction to Inductive sensor	Thermal sensors: Introduction	Magnetic sensors: Introduction	Measurement of Non-Electrical quantity: Introduction
	SLO-2	Classification based on different criteria	Sensitivity and linearity of the sensor	Thermal Expansion type.	Villari effect	Flow Measurement – Introduction.
S-2	SLO-1	Characteristics of measurement systems	Transformer type transducer	Acoustics temperature sensors.	Wiedmann effect	Ultrasonic Flow Meters.
	SLO-2	Static characteristics Accuracy, Precision, Resolution, Sensitivity	Electromagnetic transducer	Thermo-emf sensor.	Hall effect	Hot Wire Anemometers.
S-3	SLO-1	Dynamic characteristics.	Magnetosrtictive transducer	Materials for thermos-emf sensors.	Construction,	Electromagnetic Flow meters.
	SLO-2	Environmental Parameters	Materials used in inductive sensor	Thermocouple construction	performance characteristics,	Principle and types.
S-4	SLO-1	Characterization and its type	Mutual Inductance change type	Types.	and its Application	Measurement of Displacement.
	SLO-2	Electrical characterization.	LVDT: Construction.	Thermo-sensors using semiconductor device	Introduction to smart sensors	Introduction and types.
S-5	SLO-1	Mechanical Characterization.	Material, input output relationship,	Pyroelectric thermal sensors	Film sensors: Introduction	Measurement of Velocity/ Speed.
	SLO-2	Thermal Characterization	Synchros-Construction	Introduction	Thick film sensors	Introduction and types.

S-6	SLO-1	*Optical Characterization.*	*Capacitive sensor: Introduction*	*characteristics*	*Microelectromechanical systems*	*Measurement of Liquid Level.*
	SLO-2	*Errors and its classification.*	*Parallel plate capacitive sensor*	*Application*	*Micromachining.*	*Introduction and types.*
S-7	SLO-1	*Selection of transducers.*	*Variable thickness dielectric capacitive sensor*	*Radiation sensors*	*Nano sensors*	*Measurement of Pressure.*
	SLO-2	*Introduction to mechanical sensors*	*Electrostatic transducer*	*Introduction*	*Applications: Industrial weighing systems: Link–lever mechanism.*	*Introduction and types.*
S-8	SLO-1	*Resistive potentiometer and types*	*Piezoelectric elements*	*Characteristics*	*Load cells – pneumatic, elastic and their mounting.*	*Measurement of Vibration.*
	SLO-2	*Strain gauge: Theory, type, design consideration, sensitivity.*	*Ultrasonic Sensors*	*Geiger counters*	*different designs of weighing systems.*	*Introduction and types.*
S-9	SLO-1	*Resistive transducer: RTD, materials used in RTD*	*Calculation of sensitivity.*	*Scintillation detectors*	*conveyors type.*	*Application of sensors in industries*
	SLO-2	*Thermistor: thermistor material, shape*	*Capacitor microphone, response characteristics*	*Application on radiation sensors*	*weighfeeder type.*	*Application of sensors in home appliances*

Learning Resources	1. *Patranabis, D., "Sensors and Transducers", 2nd Edition, Prentice Hall India Pvt. Ltd, 2010* 2. *Doeblin, E.O., "Measurement Systems: Applications and Design", 6thEdition, Tata McGraw-Hill Book Co., 2011* 3. *Bentley, J. P., "Principles of Measurement Systems", 4th Edition, Addison Wesley Longman Ltd., UK, 2004.*	4. *Murthy, D.V.S., "Transducers and Instrumentation", Prentice Hall of India Pvt. Ltd., New Delhi, 2010* **5.** *Neubert H.K.P., "Instrument Transducers – An Introduction to their performance and Design", Oxford University Press, Cambridge, 2003*

Learning Assessment												
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Understand										
Level 2	Apply	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
	Analyze										
Level 3	Evaluate	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Create										
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. D. Karthikeyan, ControlsoftEngineering India Pvt Ltd, karthikeyan.d@controlsoftengg.in	*1. Dr. J. Prakash, MIT, Chennai, prakaiit@rediffmail.com*	*1. Mrs.K.Vibha, SRMIST*
2. Mr. Prasad, KCP Sugar & Industries, kcpengineering@gmail.com	*2. Mr. Prashanth Ravi, NTU, prashantrar@gmail.com*	*2. Dr. G.JoselinRetna Kumar, SRMIST*

Course Code	18ECO134T	Course Name	INDUSTRIAL AUTOMATION	Course Category	O	Open Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Electronics and Communication	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Understand basic components of PLC			
CLR-2 :	Understand the use of timers and counters in process automation			
CLR-3 :	Understand DCS architecture			
CLR-4 :	Understand operator and engineering interface in DCS			
CLR-5 :	Understand HART signal standard and Field bus			
CLR-6 :	Understand Field bus signal standard.			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	Select PLC based on I/O's	3	80	75
CLO-2 :	Apply timers and counters in process automation	3	80	75
CLO-3 :	Select LCU based on application	3	80	75
CLO-4 :	Analyse data's in Operator displays	3	80	75
CLO-5 :	Interpret industrial data communication modes	3	80	75
CLO-6 :	Gain knowledge on field bus	3	80	75

		Program Learning Outcomes (PLO)														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Select PLC based on I/O's	H	M	L	-	-	-	-	-	M	-	M	L	M		M
CLO-2 :	Apply timers and counters in process automation	H	H	H	H	H	-	L	-	H	M	L	L	H	H	H
CLO-3 :	Select LCU based on application	H	M	-	-	-	-	-	-	L	-	-	L	M	L	M
CLO-4 :	Analyse data's in Operator displays	H	H	-	H	-	-	-	-	H	M	-	L	H	L	M
CLO-5 :	Interpret industrial data communication modes	H	-	-	-	-	-	-	-	-	L	-	L	H	-	L
CLO-6 :	Gain knowledge on field bus	H	L	-	-	-	-	-	-	-	-	-	L	H	-	L

Duration (hour)		9	9	9	9	9
S-1	SLO-1	Programmable logic controllers	PLC Programming Languages	Evolution of DCS	Operator Interfaces Requirements	Introduction to HART
	SLO-2	PLC vs Computer	Ladder Diagram	Hybrid System Architecture	Process Monitoring	Evolution of Signal standard
S-2	SLO-1	Parts of a PLC	Functional block	Central Computer system Architecture	Process Control	HART Networks: Point-to-Point
	SLO-2	Architecture	Sequential Function Chart	DCS Architecture	Process Diagnostics	Multi-drop
S-3	SLO-1	PLC size and Application.	Instruction List	Comparison of Architecture	Process Record Keeping	Split range control valve
	SLO-2	Fixed and Modular I/O	Structured Text	Local Control Unit Architecture	Low Level Operator Interface	HART Field Controller Implementation
S-4	SLO-1	Discrete Input Modules	Wiring Diagram	Architectural Parameters	High Level Operator Interface	Hart Commends: Universal
	SLO-2	Discrete Output Modules	Ladder logic Program	Comparison Of LCU Architecture	Hardware Elements In The Operator Interface	Common Practice
S-5	SLO-1	Analog Input Modules	On-Delay Timer Instruction	LCU Language Requirements	Operator Input And Output Devices	Device Specific

	SLO-2	*Analog Output Modules*	*Off-Delay Timer Instruction*	*Function Blocks*	*Operator Display Hierarchy*	*Wireless Hart*
S-6	SLO-1	*Special I/O Modules*	*Retentive Timer*	*Function Block Libraries*	*Plant-Level Display*	*Field Bus Basics*
	SLO-2	*High Speed Counter Module*	*Cascading Timer*	*Problem-Oriented Language*	*Area- Level Display*	*Field Bus Architecture*
S-7	SLO-1	*Power Supplies*	*Up-Counter*	*LCU Process Interfacing Issues*	*Group- Level Display*	*Field Bus Standard*
	SLO-2	*Isolators*	*Down-Counter*	*Security Requirements*	*Loop- Level Display*	*Field Bus Topology*
S-8	SLO-1	*Input/output Devices: Switches*	*Cascading Counters*	*Security Design Approach*	*Engineering Interface Requirements*	*H1 Field Bus*
	SLO-2	*sensors*	*Combining Counter And Timer Functions*	*On-Line Diagnostics*	*Requirement For Operator Interface Configuration*	*H2 Field Bus*
S-9	SLO-1	*Relays*	*Math Operation*	*Redundant Controller Design*	*Low Level Engineering Interface,*	*Interoperability*
	SLO-2	*Solenoid valve*	*Program*	*One-On-One, One-On-Many Redundancy*	*High Level Engineering Interfaces*	*Interchangeability*

Learning Resources	**1.** *Frank D. Petruzella, Programmable Logic Controller, Tata McGraw Hill Fifth Edition, 2017* **2.** *Bolton. W, Programmable Logic Controllers, 6th Edition, Elsevier Newnes, Sixth Edition 2016.* 3. *Krishna Kant, Computer Based Industrial Control, Second edition, Prentice Hall of India, New Delhi,2015*	**4.** *Bowten, R HART Application Guide, HART Communication foundation,2015.* **5.** *Berge, J, Field Busses for process control: Engineering, operation, maintenance, ISA press,2015*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	*40 %*	-	*40%*	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	*30 %*	-	*30%*	-
	Total	100 %		100 %		100 %		100 %		100 %	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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ACADEMIC CURRICULA

Project Work, Seminar,

Internship in Industry / Higher Technical Institutions

Courses

Regulations 2018

Volume – 4 (8)

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code							Course Name	Course Category			L	T	P	C
	18ASP101L	18ASP104L	18AUP101L	18AUP104L	18BTP101L	18BTP104L	MASSIVE OPEN ONLINE COURSE - I / MASSIVE OPEN ONLINE COURSE - II		P	*Project Work, Seminar, Internship in Industry / Higher Technical Institutions*	0	0	2	1
	18CHP101L	18CHP104L	18CEP101L	18CEP104L	18CSP101L	18CSP104L								
	18EEP101L	18EEP104L	18ECP101L	18ECP104L	18MEP101L	18MEP104L								
	18MHP101L	18MHP104L	18NTP101L	18NTP104L										

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1 :	*Improve Student Academic Characteristics and learning goals through forums, discussion groups, and blogs*
CLR-2 :	*Improve Student Personal Characteristics through self-learning habits*
CLR-3 :	*Characterize self-learning environment that includes pedagogy, tools, tasks, duration, feedback and assessments*
CLR-4 :	*Improve lifelong learning habits and Learning process*
CLR-5 :	*Characterize learning engagement methods and activities*
CLR-6 :	*Inculcate self-learning behavior and lifelong learning tendency*

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)															
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	*Inculcate student characteristics: prior-knowledge, prior-experience, expertise, academic achievement and matriculation*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	-	*H*	*H*	*H*	-	*H*	-	-	-
CLO-2 :	*Inculcate self-motivation, self-confidence, intrinsic motivation, participation, social economic statute, and task-orientation*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	-	*H*	*H*	*H*	-	*H*	-	-	-
CLO-3 :	*Enhance self-learning through peer learning, learning groups, positive collaboration*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	-	*H*	*H*	*H*	-	*H*	-	-	-
CLO-4 :	*Explore different learning styles and activities, identify self-learning pace, difficulties and remedial measures*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	-	*H*	*H*	*H*	-	*H*	-	-	-
CLO-5 :	*Identify ways of students' engagement, achievement, and attrition*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	-	*H*	*H*	*H*	-	*H*	-	-	-
CLO-6 :	*Identify ethical practices in self-learning and practice both individual and group learning dynamics*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	-	*H*	*H*	*H*	-	*H*	-	-	-

MOOC Course Selection: List of MOOC Courses that are Approved to be learned by the student in the respective semester will be displayed by the Department MOOC Committee. Student can pick any course from that list.

Learning Assessment	
MOOC Certification Obtained (80% weightage)	Final Presentation (20% weightage)

Note: Final Presentation by the student would be evaluated by the Department MOOC Committee.

Course Code	18ASP102L 18CHP102L 18EEP102L 18MHP102L	18ASP105L 18CHP105L 18EEP105L 18MHP105L	18AUP102L 18CEP102L 18ECP102L 18NTP102L	18AUP105L 18CEP105L 18ECP105L 18NTP105L	18BTP102L 18CSP102L 18MEP102L	18BTP105L 18CSP105L 18MEP105L	Course Name	INDUSTRIAL TRAINING – I / INDUSTRIAL TRAINING – II	Course Category	P	*Project Work, Seminar, Internship in Industry / Higher Technical Institutions*	L	T	P	C
												0	0	2	1

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Train oneself in finding the aspects in real-time work environment and prepare them to join the workforce in the future*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Gain Exposure to the actual working conditions including rules, regulations and safety practices*			
CLR-3 :	*Enhance and supplement the knowledge and skills of the students*			
CLR-4 :	*Develop the students in terms of ability, competence and interpersonal relationship*			
CLR-5 :	*Enhance students' knowledge in one particular technology*			
CLR-6 :	*Provide learning platform that can enhance their employ ability skills*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	*Apply knowledge of Mathematics, Science, and Engineering Fundamentals in the real world of work*	3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	-	-	-
CLO-2 :	*Demonstrate competency in relevant engineering fields through problem identification, formulation and solution*	3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	-	-	-
CLO-3 :	*Effectively implement skills in professional communication, technical writing and using multimedia tools*	3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	-	-	-
CLO-4 :	*Develop ability to work as an individual and in a group as an effective team member*	3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	-	-	-
CLO-5 :	*Master the professional and ethical responsibilities of an engineer*	3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	-	-	-
CLO-6 :	*Generate a report based on the experiences and projects carried out in a real-world work environment*	3	95	85	H	M	M	H	H	H	L	H	H	H	H	H	-	-	-

Industrial Training Selection: List of Industries for Industrial Training for students would be finalized by the Department Internship/Industrial Training Committee.

Learning Assessment	
Industrial Training Certification Obtained (80% weightage)	Final Presentation (20% weightage)

Note: Final Presentation Evaluation would be done by the Internship/Industrial Training Committee formed by the Department.

Course Code	18ASP103L 18CHP103L 18EEP103L 18MHP103L	18ASP106L 18CHP106L 18EEP106L 18MHP106L	18AUP103L 18CEP103L 18ECP103L 18NTP103L	18AUP106L 18CEP106L 18ECP106L 18NTP106L	18BTP103L 18CSP103L 18MEP103L	18BTP106L 18CSP106L 18MEP106L	Course Name	SEMINAR – I / SEMINAR – II	Course Category	P	*Project Work, Seminar, Internship in Industry / Higher Technical Institutions*	L	T	P	C
												0	0	2	1

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Utilize fundamental principles, generalizations, or theories and ability to present the same*			
CLR-2 :	*Increase self-motivation, personal responsibility, understand one's role of being an informed participant*			
CLR-3 :	*Create an environment that helps the student establish healthy relationships and support networks*			
CLR-4 :	*State and explain some specific skills, competencies, and points of view*			
CLR-5 :	*Identify, apply appropriate note-taking, test-taking, and time-management strategies to the academic studies*			
CLR-6 :	*Develop critical thinking, information literacy, Interdisciplinary Inquiry, Engaging with Big Questions and Major Works*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Program Learning Outcomes (PLO)														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLO-1 :	*Gaining factual knowledge (terminology, classifications, methods, trends)*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	-	*H*	-	-	-
CLO-2 :	*Rlate to their interests, abilities, career choices, and personal development*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	-	*H*	-	-	-
CLO-3 :	*Develop a plan that demonstrates their responsibility for their own education*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	-	*H*	-	-	-
CLO-4 :	*Explain the role of self-efficacy, personal goals, and motivation in improving academic life*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	-	*H*	-	-	-
CLO-5 :	*Describe the behaviors and characteristics of an effective learner*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	-	*H*	-	-	-
CLO-6 :	*Improve the Presentation Skills, Discussion Skills, Listening Skills, Argumentative Skills, Critical Thinking, Questioning*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	-	*H*	-	-	-

Seminar Selection: List of Seminar Topics that are Approved to be learned by the student in the respective semester will be displayed by the Department Seminar Selection/Evaluation Committee. Student can pick any topic from that list.

Learning Assessment	
Seminar Preparation Materials & Report (80% weightage)	Final Presentation (20% weightage)

Note: Final Presentation Evaluation would be done by the Seminar Evaluation Committee formed by the Department.

Course Code	18ASP107L 18AUP107L 18BTP107L 18CHP107L 18CEP107L 18CSP107L 18EEP107L 18ECP107L 18MEP107L 18MHP107L 18NTP107L	Course Name	MINOR PROJECT	Course Category	P	*Project Work, Seminar, Internship in Industry / Higher Technical Institutions*	L	T	P	C
							0	0	6	3

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-1 :	*Learn responsible and professional way of working*																		
CLR-2 :	*Practice development-oriented approach to work*																		
CLR-3 :	*Enhance students' knowledge in one particular technology*																		
CLR-4 :	*Create awareness of the social, cultural, global and environmental responsibility as an engineer*																		
CLR-5 :	*Grow more empathetic, become systems thinkers, become explorers, problem-solvers.*																		
CLR-6 :	*Learn project management.*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Develop capability to acquire and apply fundamental principles of engineering*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-2 :	*Become updated with all the latest changes in technological world*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-3 :	*Make deep connections between ideas*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-4 :	*Learn to take creative risks*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-5 :	*Be ready for the creative economy also engage in iterative thinking and divergent thinking*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-6 :	*Identify, formulate and model problems and find engineering solution based on a systems approach*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-

Project Work Selection: Project Work Titles for students would be finalized by the Department Project Work Evaluation Committee.

Learning Assessment	
MOOC Certification Obtained (80% weightage)	Final Presentation (20% weightage)

Note: Final Presentation Evaluation would be done by the Department Project Work Evaluation Committee formed by the Department.

Course Code	18ASP108L 18AUP108L 18BTP108L 18CHP108L 18CEP108L 18CSP108L 18EEP108L 18ECP108L 18MEP108L 18MHP108L 18NTP108L	Course Name	INTERNSHIP	Course Category	P	*Project Work, Seminar, Internship in Industry / Higher Technical Institutions*	L	T	P	C
							0	0	6	3

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-1 :	*Understanding of industry/organization customs and practices*																		
CLR-2 :	*Demonstrate professional skills that pertain directly to the internship experience*																		
CLR-3 :	*Demonstrate effective verbal and written communication skills, Allocate time effectively*																		
CLR-4 :	*1. Demonstrate effective listening skills*																		
CLR-5 :	*2. Participate well as a team member and build professional network*																		
CLR-6 :	*Build a record of work experience, Develop work habits and attitudes necessary for job success*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*3. Adapt effectively to changing conditions*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-2 :	*4. Demonstrate appropriate workplace attitudes*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-3 :	*Demonstrate individual responsibility*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-4 :	*Demonstrate effective management of personal behavior, ethics and attitudes*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-5 :	*Practice ethical standards appropriate to the internship site*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-6 :	*Explore career alternatives prior to graduation, Integrate theory and practice*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-

Internship Training Selection: List of Industries / Research Centre's for Internship Training for students would be finalized by the Department Internship/Industrial Training Committee.

Learning Assessment	
Internship Certification Obtained (80% weightage)	Final Presentation (20% weightage)

Note : Final Presentation Evaluation would be done by the Internship/Industrial Training Committee formed by the Department.

Course Code	18ASP109L 18AUP109L 18BTP109L 18CHP109L 18CEP109L 18CSP109L 18EEP109L 18ECP109L 18MEP109L 18MHP109L 18NTP109L	Course Name	PROJECT	Course Category	P	*Project Work, Seminar, Internship in Industry / Higher Technical Institutions*	L	T	P	C
							0	0	20	10

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-1 :	*Learn responsible and professional way of working*																		
CLR-2 :	*Practice development-oriented approach to work*																		
CLR-3 :	*Enhance students' knowledge in one particular technology*																		
CLR-4 :	*Create awareness of the social, cultural, global and environmental responsibility as an engineer*																		
CLR-5 :	*Grow more empathetic, become systems thinkers, become explorers, problem-solvers.*																		
CLR-6 :	*Learn project management.*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Develop capability to acquire and apply fundamental principles of engineering*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-2 :	*Become updated with all the latest changes in technological world*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-3 :	*Make deep connections between ideas*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-4 :	*Learn to take creative risks*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-5 :	*Be ready for the creative economy also engage in iterative thinking and divergent thinking*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-6 :	*Identify, formulate and model problems and find engineering solution based on a systems approach*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-

Project Work Selection: Project Work Titles for students would be finalized by the Department Project Work Evaluation Committee.

Learning Assessment	
Project Report (80% weightage)	Final Presentation (20% weightage)

Note: Final Presentation Evaluation would be done by the Department Project Work Evaluation Committee formed by the Department.

Course Code	18ASP110L 18AUP110L 18BTP110L 18CHP110L 18CEP110L 18CSP110L 18EEP110L 18ECP110L 18MEP110L 18MHP110L 18NTP110L	Course Name	SEMESTER INTERNSHIP	Course Category	P	*Project Work, Seminar, Internship in Industry / Higher Technical Institutions*	L	T	P	C
							0	0	20	10

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-1 :	*Become job ready along with real corporate exposure*																		
CLR-2 :	*Increase self-confidence and helps in finding their own proficiency*																		
CLR-3 :	*Cultivate leadership ability and responsibility to perform or execute the given task*																		
CLR-4 :	*Inculcate learners hands on practice within a real job situation*																		
CLR-5 :	*Create awareness of the social, cultural, global and environmental responsibility as an engineer*																		
CLR-6 :	*Become able to identify, formulate and model problems and find engineering solution based on a systems approach*																		
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																		
CLO-1 :	*Enhance capability to acquire and apply fundamental principles of engineering*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-2 :	*Become master in one's specialized technology*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-3 :	*Become updated with all the latest changes in technological world*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-4 :	*Demonstrate hands on practice within a real job situation*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-5 :	*Inculcate self-improvement through continuous professional development and life-long learning*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-
CLO-6 :	*Be a multi-skilled engineer with good technical knowledge, management, leadership and entrepreneurship skills*	*3*	*95*	*85*	*H*	*M*	*M*	*H*	*H*	*H*	*L*	*H*	*H*	*H*	*H*	*H*	-	-	-

Internship Training Selection: List of Industries / Research Centre's for Internship Training for students would be finalized by the Department Internship/Industrial Training Committee.

Learning Assessment	
Internship Certification Obtained (80% weightage)	Final Presentation (20% weightage)

Note : Final Presentation Evaluation would be done by the Internship/Industrial Training Committee formed by the Department.

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram District-603203, Tamil Nadu, India

ACADEMIC CURRICULA

Mandatory Courses

Regulations - 2018

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

(Deemed to be University u/s 3 of UGC Act, 1956)

Kattankulathur, Kancheepuram, Tamil Nadu, India

Course Code	18PDM201L	Course Name	COMPETENCIES IN SOCIAL SKILLS	Course Category	M	Mandatory	L	T	P	C
							0	0	2	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	enable students understand subtle meanings of words used in academic texts	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	determine the grammatical, syntactical, and logical accuracy of sentences			
CLR-3 :	comprehend an argument's line of reasoning			
CLR-4 :	understand the structure, organization, tone, and main idea behind the passage			
CLR-5 :	recognize the logical coherence of ideas in a text			
CLR-6 :	give the right knowledge, skill and aptitude to face any competitive examination			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
CLO-1 :	build vocabulary through methodical approaches and nurture passion for enriching vocabulary	3	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-
CLO-2 :	detect and correct any grammatical, syntactical, and logical fallacies	2	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-
CLO-3 :	hone critical thinking skills by analyzing arguments with explicit and implicit premises to validate the author's point of view	3	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-
CLO-4 :	analyze and evaluate texts critically in multifarious ways	3	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-
CLO-5 :	identification of relationships between sentences based on their function, usage and characteristics	2	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-
CLO-6 :	ace competitive examinations	2	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-
					Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Synonyms in Isolation and Context	Spotting Errors – Level I	Critical Reasoning – Weakening	Reading Comprehension – Main Idea	Para Jumble-Type I
	SLO-2	Practice	Practice	Practice	Practice	Practice
S-2	SLO-1	Antonyms in Isolation and Context	Spotting Errors – Level II	Critical Reasoning – Inference	Reading Comprehension – Tone	Para Jumble-Type II
	SLO-2	Practice	Practice	Practice	Practice	Practice
S-3	SLO-1	Common Confusables	Spotting Errors – Level II	Critical Reasoning – Conclusion	Reading Comprehension – Inference	Para Jumble-Type III
	SLO-2	Practice	Practice	Practice	Practice	Practice
S-4	SLO-1	Cloze Passage	Sentence Correction-Type I & II	Critical Reasoning - Explain the paradox	Reading Comprehension – Summary	Para Completion
	SLO-2	Practice	Practice	Practice	Practice	Practice
S-5	SLO-1	Word Analogy	Sentence Correction-Type III & IV	Critical Reasoning – Miscellaneous	Reading Comprehension – Conclusion	Para Completion
	SLO-2	Practice	Practice	Practice	Practice	Practice

S-6	SLO-1	*Sentence Completion*	*Sentence Correction-Type V& VI*	*Critical Reasoning – Miscellaneous*	*Reading Comprehension – Miscellaneous*	*Para Summary*
	SLO-2	*Practice*	*Practice*	*Practice*	*Practice*	*Practice*

Learning Resources	1. *Charles Harrington Elstor, Verbal Advantage: Ten Easy Steps to a Powerful Vocabulary, Random House Reference, 2002* 2. *Merriam Webster's Vocabulary Builder, Merriam Webster Mass Market, 2010* 3. *Norman Lewis, How to Read Better and Faster, Goyal, 4th Edition* 4. *Franklin GRE Word List, 3861 GRE Words, Franklin Vocab System, 2014* 5. *Wiley's GMAT Reading Comprehension Grail, Wiley, 2016*	6. *Manhattan Prep GRE : Reading Comprehension and Essays, 5th Edition* 7. *Martin Hewings, Advanced Grammar in Use. Cambridge University Press, 2013* 8. *Manhattan GMAT – Critical Reasoning, GMAT Strategy Guide, 12th Edition* 9. *Joern Meissner, Manhattan Review, GRE Analytical Writing Guide, Manhattan Review Inc, 2011* 10. *GRE Analytical Writing, Solutions to the Real Essay Topics (Test Prep. Series), Vibrant Publishers, 2011*

Learning Assessment											
	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40%*	-	*30%*	-	*30%*	-	*30%*	-	-
	Understand										
Level 2	Apply	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-	-
	Analyze										
Level 3	Evaluate	-	*20%*	-	*30%*	-	*30%*	-	*30%*	-	-
	Create										
	Total	100 %		100 %		100 %		100 %		-	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Mr. Vijay Nayar, Director, Education Matters, vijayn@edumat.com	*1. Dr. Dinesh Khattar, Delhi University, dinesh.khattar31@gmail.com*	*1. Dr. M. Snehalatha, SRMIST*	*3. Dr. P. Madhusoodhanan, SRMIST*
2. Mr. Ajay Zenner, Career Launcher, ajay.z@careerlauncher.com	*2. Mr. Nishith Sinha, due North India Academics LLP, nsinha.alexander@gmail.com*	*2. Mr Jayapragash J., SRMIST*	*4. Mr. Clement A, SRMIST*

Course Code	18PDM202L	Course Name	CRITICAL AND CREATIVE THINKING SKILLS	Course Category	M	Mandatory	L	T	P	C
							0	0	2	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	identify problems			
CLR-2 :	recognize the logical coherence of ideas			
CLR-3 :	understand the structure and principles of writing			
CLR-4 :	interpret the structure, organization, tone, and main idea of the content			
CLR-5 :	hone comprehension skills			
CLR-6 :	give the right knowledge, skill and aptitude to face any competitive examination			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	solve problems	3	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-2 :	grasp the approaches and strategies to find solutions	2	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-3 :	organize and articulate ideas clearly	2	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-4 :	analyze and evaluate contents critically in multifarious ways	2	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	understand, comprehend and provide logical conclusions	2	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-
CLO-6 :	gain appropriate skills to succeed in preliminary selection process for recruitment	3	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Ages	Permutations-Types	Probability-Intro	Logical Reasoning – Blood relations, Directions	Information Ordering - Analogy
	SLO-2	Solving Problems	Solving Problems	Solving Problems	Series completion	Math operations
S-2	SLO-1	Case Study	Statement Completion	Principles of Writing	Reading Comprehension – Bold Faced	Para Completion
	SLO-2	Discussion	Practice	Practice	Practice	Practice
S-3	SLO-1	Quadratic Equations	Combination-Concepts	Probability theory -Applications	Logical Reasoning- Cubes	Analytical Reasoning-Intro
	SLO-2	In-equations	Solving Problems	Solving Problems	Logical Reasoning-syllogism	Analytical Reasoning - Level I
S-4	SLO-1	Case Study	Statement Completion	Principles of Writing	Reading Comprehension – Bold Faced	Para Completion
	SLO-2	Discussion	Practice	Practice	Practice	Practice
S-5	SLO-1	Permutations-Concepts	Combination- Miscellaneous	Logical Reasoning – Coding and Decoding	Information Ordering - Arrangements	Analytical Reasoning-Level II
	SLO-2	Solving Problems	Solving Problems	Practice	Practice	Analytical Reasoning - Level III

S-6	SLO-1	*Case Study*	*Statement Completion*	*Principles of Writing*	*Reading Comprehension – Miscellaneous*	*Para Completion*
	SLO-2	*Discussion*	*Practice*	*Practice*	*Practice*	*Practice*

Learning Resources	1. *Dinesh Khattar-The Pearson Guide to Quantitative Aptitude for competitive examinations* 2. *Hari Mohan Prasad, Verbal Ability for Competitive Examinations, Tata McGraw Hill Publications* 3. *Edgar Thrope, Test of Reasoning for Competitive Examinations, Tata McGraw Hill, 4th Edition, 2012* 4. *Norman Lewis, Word Power Made Easy, W.R. Goyal Publications, 2011*	5. *Ellet William, The Case Study Handbook: How to read, discuss, and write persuasively about cases* 6. *Manhattan GMAT – Critical Reasoning, GMAT Strategy Guide, 12th Edition* 7. *Wiley's GMAT Reading Comprehension Grail, Wiley, 2016* 8. *Manhattan Prep GRE : Reading Comprehension and Essays, 5th Edition*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	-	*40%*	-	*30%*	-	*30%*	-	*30%*	-	-
Level 2	Apply Analyze	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-	-
Level 3	Evaluate Create	-	*20%*	-	*30%*	-	*30%*	-	*30%*	-	-
	Total	100 %		100 %		100 %		100 %		-	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Mr. Vijay Nayar, Director, Education Matters, vijayn@edumat.com	*1. Dr. Dinesh Khattar, Delhi University, dinesh.khattar31@gmail.com*	*1. Dr. M. Snehalatha, SRMIST*	*3. Dr. P. Madhusoodhanan, SRMIST*
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Course Code	18PDM203L	Course Name	ENTREPRENEURIAL SKILL DEVELOPMENT	Course Category	M	Mandatory	L	T	P	C
							0	0	2	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Career Development Centre	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
CLR-1 :	gain knowledge about Entrepreneurship	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	study mindsets of Entrepreneur			
CLR-3 :	assimilate skills and behavioral aspects of entrepreneurship			
CLR-4 :	generate creative and innovative ideas			
CLR-5 :	acquire knowledge about the entrepreneurial processes			
CLR-6 :	develop entrepreneurial skills			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Understand the concept of Entrepreneurship and Entrepreneur	2	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-2 :	Comprehend the mindset of Entrepreneurs	2	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-3 :	Understand the skills and behavioral aspects required in Entrepreneurs	3	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-4 :	Analyze the role of Creativity and Innovation in their Entrepreneurial journey	3	80	75	L	H	-	M	-	-	-	-	M	L	-	H	-	-	-
CLO-5 :	Create and present their Business Model	3	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-
CLO-6 :	Acquire entrepreneurial skills	1	80	75	L	H	-	M	-	-	-	-	M	H	-	H	-	-	-

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Introduction	Motivation	Self Analysis	Negotiating skill	Business Model Canvas
	SLO-2	Benefits of entrepreneurship	External and internal	SWOT	People Management	Business Model Canvas
S-2	SLO-1	Origin of Entrepreneurship	Theories of Entrepreneurship	Communication	Creativity	Business Opportunity Identification
	SLO-2	Evolution of Entrepreneurship	Theories of Entrepreneurship	Networking	Idea Generation	Business Opportunity Identification
S-3	SLO-1	Social and Economic factors Influencing Entrepreneurship	Success Stories – Case Study Analysis	Interpersonal skills	Problem Solving	Business Model canvas presentation
	SLO-2	Environment and Psychological factors Influencing Entrepreneurship	Success Stories – Case Study Solution	Collaborative skills	Problem solving	Business Model canvas presentation
S-4	SLO-1	Myths about entrepreneurship	Success Stories – Case Study Analysis	Team management skills	Decision Making	Business Model canvas presentation
	SLO-2	Myths about entrepreneurship	Success Stories – Case Study Solution	Team management skills	Six Thinking hats	Business Model canvas presentation
S-5	SLO-1	Entrepreneurship Failures	Risk-taking Behavior	Leadership	Inventions	Business model presentation

	SLO-2	*Entrepreneurship Failures*	*Resilience*	*Shared leadership*	*Inventions*	*Business model presentation*
S-6	SLO-1	*Entrepreneurship in India – A Preview*	*Global Markets for Entrepreneurs*	*Time Management*	*Innovations*	*Business model presentation*
	SLO-2	*Indian Entrepreneurships*	*Understanding the cross cultural behaviors and differences*	*Prioritisation*	*Innovations*	*Business model presentation*

Learning Resources	1. *Elon Musk – Ashley Vance- Virgin Books-2015* 2. *Think and Grow Rich – Napolean Hill - The Ralston Society – 1937* 3. *The Lean Startup – Eric Ries - Crown Publishing Group (USA) – 2011* 4. *The $100 Startup – Chris Gullibeau - Crown Business- 2012* 5. *Creativity, Innovation, and Entrepreneurship: The Only Way to Renew Your Organization - H. James Harrington - Productivity Press- December 2018*	6. *www.wfnen.org; National Entrepreneurship Network – Wadhwani Foundation* 7. *https://www.forbes.com/sites/.../2017/.../top-entrepreneur-stories-to-inspire-you-in-2017/* 8. *https://bizztor.com/in/successful-indian-entrepreneurs-stories* 9. *https://www.entrepreneur.com/article/299214* 10. *https://www.fundera.com/blog/young-entrepreneurs* 11. *The Entrepreneurs: Success and Sacrifice - by Kip Marlow* *cbseacademic.nic.in/web material/Curriculum19/Main.../20_Entrepreneurship.pdf*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40%*	-	*30%*	-	*30%*	-	*30%*	-	-
	Understand										
Level 2	Apply	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-	-
	Analyze										
Level 3	Evaluate	-	*20%*	-	*30%*	-	*30%*	-	*30%*	-	-
	Create										
	Total	100 %		100 %		100 %		100 %		-	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Mr. Vijay Nayar, Director, Education Matters, vijayn@edumat.com	*1. Mr. Ashok Kumar V, NITTE School of Management Entrepreneurship Development, ashokkumarvv2007@gmail.com*	*1. Dr. Shantanu Patil, SRMIST*	*3. Dr. W. Richard Thilagaraj, SRMIST*
2. Mr. Ajay Zenner, Career Launcher, ajay.z@careerlauncher.com	*2. Dr. A.K. Sheik Manzoor, Anna University, sheikmanzoor@annauniv.edu*	*2. Mr. Ananth Kumar, SRMIST*	*4. Mrs. Deepa Narayanan. SRMIST*

Course Code	18PDM204L	Course Name	BUSINESS BASICS FOR ENTREPRENEURS	Course Category	*M*	*Mandatory*	L	T	P	C
							0	0	2	0

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Career Development Centre*	Data Book / Codes/Standards	*Nil*		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	Learning		
		1	2	3
CLR-1 :	*Provides a base of Managerial application skills that enable students to understand practical managerial concepts*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-2 :	*Comprehend business models*			
CLR-3 :	*Understand different accounting concepts*			
CLR-4 :	*Understand the taxation and tax laws*			
CLR-5 :	*Understand the process of design thinking*			
CLR-6 :	*Acquire knowledge on business skills*			

Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLO-1 :	*Explain the nature and purpose of marketing; understand the fundamentals of each of the most important marketing tasks*	*1*	*80*	*75*
CLO-2 :	*Use the Business Models in their startups*	*1*	*80*	*75*
CLO-3 :	*Identify and appreciate the strong linkages between finance and globalization*	*2*	*80*	*75*
CLO-4 :	*Implement tax process*	*2*	*80*	*75*
CLO-5 :	*Acquire Design Thinking concepts to implement in the startup*	*1*	*80*	*75*
CLO-6 :	*Implement the essential business basics*	*3*	*80*	*75*

Program Learning Outcomes (PLO)															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
L	*H*	-	*M*	-	-	-	-	*M*	*L*	-	*H*	-	-	-
L	*H*	-	*M*	-	-	-	-	*M*	*L*	-	*H*	-	-	-
L	*H*	-	*M*	-	-	-	-	*M*	*L*	-	*H*	-	-	-
L	*H*	-	*M*	-	-	-	-	*M*	*L*	-	*H*	-	-	-
L	*H*	-	*M*	-	-	-	-	*M*	*H*	-	*H*	-	-	-
L	*H*	-	*M*	-	-	-	-	*M*	*H*	-	*H*	-	-	-

		Marketing Management	Business Models	Financial Management	Costing and Taxation	Design Thinking
Duration (hour)		6	6	6	6	6
S-1	SLO-1	*Introduction to Marketing Management*	*Business Models for startups*	*Introduction to Finance Management*	*Pricing Strategies*	*Design Thinking*
	SLO-2	*Understand the market*	*Introduction to SAAS*	*Effective and efficient management of money*	*Pricing for market penetration*	*Developing design concepts*
S-2	SLO-1	*6 P's of Marketing*	*Business model*	*Accounting Process*	*Types of Pricing*	*Five stages of design concepts*
	SLO-2	*5 P's of Marketing*	*Introduction to PAAS*	*Four steps in business transactions*	*Pricing strategies*	*Super charging with design thinking*
S-3	SLO-1	*Introduction to Consumer Behavior*	*Revenue Models*	*Basic Accounting Procedures*	*Introduction to MIS*	*Creating concepts*
	SLO-2	*Create value proposition*	*Application of revenue models*	*Basic book keeping for financial transactions*	*Data Analysis*	*Creating concepts*
S-4	SLO-1	*Types of Marketing*	*Outsourcing Models*	*Financial Statements*	*Taxation*	*Hackathon / Challenge Labs*
	SLO-2	*Business marketing concepts*	*Partnership Models*	*Profit and Loss account, Balance sheet Statement of cash flow*	*Taxation*	*Hackathon / Challenge Labs*

S-5	SLO-1	*Market Segmentation*	*Profitability*	*Working Capital Management*	*Tax laws*	*Hackathon / Challenge Labs*
	SLO-2	*Market Positioning*	*Business Metrics*	*Utilizing current assets and current liabilities for efficient operation*	*Tax laws*	*Hackathon / Challenge Labs*
S-6	SLO-1	*Branding*	*Business Model Analysis*	*Financial Ratios*	*Case studies and Problem Solving*	*Hackathon / Challenge Labs*
	SLO-2	*Creating USP*	*Practical Implementation*	*Profitability, Liquidity, Operating, Leverage*	*Case studies and Problem Solving*	*Hackathon / Challenge Labs*

Learning Resources	1. *Elon Musk – Ashley Vance- Virgin Books-2015* 2. *Think and Grow Rich – Napolean Hill - The Ralston Society – 1937* 3. *The Lean Startup – Eric Ries - Crown Publishing Group (USA) – 2011* 4. *The $100 Startup – Chris Gullibeau - Crown Business- 2012* 5. *Creativity, Innovation, and Entrepreneurship: The Only Way to Renew Your Organization - H. James Harrington - Productivity Press- December 2018*	6. *www.wfnen.org; National Entrepreneurship Network – Wadhwani Foundation* 7. *https://www.forbes.com/sites/.../2017/.../top-entrepreneur-stories-to-inspire-you-in-2017/* 8. *https://bizztor.com/in/successful-indian-entrepreneurs-stories* 9. *https://www.entrepreneur.com/article/299214* 10. *https://www.fundera.com/blog/young-entrepreneurs* 11. *The Entrepreneurs: Success and Sacrifice - by Kip Marlow* *cbseacademic.nic.in/web material/Curriculum19/Main.../20_Entrepreneurship.pdf*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)								Final Examination	
		CLA – 1 (20%)		CLA – 2 (30%)		CLA – 3 (30%)		CLA – 4 (20%)#			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40%*	-	*30%*	-	*30%*	-	*30%*	-	-
	Understand										
Level 2	Apply	-	*40%*	-	*40%*	-	*40%*	-	*40%*	-	-
	Analyze										
Level 3	Evaluate	-	*20%*	-	*30%*	-	*30%*	-	*30%*	-	-
	Create										
	Total	100 %		100 %		100 %		100 %		-	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Mr. Vijay Nayar, Director, Education Matters, vijayn@edumat.com	*1. Mr. Ashok Kumar V, NITTE School of Management Entrepreneurship Development, ashokkumarvv2007@gmail.com*	*1. Dr. Shantanu Patil, SRMIST*	*3. Dr. Revathi Venkataraman, SRMIST*
2. Mr. Ajay Zenner, Career Launcher, ajay.z@careerlauncher.com	*2. Dr. A.K. Sheik Manzoor, Anna University, sheikmanzoor@annauniv.edu*	*2. Mr. Ananth Kumar, SRMIST*	*4. Mrs. Kavitha Srisarann. SRMIST*

Course Code	18CYM101T	Course Name	ENVIRONMENTAL SCIENCE	Course Category	M	Mandatory	L	T	P	C
							1	0	0	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Chemistry	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:	Learning		
		1	2	3
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)
CLR-1 :	Acquire knowledge on various causes, effects and control measures of environmental air and water pollution			
CLR-2 :	Analyze causes, effects and control measures of soil, thermal and radiation pollution			
CLR-3 :	Utilize processes involved in waste water treatment and study the cause of a local polluted site			
CLR-4 :	Analyze impacts, disposal methods and treatments involved in solid waste management			
CLR-5 :	Identify impacts, disposal methods, treatments involved in biomedical waste management			
CLR-6 :	Analyze the environmental issues and identify appropriate solutions			

Course Learning Outcomes (CLO):	At the end of this course, learners will be able to:	Learning			Program Learning Outcomes (PLO)														
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
		Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Engineering Knowledge	Problem Analysis	Design & Development	Analysis, Design, Research	Modern Tool Usage	Society & Culture	Environment & Sustainability	Ethics	Individual & Team Work	Communication	Project Mgt. & Finance	Life Long Learning	PSO - 1	PSO - 2	PSO – 3
CLO-1 :	Analyze the sources, effects and control measures of environmental air pollution	1	80	70	H	H	H	H	-	-	H	-	-	-	-	-	-	-	-
CLO-2 :	Acquire knowledge on the treatment of soil, thermal and radiation management	1	75	65	H	H	H	H	-	-	H	-	-	-	-	-	-	-	-
CLO-3 :	Acquire knowledge on various process involved in the treatment of wastewater	1	80	70	H	H	H	H	-	-	H	-	H	-	-	-	-	-	-
CLO-4 :	Identify sources, disposal and treatment methods of solid waste management	1	80	75	H	H	H	H	-	-	H	-	H	-	-	-	-	-	-
CLO-5 :	Identify sources, disposal and treatment methods of biomedical waste management	1	75	65	H	H	H	H	-	-	H	-	H	-	-	-	-	-	-
CLO-6 :	Utilize the concepts learnt in protecting the environment towards sustainable development	1	80	70	H	H	H	H	-	-	H	-	H	-	-	-	-	-	-

Duration (hour)		3	3	3	3	3
S-1	SLO-1	Environmental segments Structure of atmosphere	Determination of BOD, COD	Waste water treatment- Introduction	Solid waste management: Types	Biomedical Waste Management Definition and Effects
	SLO-2	Composition of atmosphere	Determination of TDS and trace metals	Primary treatment	Effects Process of waste management	Categories of biomedical waste
S-2	SLO-1	Air Pollution Sources	Sources, effects and control measures of Soil pollution	Secondary treatment	Disposal methods, Open dumping Engineered land filling	Process of biomedical waste management
	SLO-2	Effects – acid rain, ozone layer depletion and greenhouse effect	Sources, effects and control measures of Thermal pollution	Tertiary treatment	Composting Incineration	Treatment and disposal methods
S-3	SLO-1	Control measures of air pollution	Sources and effects of: Radiation pollution	Activity: Visit to a local polluted site-Urban/Rural/Industrial/Agricultural	Activity: Monitoring solid waste management in local areas	Activity: Visit a hospital to understand the biomedical waste management
	SLO-2	Sources, Effects and control measures of Water pollution	Control measures of Radiation pollution	Activity: Visit to a local polluted site-Urban/Rural/Industrial/Agricultural	Activity: Monitoring solid waste management in local areas	Activity: Visit a hospital to understand the biomedical waste management

Learning Resources	
	1. Erach Bharucha, Textbook of Environmental Studies for Undergraduate Courses, 2nd ed., UGC
	2. Kamaraj. P, Arthanareeswari. M, Environmental Science–Challenges and Changes, 6th ed., Sudhandhira Publications, 2013
	3. R. Jeyalakshmi, Principles of Environmental Science, 2nd ed., Devi publications, 2008
	4. Helen P Kavitha, Principles of Environmental Science, 1st ed., Shine Publications and Distributors, 2013

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	Understand										
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-	-	-
	Analyze										
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	*30%*	-	-	-
	Create										
	Total	100 %		100 %		100 %		100 %		-	

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Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Sudarshan Mahapatra, Encube Ethicals Pvt. Ltd, sudarshan.m@encubeethicals.com	*1. Prof. G. Sekar, IIT Madras, gsekar@iitm.ac.in*	*1. Prof. M. Arthanareeswari, SRMIST*
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