KIT - Kalaignarkarunanidhi Institute of Technology

(An Autonomous Institution)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NAAC with 'A' GRADE & NBA (CSE, ECE, EEE, MECH)
An ISO 9001 : 2015 Certified Institution

Coimbatore - 641 402.

REGULATIONS, CURRICULUM & SYLLABUS - 2019

(For Students admitted from the Academic Year 2019-20 and onwards)

MASTER OF ENGINEERING DEGREE
IN
COMPUTER SCIENCE AND ENGINEERING

DEPARTMENT OF
COMPUTER SCIENCE AND ENGINEERING

Vision and Mission of the Department

Vision

◎	To produce intellectual graduates to excel in the field of Computer Science Engineering and Technologies.

Mission

◎	Providing excellent and intellectual inputs to the students through qualified faculty members.
◎	Imparting technical knowledge in latest technologies through the industry institute interaction and thereby making the graduates ready for the industrial environment.
◎	Enriching the student's knowledge for active participation in co-curricular and extracurricular activities.
◎	Promoting research-based projects in contexts to social, legal and technical aspects.

Program Educational Objectives (PEO's)

PEO 1	Graduates will pursue research, or be successfully employed in academia / industries associated with Computer Science and Engineering, or become entrepreneurs, adapting to new technologies and engaging in continuous education and training.
PEO 2	Graduates will take leadership roles, making holistic decisions guided by professional, ethical, societal, economic, legal and environmental considerations, and communicating clearly with stakeholders.
PEO 3	Graduates will engage in lifelong learning activities by adapting to the advanced software technologies for continuous professional development.

Programme Outcomes (PO's)

After the successful completion of the P.G. programme in Computer Science and Engineering, Graduates will be able to :

PO 1	**Engineering knowledge :** Acquire in-depth knowledge of computer science and engineering to analyse, evaluate, and synthesize computing systems.
PO 2	**Problem analysis :** Identify, formulate and critically analyse complex computing problems.
PO 3	**Design/development of solutions :** Conceptualize solutions, evaluate the alternatives, and arrive at an optimal solution after considering societal, environmental and cultural factors.

PO 4	**Conduct investigations of complex problems :** Apply appropriate research methodologies while solving unfamiliar problems, survey research literature, design & conduct experiments, and analyse & interpret results in a broader perspective.
PO 5	**Modern tool usage :** Create, select, and apply state-of-the-art techniques and tools to analyse requirements, design, develop, evaluate, and maintain complex computing systems.
PO 6	**The engineer and society :** Demonstrate understanding of societal, health, cultural, safety, environmental and legal issues, and consequent responsibilities relevant to computing practice.
PO 7	**Environment and sustainability :** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics :** Understand and commit to professional ethics and norms of computing practices.
PO 9	**Individual and team work :** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication :** Communicate effectively with diverse stakeholders through clear instructions, reports and presentations.
PO 11	**Project management and finance :** Apply management principles to projects in computing as well as multidisciplinary environments considering economic factors..
PO 12	**Life-long learning :** Engage in independent, reflective and continuous learning in the context of social and technological changes

Program Specific Outcome (PSO's)	
After the successful completion of the P.G. programme in Computer Science and Engineering, Graduates will be able to:	
PSO 1	Acquire proficiency in developing and implementing efficient solutions using emerging technologies, platforms and Free and Open-Source Software (FOSS).
PSO 2	Gain critical understanding of hardware and software tools catering to the contemporary needs of IT industry.

PG Regulations

1. SHORT TITLE AND COMMENCEMENT

- These Regulations shall be called the "KIT - Kalaignarkaraunanidhi Institute of Technology, Coimbatore, Regulations for the Award of M.E. / M.B.A / M.C.A., Degree".
- They have been evolved, drafted and implemented after deliberations in and approvals from UGC, Anna University and Academic Council of the Institute, and are subject to change / modifications from time to time; (major modifications at a frequency of FOUR years in synchronization with the curriculum structure revision and minor changes as and when applicable).
- The latest / first version shall be applicable for the students enrolling for M.E. / M.B.A / M.C.A., degree programs at this Institute from Academic year 2019 - 2020.

2. PREAMBLE

The regulations prescribed herein have been made by KIT, an autonomous institution, approved by AICTE, New Delhi and affiliated to the Anna University, Chennai to facilitate the smooth and orderly conduct of its academic programmes and activities at the M.E. / M.B.A / M.C.A., level. It is expected that the regulations will enable the students to take advantage of the various academic opportunities at the Institute and prepare themselves to face the challenges in their professional careers ahead. It may be noted that:

a. The provision made herein shall be applicable to all the M.E. / M.B.A / M.C.A., programmes offered at the institute,at present;

b. They shall also be applicable to all the new M.E. / M.B.A / M.C.A., programmes which may be started at the Institute in the future;

c. Academic and non-academic requirements prescribed by the Academic Council have to be fulfilled by a student for eligibility towards award of M.E. / M.B.A / M.C.A., Degree.

3. PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires :

Sl. No.	Name	Definition
1.	**Programme**	Refers to Degree Programme that is M.E./M.B.A/ M.C.A., Programme.
2.	**Discipline**	Refers to specialization or branch of M.E. Degree
3.	**Course**	Refers to a theory or practical subject that is normally studied in a semester, like Applied Mathematics etc.,
4.	**Head of the Institution**	Refers to the Principal of the College.
5.	**Controller of Examinations (CoE)**	Refers to the authority of the college who is responsible for all activities of the Semester End Examinations.
6.	**Head of the Department**	Refers to the Head of the Department concerned.
7.	**University**	Refers to Anna University, Chennai.

8.	**College**	Refers to KIT-Kalaignarkarunanidhi Institute of Technology, Coimbatore.
9.	**Curriculum**	Refers to the various components/courses studied in each programme that provide appropriate outcomes (knowledge, skill and behavior/attitude) in the chosen branch of study.
10.	**T– P – TU – C**	Refers to Theory, Practical, Tutorial, and Credits respectively.
11.	**Foundation Courses (FC)**	may include Mathematics or other basic courses
12.	**Professional Core (PC)**	Courses include the core courses relevant to the chosen specialization/branch.
13.	**Professional Elective (PE)**	Courses include the elective courses relevant to the chosen specialization/ branch.
14.	**Employability Enhancement Courses(EEC)**	Includes Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/ Practical Training.
15.	**Academic Evaluation Committee (AEC)**	The committee includes Principal, CoE, HoD concerned
16.	**Department Evaluation Committee (DEC)**	The committee included HoD (need basis), senior faculty member(s) of department from various levels, class advisor, Mentor of the students.

4. ADMISSION

4.1 Candidates seeking admission to M.E. / M.B.A / M.C.A., Degree Programme :

Candidates for admission to the first semester of the Post-Graduate Degree Programme shall be required to have passed an appropriate Under-Graduate Degree Examination of Anna University or equivalent as specified under qualification for admission as per the Tamil Nadu Common Admission (TANCA) criteria.

Note : TANCA releases the updated criteria during the admissions every academic year.

Admission shall be offered only to the candidates who possess the qualification prescribed against each programme.

Any other relevant qualification which is not prescribed against each programme shall be considered for equivalence by the committee constituted for the purpose. Admission to such degrees shall be offered only after obtaining equivalence to such degrees.

4.2 Re - admission

Students, who have discontinued for reasons other than disciplinary action, may be readmitted as per guidelines given by DoTE, Government of Tamilnadu and Anna University.

Department Evaluation Committee (DEC) shall study and recommend on the exception and addition of courses to be registered for, by the student concerned during re-admission. The details shall be forward to Academic Evaluation Committee (AEC) for approval and the committee's decision shall be final.

5. PROGRAMMES OFFERED

M.E. / M.B.A / M.C.A. Programmes under the Faculty of Civil Engineering, Faculty of Mechanical Engineering, Faculty of Electrical Engineering, Faculty of Information and Communication Engineering and Faculty of Technology. KIT offers 2 year (4 Semesters) M.E../M.B.A., and 3 year (6 Semesters) M.C.A., Degree programme affiliated to Anna University, under Choice Based Credit System (CBCS) for students admitted from 2019 onwards in the following branches of Engineering and Technology as in Table 1.

Table 1. List of B.E. / B.Tech. programmes offered

M.E., Applied Electronics
M.E., VLSI Design
M.E., Engineering Design
M.E., Computer Science and Engineering
M.E., Power Systems and Engineering
M.B.A., Master of Business Administration
M.C.A., Master of Computer Application

6. ACADEMIC STRUCTURE OF PROGRAMMES

6.1 Medium of Instruction

The medium of instruction is English for all courses, examinations, seminar presentations and project / thesis / dissertation.

6.2 Categorization of Courses

Every Post Graduate Degree Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

i. **Foundation Courses (FC)** may include Mathematics or other basic courses

ii. **Professional Core (PC)** courses include the core courses relevant to the chosen specialization/branch.

iii. **Professional Elective (PE)** courses include the elective courses relevant to the chosen specialization/ branch.

iv. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Summer Project, Case Study and Industrial / Practical Training.

Instead of two electives in the curriculum, the student may be permitted to choose a maximum of 2 courses from other PG programmes with the approval of the Head of the Department offering such courses.

6.3 Number of courses per semester

Curriculum of a semester shall normally have a blend of lecture courses and practical courses including Employability Enhancement Courses. Each course may have credits assigned as per clause 6.4.

6.4 Credit Assignment

Each course offered is given a T-P-TU-C structure, depending on the number of lecture periods (T), number of periods for practical (P) and number of tutorial periods (T) required per week for an efficient teaching – learning process. A student is expected to put-in his/her own efforts in proportion with periods spent in classroom, as defined in T-P-TU-C structure. On successful completion of the course a student is said to have earned a specified number of credits defined for each course. Each course is assigned certain number of credits based on the following table:

Table 4 : Credit Assigned

Contact period per week	Credits
1 Lecture Period (**T** = Lectures given during class by the faculty)	1
1 Tutorial Periods (**TU** = Tutorial, also class based with more emphasis on problem solving)	1
2 Practical Period (**P**) (Laboratory Periods / CEC / Projects)	1

6.5 Industrial Training / Internship

The students may undergo Industrial training for a period as specified in the curriculum during summer / winter vacation. In this case the training has to be undergone continuously for the entire period.

The students may undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) for the period prescribed in the curriculum during summer / winter vacation, in lieu of Industrial training.

6.6 Value added Courses

The Students may optionally undergo Value Added Courses and the credits earned through the Value Added Courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. One / Two credit courses shall be offered by the Department with the prior approval from the Head of the Institution. The details of the syllabus, time table and faculty may be sent to AEC and the Controller of Examinations after approval from the Head of the Institution concerned atleast one month before the course is offered. Students can take a maximum of two one credit courses / one two credit course during the entire duration of the Programme.

6.7 Online Courses

Students may be permitted to register for online courses (which are provided with certificate after evaluation of the performance, SWAYAM/NPTEL), during third to sixth semester of his/her study. On successful completion of the course, he/she has to submit the copy of the certificates to the Head of the Department. The assemment will not be calculated for CGPA.

6.8 Course Numbering Scheme

Each course is denoted by a unique code consisting of 10 alphanumeric characters. The details of the numbering scheme are in APPENDIX A.

6.9 Credit Requirement for Programmes

The total number of credits that a student earns during the period of study is called the Total credits.The minimum prescribed credits required for the award of the degree shall be within the limits specified below :

Programme	Prescribed Credit Range
M.E. / M.Tech.	

Programme	Prescribed Credit Range
M.C.A.	
M.B.A.	

7. DURATION OF THE PROGRAMMES

7.1 The minimum and maximum period for completion of the P.G. Programmes are given below :

Programme	Min. No. of Semesters	Max. No. of Semesters
M.E. / M.Tech. (Full-Time)	4	8
M.C.A. (Full Time)	6	12
M.B.A. (Full Time)	4	8

7.2 The Curriculum and Syllabi of all the P.G. Programmes shall be approved by the Academic Council of KIT. The number of Credits to be earned for the successful completion of the programme shall be as specified in the Curriculum of the respective specialization of the P.G. Programme

7.3 Each semester normally consists of 90 working days, including test and examination days. In any contingent situation, the number of working days per semester shall not be less than 65 days. The Principal is given the discretionary powers to decide the number of working days. In such contingencies, the Principal shall ensure that every faculty member teaches the full content of the specified syllabus for the course being taught.

7.4 The total period for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 7.1 irrespective of the period of break of study in order that he/she may be eligible for the award of the degree .

7.5 For the purpose of regulations, the academic year will be divided into two semesters, the odd semester normally spanning from June to November and the even semester from December to May.

8. COURSE REGISTRATION

Each student, on admission shall be assigned to a mentor who shall advice and counsel the student about the details of the academic programme and choice of courses, considering the student's academic background and career objectives. Some courses require students to register through a course registration process via online.

8.1. Course Registration

Each student on admission shall register for all the courses prescribed in the curriculum in the students first semester of the study.

The registration process for the courses offered in the online registration mode in the forthcoming semester, will commence preferably 10 working days prior to the last working day of the current semester.

A department shall offer a course only if a minimum number of students register for that course. This minimum number may vary from course to course and shall be specified by the department from time to time.

After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continous Assessment Marks and appear for the Semester End Examination (SEE).

8.2 Credits details for Course Registration

A student has to earn the total credits specified in the curriculum of the respective programme of study, in order to be eligible to obtain the degree. However, if the student wishes, then he/she is permitted to earn more than the total number of credits prescribed in the curriculum.

The number of credits, most students are expected to register for, in a semester, will be about 22-26 credits, so that they complete the programme within the specified duration of the programme. The minimum credits a student can register for, in a regular semester shall be 16.

8.3 Flexibility to Drop courses

A student has to earn the total number of credits specified in the curriculum of the respective programme of the study in order to be eligible to obtain the degree. From semester 3 to 8, the student has the options for dropping an existing course. The total number of credits that a student can drop is limited to 6. Practical courses cannot be dropped.

8.4 Reappearance Registration

8.4.1 If`a student fails in a theory or practical course, the student shall do reappearance registration for that course in the subsequent semester by retaining the Continuous Assessment Marks already earned.

8.4.2 If the theory course, in which the student has failed, is a Professional Elective or an Open Elective, the student may register for the same or any other Professional Elective or Open Elective course respectively in the subsequent semesters. Such changes can be done only with due approval by DEC.

8.43 The student who fails in Project work/ Seminar other than Practical courses shall register for the same in the subsequent semester and reappear for the End Semester Examination.

8.4.4 If a student is not eligible to appear for end semester examination of a course due to lack of attendance, the student has to register for that course again, when offered next, attend the classes and fulfill the attendance requirements. If the course, in which the student has lack of attendance, is an elective, the student may register for the same or any other elective in the subsequent semesters.

8.4.5 If a student has completed the 8 semesters and has obtained RA grade in one or more courses, he can register and appear for arrear examination directly whenever conducted next.

8.4.6 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear the same course for improvement of Grade/ Marks.

9. REQUIREMENTS FOR APPEARING FOR CIA AND SEE

9.1 A student who has fulfilled the following conditions shall be deemed to be eligible to appear for the CIA-1, Midsem, CIA-3 and SEE. Ideally, every student is expected to attend all the classes and earn 100% attendance. Students who have earned not less than 75% attendance course wise taking into account the number of periods required for that course as specified in the curriculum. Table 5 illustrates the mandatory attendance requirement for CIAT-1, Midsem, CIA-3 and SEE.

Test / Examination Type	Period of Calculation	Max. No. of Semesters
Continuous Assessment Test 1 (CIA - 1)	**First Semester** From the date of joining of course to three working days before the start of CIA -1	60%
	Second to Eighth semester From the date of commencement of the course to one week before the start of CIA - 1	75%

Midsem Exam	From the date of joining (1st semester) / date of commencement of course (2nd to 4th / 6th Semester) to one week before the start of Midsem Exam	75% (for students maintaining 80% or more attendance between CIA 1 and Midsem Exam, but falls short of the 75% cumulative requirement, the requirement may be relaxed if recommended by the AEC)
Continuous Assessment Test 3 (CIA - 3)	From the date of joining (1st semester) / date of commencement of course (2nd to 4th / 6th Semester) to one week before the start of CIA - 3	75% (for students maintaining 80% or more attendance between Midterm Exam and CIA 3, but falls short of the 75% cumulative requirement, the requirement may be relaxed if recommended by the AEC)
End Semester Examination (SEE)	From the date of joining (1st semester)/date of commencement of course (2nd to 4th/6th Semester) to the last day of instruction.	75%

9.1.1 A student shall normally be permitted to appear for End semester examination of the course if he / she has satisfied the attendance requirements (vide Clause - 9.1). He / she is eligible to register for SEE in that semester by paying the prescribed fee.

9.1.2 Students who have earned attendance less than 75% in a course will not be permitted to appear for Semester End Examination for that course. The student has to register and repeat the particular course in a subsequent semester when it is offered next. However, exemption may be given for the students who earned attendance between 65% and less than 75% in a particular course from the prescribed attendance requirement based on medical leave and On Duty Leave(ODL) with prior approval from the Principal / competent authority.

9.1.3 If a student has lack of attendance in 2 or more courses which are 3 or 4 credit courses (1 credit courses not taken into account) offered in a particular semester. He / she will be detained in that semester and hence cannot proceed to the next semester. He / she shall seek re-admission as per the norms of the affiliating university / DOTE (Directorate of Technical Education). However, in cases of absence due to genuine reasons, he/she may apply to the CoE, for revocation of detainment. The committee composition and the process are as in Appendix IV. The Committee's decision is final.

9.1.4 The students who are consistently good in academics ONLY be considered for the grant of ODL under Co-curricular activities by the competent authorities. The following activities shall be considered for the sanction of ODL;

- Sports and Games: TIES, Inter Collegiate, Inter Zonal, Inter University, State Level, National Level and Open Tournaments.
- NCC: Camps and expeditions, NSS camps
- Cultural Programme at State, National and International Level
- Seminar / Symposia: Paper presentation / Quiz
- Leadership courses organized by other organizations & Alumni Association activities, Association activities, Placement activities.
- Training programs/Internship at industries and Higher learning Institutions
- Personal damage incurred during the extracurricular activities
- The ODL requisition letter shall be forwarded to the Principal through the HoD of the student by the staff-in-charge of the respective activities before completion of every activity.
- The ODL sanctioned letters shall be submitted to the Department Office. The faculty-in-charge of the department office will check the eligibility for the award of attendance at the end of semester and the same may be submitted to DEC for approval.

9.1.5 The student should register all the courses of current semester and all the arrear courses in the previous semesters. If any student fails to register and pay the examination fees within the due date, he/she shall not be permitted to attend the semester end examinations. However, he/she will be permitted to continue their studies in the next higher semester, provided that the student satisfies the requirements as stipulated in this clause of this regulation.

9.1.6 Those students who are not deemed to have completed the semester with references to the conditions specified above shall undergo the semester again in all the courses in the respective semester during next academic year. He/she shall seek re-admission as per the norms of the affiliating University/DOTE (Directorate of Technical Education).

The days of suspension for a student on disciplinary grounds will be considered as days of absence for calculating the percentage of attendance for each individual course.

9.1.7 Supplementary Examination

If a student has completed the programmes and has obtained RA grade in one or more courses, he can register and appear for arrear examinations directly whenever conducted next.

10. PROVISION FOR WITHDRAWAL FROM EXAMINATION

A student may, for valid reasons (medically unfit / unexpected family situations/Sports person representing Tamilnadu / India with prior permission for participation from Principal / CoE / DEC), be

granted permission to withdraw (after registering for the examinations) from appearing for any course or courses in the Semester End Examination of a particular semester. The student may withdraw by following the due process of the CoE's office before the commencement of examination. This facility can be availed only once during the entire duration of the degree programme.

Withdrawal from SEE will be valid only if the student is, otherwise, eligible to write the examination and the application for withdrawal is made to the CoE, prior to the examination in the course or courses concerned. The application for withdrawal should be recommended by the Head of the Department concerned and approved by the Head of the Institution.

11. TEMPORARY BREAK OF STUDY FROM A PROGRAMME

11.1 Break of study is normally not permitted. However, if a student intends to temporarily discontinue the programme in the middle of a semester / year for valid reasons (such as Internships, accident or hospitalization due to prolonged ill health) and wishes to re-join the programme in the next academic year, he / she shall apply in advance to the Principal through the Head of the Department, stating the reasons. The application shall be submitted not later than the last date for registering for the semester examinations. Break of study is permitted only once during the entire period of the degree programme.

11.2. The student permitted to re-join the programme after the break shall be governed by the rules and regulations in force, at the time of re-joining.

11.3. The duration specified for passing all the courses for the purpose of classification of degree(vide clause 19) shall be increased by the period of such break of study permitted(vide clause 11)

11.4 If a student is detained for want of requisite attendance, academic progress and good conduct, the period spent in that semester shall not be considered as permitted Break of Study and Clause 11.3 is not applicable for such cases.

12. REMEDIAL MEASURES FOR ABSENCE / FAILURE IN MIDSEM

12.1 Absence from the MIDSEM

No Retest will be conducted. A student who has not appeared for a Midsem (theory courses) shall be permitted to be eligible for re-scaling subject to DEC and AEC approval. The student shall apply to the DEC and the AEC will approve the application for eligibility rescaling only for the following reasons:

- Absence due to prolonged illness of more than 7 working days or due to hospitalization (in-patient treatment)
- Absence due to death of immediate family members
- Absence due to participation in NCC/NSS/NSO camp's only
- Absence due to participation and representation of college in Government conducted sports events, National level design competitions and off-campus placements with prior approval

For genuine cases, recommended by DEC, Rescaling of ESM for the missed CIA will be done as follows:

Missed MIDSEM Mark = 80 % of ESM

12.2 Failure in MidSem

Students scoring < 50% in Midsem exam will be permitted to improve their marks by up to 10 marks by submitting assignments before the start of CIA-3.

13. ASSESSMENT PROCEDURES FOR AWARDING MARKS

The total marks for each course generally (Theory, Practical, Project Work) will be 100, comprising of two components namely Continuous Internal Assessment (CIA) and Semester End Examination (SEE). However, there could be some open elective courses, human excellence courses, one credit industry courses, add-on courses and Mandatory courses that have only continuous assessment for 100 marks without an End-Semester Examination. The Department Consultative Committee (DCC) has to approve such courses every semester. The scheme of assessment may also be decided by the faculty handling the course concerned with the approval from DCC and shall be made available to the students during the online course registration. Each course shall be evaluated for a maximum of 100 marks as illustrated in Table 6.

Table 6 : Course Evaluation

S. No.	Category of course	Continuous Internal Assessment	Semester End Examinations
1.	Theory Courses	40 Marks	60 Marks
2.	Laboratory Courses		
3.	Project Work		
4.	CCA (Technical Seminar / Soft Skill / Industry oriented one credit courses)	100 Marks	–

The Semester End Examination (theory and practical) of 3 hours duration shall ordinarily be conducted between October and December during the odd semesters and between April and June during the even semesters.

The Semester End Examination for project work shall consist of evaluation of the final report submitted by the student or students of the project group (of not exceeding 4 students) by an external examiner and an internal examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner, the supervisor of the project group and an internal examiner.

For the Semester End Examination in both theory and practical courses including project work the internal and external examiners shall be appointed by the Controller of Examinations..

14. MARKS DISTRIBUTION

14.1 Attendance Mark

Marks are awarded for the attendance earned by the students for individual courses as per the following table.

Attendance Range in %	Marks to be earned by the students
96 - 100	5
91 - 95	4
86 - 90	3
81 - 85	2
75 - 80	1

14.2 Question paper pattern

a. Table 7.1 Continuous Internal Assessment

(CIA 1, CIA -2 and CIA-3)

2 Marks	12 Marks	Total marks
7	3 (3 out of 5)	50

b. Table 7.2 Midsem and Semester End Examinations

2 Marks	13 Marks	15 marks	Total Marks
10	5 (Either or Type)	1 (Either or Type)	100
For Mathematics paper only			
2 Marks	16 Marks		Total Marks
10	5		100

14.3 Theory Courses

Continuous Internal Assessment tests are conducted by the Office of the Controller of Examination. Continuous Internal Assessment comprises three Continuous assessment tests, Assignment / Class test / Presentation / Online Test / Mini projects / Tutorials and Attendance. By adopting this method, the students will go through a continuous and systematic study pattern. The Corresponding weightages are given below.

Table 8 : Continuous Assessment Test for UG Theory Courses

Particulars	Syllabus	Duration	Exam Mark	Internal Mark	
Continuous Internal Assessment 1	1.5 Units	1.5 hours	50 marks	10	20 (Best of Two CIA)
Continuous Internal Assessment 2	1.5 Units	1.5 hours	50 marks	10	
Continuous Internal Assessment 3	1.5 Units	1.5 hours	50 marks	10	
Mid sem Exam	3.5 Units	3 hours	100 marks	10	
Assignment / Class Test / Online Test / Mini Project / Tutorial / Presentation / Online course / Certificate Course				5	
Attendance				5	
Total				40	

14.3 Criteria for Assessment for Lab Courses

Every exercise / experiment in all practical courses shall be evaluated on a continuous basis. The criteria for Continuous Assessment (for each cycle of exercise/experiment) are given in Table 9.

Table 9 : Assessment for Lab Courses

Sl. No.	Description		Weightage
1.	Continuous Internal Assessment Marks (CIAM)		
	a.	Average of Experimental Report / Workbook	25
	b.	Model examination	10
	c.	Attendance	5
	Total CIAM		**40**
2.	Semester End Exam Marks (SEEM)		
	a.	Lab Examination with Viva Voce	60
	Total ESM		**60**
		Total Marks	**100**

14.4 PROJECT WORK

For Project Work (Phase I & II) out of 100 marks, the maximum marks for Continuous Assessment is 40 marks and that for the End Semester Examination (project report evaluation and viva-voce examination) is 60 marks. Project work may be assigned to a single student or to a group of students not exceeding 4 per group, under the supervision of faculty guide(s).

The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three faculty members in the review committee. There shall be three reviews (as per Table 10) in total, during the semester by a review committee. The student shall make presentation on the progress made before the committee.

Interim project report shall be submitted before the project reviews with the approval of the guide. The Project Report, prepared according to the approved guidelines and duly signed by the guide and the Head of the Department, shall be submitted to the department as per the timeline announced by the department. The End Semester Examination for project work shall consist of evaluation of the final project report by an external examiner, followed by a viva-voce examination conducted separately for each student, by a committee consisting of the external examiner, and an internal examiner. The Controller of Examinations (CoE) shall appoint Internal and External Examiners for the End Semester Examination of the Project Work.

The Continuous Internal Marks (CIM) and Semester End marks (SEM) for Project Work and the Viva-Voce Examination will be distributed as indicated in Table 10.

Table 10 : CIM and SEM break-up for project work

Sl.No.	Review No.		Description	Marks	Total Marks
1.	**Continuous Assessment Marks**				
	a.	Review 1	Review Committee	5	10
			Guide	5	
	b.	Review 2	Review Committee	7	15
			Guide	8	
	c.	Review 3	Review Committee	7	15
				8	
Total CAM					**40**
2.	**Semester End Examinations Marks**				
	a.	Evaluation of final report and viva-voce	Internal Examiner	10	**50**
			External Examiner	40	
	b.	Outcome*	Publication of papers / prototype / patents etc.,	10	10
Total ESM					**60**
Total Marks					**100**

Review committee consists of internal faculty members nominated by the Head of the Department. The guide of student being examined shall not be part of the committee.

* Outcome – in terms of paper publication, patents, product development and industry projects shall be awarded by both internal and external examiners, based on the document proofs submitted by the student concerned.

If a student fails to submit project report / does not appear for the SEE /fails in the Semester End Examination (SEE)/ fails in Continuous Internal assessment (CIA) he/she is deemed to have failed in the project work and shall have to re-register for the same when offered next.

15. PASSING REQUIREMENTS

15.1 A student is declared to have successfully passed a theory based course if he/she has secured:

- A minimum of 50% marks in the semester end examinations.
- A minimum of 50% marks on combining both Continuous Assessment Marks (CAM) and Semester End Examination Marks (SEEM).

15.2 A student is declared to have successfully passed a practical / project based course if he / she has secured:

- A minimum of 50% marks in the semester end examinations.
- A minimum of 50% marks on combining both Continuous Assessment Marks (CAM) and Semester End Examination Marks (SEEM).

15.3 For a student who does not meet the minimum passing requirements, the term “RA” against the course will be indicated in his/her grade sheet. He / she shall reappear in the subsequent examinations for the course as arrear or re-register for the course when offered .

15.4 For a student who is absent for end-semester theory / practical / project viva-voce, the term “RA-AB” will be indicated against the corresponding course. He / she shall reappear for the end semester examination of that course as arrear in the subsequent semester or when offered next. .

15.5 The letter grade “W” will be indicated for the courses for which the student has been granted authorized withdrawal (refer Clause 10).

15.6 For mandatory courses (non-credit), the student must satisfy the minimum attendance requirement & passing criteria as specified for the course as detailed in Section 17.2

16. METHODS FOR REDRESSAL OF GRIEVANCES IN EVALUATION

Students who are not satisfied with the grades awarded in the End Semester Examination of Theory for regular and arrear exams can seek redressal as illustrated in Table 11.

Table 11 : Grievance Redressal Mechanism

Sl. No.	Redressal Sought	Methodology	
		Regular Exam	Arrear Exam
1.	Revaluation	⦿ Apply for photo copy of answer book ⦿ Then apply for revaluation after course expert recommendation	

2.	Challenge of Evaluation	⊙ Apply for photo copy of answer book ⊙ Then apply for revaluation after course expert recommendation ⊙ Next apply for challenge of evaluation
Note : All applications to be made to COE along with the payment of the prescribed fee.		

Challenge of Evaluation – Flow Process

Table 12 : Evaluation – Flow Process

Step 1	A student can make an appeal to the CoE for the review of answer scripts after paying the prescribed fee
Step 2	CoE will issue the photocopy of answer scripts to the student
Step 3	The faculty who had handled the subject will evaluate the script and HoD will recommend
Step 4	A committee consisting of 2 evaluators appointed by CoE will review and declare the result
Step 5	If the result is in favour of the student, the fee collected will be refunded to the student
Step 6	The final mark will be announced by CoE.

17. LETTER GRADE

Absolute grading system is adopted in converting marks to grads

17.1 Absolute Grading Policy

All assessments of a course will be evaluated on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

Table 13 : Absolute Grading – Letter Grade and its Range

Sl.No.	Range of percentage of total marks	Letter Grade	Grade Points
1.	91 - 100	O (Outstanding)	10
2.	81 – 90	A+ (Excellent)	9
3.	71 – 80	A (Very Good)	8
4.	61 – 70	B+ (Good)	7
5.	50 – 60	B (Average)	6
6.	<50	RA (Re-appearance)	0

7.	Shortage of attendance	RA - SA (Re-appearance due to shortage of attendance)	0
8.	Absent	RA – AB (Re-appearance due to absence)	0
9.	Withdrawal from examination	W	0
10.	Pass in Mandatory non-credit courses	P	0
11.	Fail in Mandatory non-credit courses	F	0

A student is deemed to have passed and acquired the corresponding credits in a particular course if he/she obtains any one of the following grades: “O”, “A+”, “A”, “B+”,“B”. ‘RA’ indicates that Reappearance is mandatory for that course concerned. ‘SA’ denotes shortage of attendance (as per Clause 10) and hence prevented from writing the Semester End Examination. P and F are grades for mandatory, but non-credit courses.

17.2 Grading for Mandatory Courses

Mandatory Courses are courses that are required to be completed to fulfill the degree requirements (e.g. Human excellence, Environmental science, etc.). They are normally non – credit based. These courses will not be taken in to consideration for the SGPA / CGPA calculations. Each of these courses is assessed continuously and internally for a total mark of 100. The pass mark is 50%. Students, who fail to pass this course, are required to repeat the course, when offered next.

17.2.1 For Mandatory non-credit courses the student must satisfy the minimum attendance requirement & passing criteria as specified for the course. These courses do not carry credits but needs to be completed to fulfill the degree requirements.

17.2.2 For the Mandatory non-credit courses student completing the course will be awarded Pass grade (P) and those who fail to satisfy the attendance requirement or fail to satisfy the minimum passing requirement of 50% marks, will be awarded Fail (F) grade and the student must re-register for the course when it is offered next.

17.2.3 Grade Sheet

After the results are declared, grade sheets will be issued to each student, which will contain the following details:

- The College Name and Affiliating University.
- The list of courses registered during the semester and the grades scored.

- The Semester Grade Point Average (SGPA) for the semester.
- The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

On completion of a semester, each student is assigned a Semester Grade Point Average which is computed as below for all courses registered for, by the student during that semester.

$$\text{Semester Grade Point Average} = \frac{\sum(C_i \times GP_i)}{\sum C_i}$$

where C_i is the credit for a course in that semester and GP_i is the Grade Point earned by the student for that course. The SGPA is rounded off to two decimals.

The overall performance of a student at any stage of the Degree programme is evaluated by the Cumulative Grade Point Average (CGPA) up to that point of time.

$$\text{Cumulative Grade Point Average} = \frac{\sum(C_i \times GP_i)}{\sum C_i}$$

where C_i is the credit for each course in each of the completed semesters at that stage and GP_i is the grade point earned by the student for that course. The CGPA is rounded off to two decimals.

17.2.4 FORMULA FOR CALCULATING PERCENTAGE

CGPA X 10 = % of Marks

18. ELIGIBILITY FOR THE AWARD OF DEGREE

A student shall be declared to be eligible for the award of the M.E / MBA / MCA. Degree provided the student has

i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.

ii. Successfully completed the course requirements, appeared for the -Semester End examinations and passed all the subjects prescribed in all the semesters within a maximum period of 7 years and 6 years in the case of Lateral Entry reckoned from the commencement of the first (third in the case of Lateral Entry) semester to which the candidate was admitted.

iii. Successfully passed any additional courses prescribed by the Academic council

iv. Successfully passed any additional courses prescribed by the Department concerned whenever readmitted under regulations 2019 (R19) (vide Clause 4.3)

v. No disciplinary action pending against the student.

vi. The award of Degree must have been approved by the Academic Council of KIT.

19. CLASSIFICATION OF M.E / MBA / MCA DEGREE

The degree awarded to eligible students will be classified as given in Table 14.

Table 14 : Classification of the M.E / MBA / MCA Degree

Sl.No.	Class Awarded	Criteria
1.	First class with distinction	A student who satisfies the following conditions shall be declared to have passed the examination in **First class with Distinction :** **M.E. / M.B.A.** ⊙ Should have passed the examination in all the courses of all the four semesters in the student's First Appearance within three years, which includes authorised break of study of one year (if availed). Withdrawal from examination (vide Clause 18) will not be considered as an appearance.
		⊙ Should have secured a CGPA of not less than 8.50. ⊙ Should NOT have been prevented from writing Semester end examination due to lack of attendance in any of the courses **M.C.A** ⊙ Should have passed the examination in all the courses of all the six semesters in the student's First Appearance within four years, which includes authorised break of study of one year (if availed). Withdrawal from examination (vide Clause 18) will not be considered as an appearance. ⊙ Should have secured a CGPA of not less than 8.50. ⊙ Should NOT have been prevented from writing end Semester examination due to lack of attendance in any of the courses.
2.	First Class	A student who satisfies the following conditions shall be declared to have passed the examination in **First class :** **M.E. / M.B.A** ⊙ Should have passed the examination in all the courses of all four semesters within three years , which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable). ⊙ Should have secured a CGPA of not less than 7.00. **M.C.A** ⊙ Should have passed the examination in all the courses of all six semesters within four years , which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable). ⊙ Should have secured a CGPA of not less than 7.00.

3.	Second Class	All other students (not covered in clauses Sl.No.1 and 2 under clause 19) who qualify for the award of the degree (vide Clause 20) shall be declared to have passed the examination in Second Class.
Note: A student who is absent for the semester endr examination in a course / project work Viva Voce after having registered for the same will be considered to have appeared for that examination (except approved withdrawal from semester end examinations as per Clause 9) for the purpose of classification.		

20. AWARD OF DEGREE

The Academic Council of the institution will approve the award of Degree to all eligible students. The degree will be issued by Anna University, Chennai and the consolidated Grade Sheet will be issued by the institution. The consolidated grade sheet will specify any specializations and distinctions that the student has earned during the course of the study.

21. FACULTY MENTOR

To help the students in palnning their courses of study and for general advice on the academic progarmme, the Head of the Department will attach a certain number of students (maximum 20) to a faculty member of the department. He/She shall function as Faculty Mentor for these students throughout their period of study. The faculty mentor shall,

- Advice the students in registering and reappearance registering of courses
- Monitor their attendance, academic progress and discipline of the students
- Counsel periodically or during the faculty mentor meeting scheduled in the class time table.
- Inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities.
- If necessary, the faculty mentor may also discuss with or inform the parents about the progress of the students through Head of the Department or in Parent-Teacher meeting.

22. CLASS COMMITTEE

The objective of the Class Committee is to improve the teaching-learning process.

The functions of the class committee include :

- Resolving difficulties experienced by students in the classroom and in the laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein.
- Discussing the progress of academic schedule and deviations if any.
- Evaluating the performance of the students of the class after each test and finding the ways and means of improvement.
- Every class in first year of study shall have a class committee consisting of faculty members who are teaching in that class, student representatives (cross section of students from boys and girls) and a chairperson who is a faculty not handling the course for the class.
- From III semester onwards, Class committee comprises of all the faculty members who are handling courses in that particular semester and two student representatives from each course.

A chairperson who is a faculty not handling course for that particular semester, nominated by the Head of the Department shall coordinate the activities of this committee.

- The class committee shall be constituted by the Head of the Department/Chief Tutor on the first week of commencement of the semester.
- The class committee shall meet three times in a semester as specified in the academic calendar.
- The Principal may participate in any class committee of the institution.
- During these meetings, the representative of the class shall meaningfully interact and express the opinions and suggestions of the other students of the class to improve the effectiveness of the teaching-learning process.
- The Chairperson is required to prepare the minutes of the meeting, signed by the members and submit the same to Head of the Department within five working days of the meeting. Head of the Department will in turn consolidate and forward the same to the Principal, within 10 working days of the meeting.
- In each meeting, the action taken report of the previous meeting is to be presented by the Chairperson of the class committee.

23. COMMON COURSE COMMITTEE

- A theory course handled by more than one teacher shall have a “Common Course Committee” comprising of all teachers teaching that course and few students who have registered for that course. There shall be two student representatives from each batch of that course. One of the teachers shall be nominated as Course Coordinator by the HoD concerned and duly approved by the Principal
- The first meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. The nature and weightage of the continuous assessments shall be decided in the first meeting, within the framework of the Regulations. Two or three subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to the whole batch.
- In addition, the “Common Course Committee” (without the student representatives) shall meet to ensure uniform evaluation of continuous assessments after arriving at a common scheme of evaluation for the assessments.
- Wherever feasible, the common course committee (without the student representatives) shall also prepare a common question paper for the continuous assessment tests. The question paper for the end semester examination is common and shall be set by the Course Coordinator in consultation with all the teachers or the external member as appointed by the Controller of Examinations.

24. DETAILS OF FACULTY PEDAGOGICAL AND STUDENT ASSESSMENT RECORD

Every teacher is required to maintain a Faculty Record Book/ course file consisting of the following details as shown below;

- Time-table, course syllabus, program outcomes, course outcomes.
- Details of attendance of each student marked in each theory/practical/project work class.
- CIA marks, Midsem marks, Details of Assignment/ seminar given, course delivery details, corrective and preventive actions on test performance of students and any other additional details.

The record book should be submitted to the HOD periodically (at least three times in a semester) for checking the syllabus covered, the test marks and attendance. The HOD shall put his/her signature and date in the record book after due verification. At the end of the semester, the record book shall be verified by the Principal who will also ensure safe custody of the document for at least four years. The university or any inspection team appointed by the University/UGC/AICTE may verify the records of attendance and assessment of both current and previous semesters.

25. DISCIPLINE

Every student is required to maintain discipline and decorum both inside and outside the institution campus. They shall follow all the rules and regulations and should not indulge in any activity which can tarnish the reputation of the University or Institution. The Principal shall refer any act of indiscipline by students to the Discipline and Welfare Committee and other appropriate committees for action.

26. REVISION OF REGULATIONS AND CURRICULUM

The institution may from time to time revise, amend or change the Regulations, scheme of Examinations and syllabi, if found necessary. Academic Council assisted by Board of Studies and Standing Committee will make such revisions / changes.

Note : Any ambiguity in interpretation of this regulation is to be put up to the Standing Committee, whose decision will be final.

27. SPECIAL CASES

In the event of any clarification in the interpretation of the above rules and relations, they shall be referred to the Standing Committee. The standing committee will offer suitable interpretations/clarifications/ amendments required for special case on such references and get them ratified in the next meeting of the Academic Council. The decision of the Academic Council is final.

ANNEXURE - I

COURSE NUMBERING SCHEME

M	1	9	M	E	T	7	0	9	9
Programme	Regulation		Department Code		Course Type	Semester	Course Mode	Sequence Number	

Programme : Masters Degree (M.E./M.Tech) - M **Regulation :** R – 19 **Department Code** AE - Applied Electronics CS - Computer Science and Engineering ED - Engineering Design PS - Power System Engineering VD - VLSI Design CA - Computer Application MB - Management Studies EN - English MA - Mathematics CE - Career Enhancement	**Course Type** T - Theory P - Practical / Project/ Internship E - Elective O - Open Elective C - One Credit Courses N - Online courses S - Special Electives **Semester** 1 - First Semester 2 - Second Semester 3 - Third Semester 4 - Fourth Semester 5 - Fifth Semester 6 - Sixth Semester Sequence Number 00-99

ANNEXURE - II

POLICY ON MALPRACTICES

GENERAL

- It shall be the endeavour of all concerned to prevent, control and take remedial action to bring about the occurrences of malpractices to “Zero” in Examinations (both Internal and External), Assignments and in all Academic class works.
- Therefore, a comprehensive approach to the malady of malpractices has to be adopted to create a mindset of integrity and honesty, and at the same time take sufficiently stern action to make it clear that such attempts are fraught with comparably very high risk.
- In keeping with this stance, the following measures are to be taken by all concerned from class room level to the Examination Halls :

A. PREVENTION (This is the best method of tackling this malady)

a. Class room level :

All faculty members are to involve themselves in a psychological growth of students by personal example and self-respect and strive towards

- Developing a sense of honour in the minds of students so that they look down upon earning undeserved marks.
- Imbibing a sense of self-respect and internal dignity that prevents him/her from succumbing to the temptation of easy marks by cheating.

- Generating an awareness of the risks to their character and career if convicted, while also explaining the process and strict rules and regulations adopted by the educational system to prevent malpractices.
- Taking stern view of copied assignments and attempts at malpractices in internal examinations also merits equal seriousness as external examinations.
- Setting sufficiently strong deterrent rules in place and regulations like intimation to parents and warning to students in the presence of parents etc. even in case of efforts at malpractices in internal tests and/or repeated acts despite warnings in case of assignments also.

Examination Halls :

Detailed instructions on Invigilation, question paper setting and evaluation and such other instructions will be issued for Invigilation, vigilance, which are to be brought to the notice of all students prior to the examinations.

B. PENAL ACTION FOR MALPRACTICES

All instances of malpractices will be forwarded to the Principal / Chief Superintendents. The offences will be investigated by a Standing Enquiry Committee constituted by Principal, The committee is to summon and give the student an opportunity to present / plead his/her case. The Committee may also summon anybody else, if it so deems necessary for the conduct of enquiry, in the interest of proper investigation and dispensation of the case. The tenure of the committee would be a complete Academic year.

The Committee is to be guided by the following:

- The seriousness of the malpractice, in terms of deviousness, and culpability / criminality of motive
- The seriousness in terms of effort and degree of deviousness and culpability / criminality of effort
- Any FIR / Police case that has been registered in the first instance by the Principal/ Chief Superintendent
- Any other special consideration either mitigating or to the contrary.

C. PENALTY FOR OFFENSES

The penalties awarded will depend on the seriousness of the Offence. A list of Offences and penalties are placed at Annexure III.

The Enquiry Report with findings and recommendations of the Committee are to be forwarded to the Controller who will undertake necessary follow up action. Based on the recommendations of the Controller of Examinations, the Principal is empowered to award penalties for offences classified as belonging to categories 1 to 7 of the offence table. The cases falling in categories from S.No. 8 onwards are to be put up to the Principal for consideration and award of suitable penalty.

ANNEXURE - III

Sl.No.	Nature of Malpractice	Maximum Punishment
1.	Appeal by the candidate in the answer script to show mercy by way of awarding more than deserving marks.	Fine of Rs. 1000/- per subject.
2.	The candidate writing his/her name in the answer script.	
3.	The candidate writing his/her registration number/college name in places other than specified in the answer script	
4.	Any special marking in the answer script by the candidate.	
5.	The candidate communicating with neighbouring candidate orally or non-verbally; the candidate causing suspicious movement of his/her body.	
6.	Irrelevant writing by the candidate in the answer script.	
7.	The candidate writing answer on his/her question paper or making use of his/her question paper for rough work	
8.	The candidate possessing cell phones / programmable calculator(s) / any other electronic storage device(s) gadgets	Invalidating the examination of the particular subject written by the candidate
9.	The candidate possessing cell phones/ programmable calculator(s) / any other electronic storage device(s) gadgets	Invalidating the examination of the particular subject written by the candidate
10.	The candidate possessing any incriminating material(s) (whether used or not). For example:-Written or printed materials, bits of papers containing written information, writings on scale, calculator, handkerchief, dress, part of the body, Hall Ticket, etc.	
11.	The candidate possessing cell phone(s)/ programmable calculator(s)/any other electronic storage device(s) gadgets and containing incriminating materials (whether used or not).	

12.	The Candidate possessing the question paper of another candidate with additional writing on it.	Invalidating the examination of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate. Further the candidate is not considered for revaluation of answer scripts of the arrears-subjects. If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate.
13.	The candidate passing his/her question paper to another candidate with additional writing on it	
14.	The candidate passing incriminating materials brought into the examination hall in any medium (hard/soft) to other candidate(s).	
15.	The candidate copying from neighbouring candidate.	
16.	The candidate taking out of the examination hall answer booklet(s), used or unused	
17.	Appeal by the candidate in the answer script coupled with a promise of any form of consideration.	
18.	Candidate destroying evidence relating to an alleged irregularity.	Invalidating the examinations of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate. Further the candidate is not considered for revaluation of answer scripts of the arrears-subjects. If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate. **Additional Punishment :** i. If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period. ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears-subjects for two subsequent semesters.

<table>
<tr><td>19.</td><td>Vulgar/offensive writings by the candidate in the answer script.</td><td rowspan="3">Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears – subjects registered by the candidate.</td></tr>
<tr><td>20.</td><td>The candidate possessing the answer script of another candidate</td></tr>
<tr><td>21.</td><td>The candidate passing his /her answer script to another candidate</td></tr>
<tr><td>22.</td><td>Involved in any one or more of the malpractices of serial no. 8 to 21 for the second or subsequent times.</td><td rowspan="2">Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears –subjects registered by the candidate.
Additional Punishment:
i. If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period.
ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears-subjects for two subsequent semesters.</td></tr>
<tr><td>23.</td><td>The candidate substituting an answer book let prepared outside the examination hall for the one already distributed to the candidate</td></tr>
<tr><td>24.</td><td>The candidate indulge in any disruptive conduct including, but not limited to, shouting, assault of invigilator, officials or students using abusive and /or threatening language, destruction of property.</td><td rowspan="3">Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears –subjects registered by the candidate.
Additional Punishment:
i. If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for two years i.e., for four subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period.
ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears-subjects for four subsequent semesters.</td></tr>
<tr><td>25.</td><td>The candidate harass or engage others to harass on his/her behalf an invigilator, official, witnesses or any other person in relation to an irregularity by making telephone calls, visits, mails or by any other means.</td></tr>
<tr><td>26.</td><td>Candidate possessing any firearm/weapon inside the examination hall.</td></tr>
</table>

27.	Cases of Impersonation	(i) Handing over the impersonator to the police with a complaint to take appropriate action against the person involved in the impersonation by the Chief Supt. If a student of this University is found to impersonate a 'bonafide student', the impersonating student is debarred from continuing his/her studies and writing the examinations permanently. He/she is not eligible for any further admission to any programme of the University. Debarring the 'bonafide student' for whom the impersonation was done from continuing his/her studies and writing the examinations permanently. He/she is not eligible for any further admission to any programme of the University.

APPENDIX IV

Process to Consider the Application for Revocation of Detainment

The process to consider the application for revocation of detainment on account of lack of attendance in 3 or more courses, due to genuine reasons (viz. sports participation, NCC, Medical Grounds etc.) is as follows:

The student submits an application for consideration via a request letter to the CoE, not later than 3 days from the last working day, along with the HoD's recommendation, Class Advisor's report and Mentor's recommendation. A committee consisting of the Principal, CoE, HoD (Respective Department) and HoD's-2 from departments other than the student's own. The committee shall meet within 4 working days,to consider the case. Stakeholders may be called to be present in the meeting as may be required, and Decision arrived at.The decision approved by Principal shall be final.

Curriculum

Conceptual Frame work

(For Students admitted from the Academic Year 2019-20 and onwards)

Semester	Level of Course	Hrs. / Week	No of Courses	Range of Credits / Courses	Total Credits
PART - I					
A - Foundation Courses					
I	Foundation Courses (FC)	4	1	4	4
B - Professional Core Courses					
I to III	Professional Core (PC)	3	12	3 - 4	35
C - Elective Courses					
I to III	Professional Elective (PE)	3	4	3	12
D - Project Work					
III & IV	Project Work (PW)	12 - 24	2	6 - 12	18
Total Credit					**69**
PART II - Career Enhancement Courses (CEC)					
II	Article Writing and Seminar	2	1	1	1
Total Credit					**01**
Total Credit to be Earned					**70**

BoS Chairman

Scheme of Instructions and Examinations

(For Students admitted from the Academic Year 2019-20 and onwards)

Semester - I

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
Induction Programme											
M19MAT102	Applied Probability and Statistics	**FC**	4	4	0	0	**3**	40	60	100	**4**
M19CST101	Advanced Data Structures	**PC**	4	4	0	0	**3**	40	60	100	**4**
M19CST102	Advanced Computer Architecture	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CST103	Operating System Internals	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CST104	Machine Learning Techniques	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CST105	Advanced Software Engineering	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CSP101	Advanced Data Structures Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**
Total Contact Hours / Week			**24**	**20**	**4**	**0**	**Total Credits**				**22**

BoS Chairman

Semester - II											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
M19CST201	Network Design and Technologies	PC	3	3	0	0	3	40	60	100	3
M19CST202	Security Practices	PC	3	3	0	0	3	40	60	100	3
M19CST203	Internet of Things	PC	3	3	0	0	3	40	60	100	3
M19CST204	Big Data Analytics	PC	3	3	0	0	3	40	60	100	3
	Professional Elective - I	PE	3	3	0	0	3	40	60	100	3
	Professional Elective - II	PE	3	3	0	0	3	40	60	100	3
M19CSP201	Big Data Analytics Laboratory	PC	4	0	4	0	3	40	60	100	2
M19CSP202	Term Paper Writing and Seminar	CEC	2	0	2	0	3	40	60	100	1
Total Contact Hours / Week			24	18	6	1	Total Credits				21

Semester - III											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
M19CST301	Research Methodology	PC	3	3	0	0	3	40	60	100	3
	Professional Elective III	PE	3	3	0	0	3	40	60	100	3
	Professional Elective IV	PE	3	3	0	0	3	40	60	100	3
M19CSP301	Project Phase I	PW	12	0	12	0	3	40	60	100	6
Total Contact Hours / Week			21	9	12	0	Total Credits				15

BoS Chairman

Semester - IV											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
M19CSP401	Project Phase - II	**PW**	24	0	24	0	**3**	40	60	100	**12**
Total Contact Hours / Week			**24**	**0**	**24**	**0**	**Total Credits**				**12**

FOUNDATION COURSES (FC)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
M19MAT102	Applied Probability and Statistics	**FC**	4	3	0	1	**3**	40	60	100	**4**

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PROFESSIONAL CORE (PC)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
M19CST101	Advanced Data Structures	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CST102	Advanced Computer Architecture	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CST103	Operating System Internals	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CST104	Machine Learning Techniques	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CST105	Advanced Software Engineering	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CSP101	Advanced Data Structures Laboratory	**PC**	3	3	0	0	**3**	40	60	100	**2**
M19CST201	Network Design and Technologies	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CST202	Security Practices	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CST203	Internet of Things	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CST204	Big Data Analytics	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19CSP201	Big Data Analytics Laboratory	**PC**	4	0	4	0	**3**	40	60	100	**2**

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PROFESSIONAL ELECTIVES (PE)											
Semester – II											
Elective – I											
Course Code	**Course Name**	**Category**	**Instructional Hours**				**Assessment**				**Credit**
			Contact Periods	**T**	**P**	**TU**	**Hours of Exam. (ESE)**	**CIA**	**ESE**	**Total**	
M19CSE201	Advanced Databases	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19CSE202	Principles of Programming Languages	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19CSE203	Image Processing and Analysis	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19CSE204	Web Engineering	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19CSE205	Cloud Computing Technologies	**PE**	3	3	0	0	**3**	40	60	100	**3**

Semester – II											
Elective – II											
Course Code	**Course Name**	**Category**	**Instructional Hours**				**Assessment**				**Credit**
			Contact Periods	**T**	**P**	**TU**	**Hours of Exam. (ESE)**	**CIA**	**ESE**	**Total**	
M19CSE206	Real Time Systems	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19CSE207	Mobile and Pervasive Computing	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19CSE208	Parallel Programming Paradigms	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19CSE209	Information Retrieval Techniques	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19CSE210	Software Architectures and Design	**PE**	3	3	0	0	**3**	40	60	100	**3**

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Semester – III											
Elective – III											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
M19CSE301	Security for Internet of Things.	PE	3	3	0	0	3	40	60	100	3
M19CSE302	Data Visualization Techniques	PE	3	3	0	0	3	40	60	100	3
M19CSE303	Block chain Technology	PE	3	3	0	0	3	40	60	100	3
M19CSE304	Product Design and Development	PE	3	3	0	0	3	40	60	100	3
M19CSE305	Embedded Software Development	PE	3	3	0	0	3	40	60	100	3

Semester – III											
Elective – IV											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
M19CSE306	Bio Informatics	PE	3	3	0	0	3	40	60	100	3
M19CSE307	Information Storage Management	PE	3	3	0	0	3	40	60	100	3
M19CSE308	Bio-inspired Computing	PE	3	3	0	0	3	40	60	100	3
M19CSE309	Mobile Application Development	PE	3	3	0	0	3	40	60	100	3
M19CSE310	Social Network Analysis	PE	4	3	0	0	3	40	60	100	3

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PROJECT WORK (PW)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
M19CSP301	Project Work - Phase I	**PW**	12	0	12	0	**3**	40	60	100	**6**
M19CSP401	Project Work - Phase II	**PW**	24	0	24	0	**3**	40	60	100	**12**

CAREER ENHANCEMENT COURSE (CEC)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	ESE	Total	
M19CSP202	Term Paper Writing and Seminar	**CEC**	2	0	2	0	**3**	100	-	100	**1**

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Semester - I

M.E.	M19MAT102 - APPLIED PROBABILITY AND STATISTICS	T	P	TU	C
		4	0	0	4

Course Objectives	
1.	To understand the basic concepts of one dimensional random variables to introduce and some standard distributions applicable in engineering which can describe real life phenomenon.
2.	To introduce the basic concepts of two dimensional random variables that apply in engineering problems.
3.	This course is designed to provide the solid foundation on topics in various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling.
4.	It is framed to address the issues and the principles of estimation theory, testing of hypothesis.
5.	To introduce the concept of multivariate analysis in data sciences.

UNIT - I	ONE DIMENSIONAL RANDOM VARIABLES	12
Random variables - Probability function - Moments - Moment generating functions and their properties - Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.		

UNIT - II	TWO DIMENSIONAL RANDOM VARIABLES	12
Joint distributions - Marginal and conditional distributions - Functions of two dimensional random variables - Regression curve - Correlation.		

UNIT - III	TESTING OF HYPOTHESIS	12
Sampling distributions - Type I and Type II errors - Large samples: Tests based on Normal (mean and proportion). Small samples: t test for mean, F test for variance, Chi square tests for independence of attributes and goodness of fit.		

UNIT - IV	ESTIMATION THEORY	12
Unbiased estimators - Method of moments - Maximum likelihood estimation - Curve fitting by principle of least squares - Regression lines.		

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UNIT - V	MULTIVARIATE ANALYSIS	12
Random vectors and matrices - Mean vectors and covariance matrices - Multivariate normal density and its properties - Principal components - Population principal components - Principal components from standardized variables.		
		Total Instructional hours: 60

Course Outcomes : Students will be able to	
CO1	Identify Moments, MGF and solve different types of distribution problems.
CO2	Make use of two dimensional random variables in correlation and regression analysis.
CO3	Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO4	Construct Unbiased Estimators, Moments and Regression lines.
CO5	Develop the concepts of multivariate normal distribution and principle components analysis.

Reference Books	
1.	Devore, J. L., “Probability and Statistics for Engineering and the Sciences” (Cengage Learning), 8th Edition, 2014.
2.	Joseph.F.Hair, “Applied Multivariate Methods for Data Analysis”, (Pearson New International Edition), 7th Edition, 2013.
3.	Gupta S.C. and Kapoor V.K., “Fundamentals of Mathematical Statistics”, (Sultan and Sons), New Delhi, 2019.
4.	Johnson, R.A., Miller, I and Freund J., “Miller and Freund„s Probability and Statistics for Engineers”, (Pearson Education, Asia), 8th Edition, 2015.
5.	Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, (Pearson Education, Asia), 6th Edition 2018.

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M.E.	M19CST101 - ADVANCED DATA STRUCTURES AND ALGORITHMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the usage of algorithms in computing.
2.	To learn and use hierarchical data structures and its operations
3.	To learn the usage of graphs and its applications.
4.	To select and design data structures and algorithms that is appropriate for problems.
5.	To study about NP Completeness of problems.

UNIT - I	ROLE OF ALGORITHMS IN COMPUTING	9

Algorithms – Algorithms as a Technology - Insertion Sort – Analyzing Algorithms – Designing Algorithms - Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences : The Substitution Method – The Recursion-Tree Method.

UNIT - II	HIERARCHICAL DATA STRUCTURES	9

Binary Search Trees : Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion - B-Trees : Definition of B-trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps : structure – Mergeable - heap operations - Decreasing a key and deleting a node - Bounding the maximum degree.

UNIT - III	GRAPHS	9

Elementary Graph Algorithms : Representations of Graphs – Breadth - First Search – Depth - First Search – Topological Sort – Strongly Connected Components - Minimum Spanning Trees : Growing a Minimum Spanning Tree – Kruskal and Prim - Single - Source Shortest Paths : The Bellman - Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm.

UNIT - IV	ALGORITHM DESIGN TECHNIQUES	9

Dynamic Programming : Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy- Huffman Codes.

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UNIT - V	NP COMPLETE AND NP HARD	9
NP-Completeness : Polynomial Time – Polynomial-Time Verification – NP-Completeness and Reducability – NP-Completeness Proofs – NP-Complete Problems		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Apply data structures and algorithms to solve computing problems.
CO2	Apply Hierarchical structures to solve the problems using red black tree, B- tree and Heaps.
CO3	Build algorithms using graph structure and various string matching algorithms to solve real-life problems.
CO4	Apply suitable design strategy for problem solving.
CO5	Outline about NP Complete and NP hard.

Reference Books	
1.	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
2.	Robert Sedgewick and Kevin Wayne, “ALGORITHMS”, Fourth Edition, Pearson Education.
3.	S. Sridhar, “Design and Analysis of Algorithms”, First Edition, Oxford University Press, 2014.
4.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, Third Edition, Prentice-Hall, 2011.

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M.E.	M19CST102 - ADVANCED COMPUTER ARCHITECTURE	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
2.	To learn the different multiprocessor issues.
3.	To expose the different types of multicore architectures.
4.	To understand the design of the memory hierarchy.

UNIT - I	FUNDAMENTALS OF COMPUTER DESIGN AND ILP	9

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges – Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP – Multithreading

UNIT - II	MEMORY HIERARCHY DESIGN	9

Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

UNIT - III	MULTIPROCESSOR ISSUES	9

Introduction - Centralized, Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study - Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.

UNIT - IV	MULTICORE ARCHITECTURES	9

Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers - Architectures - Physical Infrastructure and Costs - Cloud Computing – Case Study - Google Warehouse-Scale Computer.

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UNIT - V	VECTOR, SIMD AND GPU ARCHITECTURES	9
Introduction - Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism - Case Studies.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Identify the limitations of ILP
CO2	Summarize the Optimization and memory Hierarchy design
CO3	Outline the issues related to multiprocessing and suggest solutions
CO4	Identify the salient features of different multicore architectures and how they exploit parallelism
CO5	Identify how data level parallelism is exploited in architectures

Reference Books	
1.	Darryl Gove, “Multicore Application Programming: For Windows, Linux, and Oracle Solaris”, Pearson, 2011.
2.	David B. Kirk, Wen-mei W. Hwu, “Programming Massively Parallel Processors”, Morgan Kauffman, 2010.
3.	David E. Culler, Jaswinder Pal Singh, “Parallel computing architecture : A hardware / software approach”, Morgan Kaufmann / Elsevier Publishers, 1999.
4.	John L. Hennessey and David A. Patterson, “Computer Architecture – A Quantitative Approach”, Morgan Kaufmann / Elsevier, 5th edition, 2012.
5.	Kai Hwang and Zhi.Wei Xu, “Scalable Parallel Computing”, Tata McGraw Hill, New Delhi, 2003.

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M.E.	M19CST103 - OPERATING SYSTEM INTERNALS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To be able to read and understand sample open source programs and header files.
2.	To learn how the processes are implemented in Linux.
3.	To understand the implementation of the Linux file system.
4.	To study Linux memory management data structures and algorithms.
5.	To acquire the knowledge in the implementation of interprocess communication.
6.	To understand how program execution happens in Linux.

UNIT - I	INTRODUCTION	9

Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types - Inodes - Access Rights - System Calls - Overview of Unix Kernels -Model - Implementation - Reentrant Kernels - Address Space - Synchronization - Interprocess Communication - Process Management - Memory Management - Device Drivers.

UNIT - II	PROCESSES	9

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes - System Calls - Kernel Threads - Destroying Processes - Termination - Removal.

UNIT - III	FILE SYSTEM	9

The Virtual File System (VFS) - Role - File Model - System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process - Filesystem Types - Special File systems - File system Type Registration - File system Handling - Namespaces - Mounting - Unmounting - Implementation of VFS System Calls.

UNIT - IV	MEMORY MANAGEMENT	9

Page frame management - page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm - page frame cache - zone allocator.

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UNIT - V	PROCESS COMMUNICATION AND PROGRAM EXECUTION	9
Process Communication - Pipes - Usage - Data Structures - Creating and Destroying a Pipe - Reading From and Writing into a Pipe. Program Execution - Executable Files - Process Credentials - Command - Line Arguments and Shell Environment - Libraries - Program Segments and Process Memory Regions - Execution tracing - Executable Formats - Execution Domains - The exec Functions.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Explain the functionality of a large software system by reading its source.
CO2	Summarize how the processes are implemented in Linux
CO3	Outline the implementation of the Linux file system.
CO4	Summarize Linux memory management data structures and algorithms.
CO5	Illustrate the knowledge in the implementation of interprocess communication and understand how program execution happens in Linux.

Reference Books

1. Daniel P. Bovet and Marco Cesati, “Understanding the Linux Kernel”, 3rd Edition, O'Reilly Publications, 2005.
2. Harold Abelson, Gerald Jay Sussman and Julie Sussman, “Structure and Interpretation of Computer Programs”, Second Edition, Universities Press, 2013.
3. Maurice J. Bach, “The Design of the Unix Operating System”, 1st Edition Pearson Education, 2003.
4. Michael Beck, Harald Bohme, Mirko Dziadzka, Ulrich Kunitz, Robert Magnus, Dirk Verworner, “Linux Kernel Internals”, 2nd Edition, Addison-Wesley, 1998.
5. Robert Love, “Linux Kernel Development”, 3rd Edition, Addison-Wesley, 2010.

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M.E.	M19CST104 - MACHINE LEARNING TECHNIQUES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To introduce students to the basic concepts and techniques of Machine Learning.
2.	To have a thorough understanding of the Supervised and Unsupervised learning techniques.
3.	To study the various probability based learning techniques.
4.	To understand graphical models of machine learning algorithms.

UNIT - I	INTRODUCTION	9

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT - II	LINEAR MODELS	9

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

UNIT - III	TREE AND PROBABILISTIC MODELS	9

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map.

UNIT - IV	DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS	9

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process.

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UNIT - V	GRAPHICAL MODELS	9
Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Compare supervised, unsupervised and semi-supervised learning.
CO2	Apply the appropriate machine learning strategy for any given problem.
CO3	Develop supervised, unsupervised or semi-supervised learning algorithms for any given problem.
CO4	Build systems that uses the appropriate graph models of machine learning.
CO5	Make use of existing machine learning algorithms to improve classification efficiency.

Reference Books	
1.	Ethem Alpaydin, “Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)”, Third Edition, MIT Press, 2014.
2.	Jason Bell, “Machine learning – Hands on for Developers and Technical Professionals”, First Edition, Wiley, 2014.
3.	Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.
4.	Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, Chapman and Hall / CRC Machine Learning and Pattern Recognition Series, 2014.
5.	Tom M Mitchell, “Machine Learning”, First Edition, McGraw Hill Education, 2013.

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M.E.	M19CST105 - ADVANCED SOFTWARE ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand Software Engineering Lifecycle Models
2.	To do project management and cost estimation
3.	To gain knowledge of the System Analysis and Design concepts.
4.	To understand software testing approaches
5.	To be familiar with DevOps practices

UNIT - I	INTRODUCTION	9

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

UNIT - II	SOFTWARE REQUIREMENT SPECIFICATION	9

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.

UNIT - III	ARCHITECTURE AND DESIGN	9

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client-server - Tiered - Pipe and filter.- User interface design.

UNIT - IV	TESTING	9

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking.

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UNIT - V	DEVOPS	9
DevOps : Motivation-Cloud as a platform - Operations - Deployment Pipeline : Overall Architecture - Building and Testing - Deployment - Case study : Migrating to Microservices.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Outline the advantages of various Software Development Lifecycle Models.
CO2	Summarize about the software requirement specification.
CO3	Develop a design using architectural styles and design patterns.
CO4	Summarize software testing approaches.
CO5	Infer the advantages of DevOps practices.

Reference Books

1. Bernd Bruegge, Alan H Dutoit, “Object-Oriented Software Engineering”, 2nd edition, Pearso Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, “Fundamentals of Software Engineering”, 2nd edition, PHI Learning Pvt. Ltd., 2010.
3. Craig Larman, “Applying UML and Patterns”, 3rd ed., Pearson Education, 2005.
4. Len Bass, Ingo Weber and Liming Zhu, “DevOps: A Software Architect’s Perspective”, Pearson Education, 2016
5. Rajib Mall, “Fundamentals of Software Engineering”, 3rd edition, PHI Learning Pvt. Ltd., 2009.
6. Stephen Schach, “Software Engineering”, 7th ed., McGraw-Hill, 2007.

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M.E.	M19CSP101 - ADVANCED DATA STRUCTURES LABORATORY	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To acquire the knowledge of using advanced tree structures.
2.	To learn the usage of heap structures.
3.	To understand the usage of graph structures and spanning trees.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Implementation of Merge Sort and Quick Sort-Analysis
2.	Implementation of a Binary Search Tree
3.	Red-Black Tree Implementation
4.	Heap Implementation
5.	Fibonacci Heap Implementation
6.	Graph Traversals
7.	Spanning Tree Implementation
8.	Shortest Path Algorithms (Dijkstra's algorithm, Bellmann Ford Algorithm)
9.	Implementation of Matrix Chain Multiplication
10.	Activity Selection and Huffman Coding Implementation.
	Total Instructional hours: 30

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Course Outcomes : Students will be able to	
CO1	Develop the sorting methods and analyze it
CO2	Apply Hierarchical structures to solve the problems using red black tree B- tree and Heaps.
CO3	Make use of Graph structure and traversal
CO4	Develop an application by using shortest path algorithms
CO5	Build the solution for NP hard abd NP complete problems

Reference Books	
1.	Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
2.	Robert Sedgewick and Kevin Wayne, “ALGORITHMS”, Fourth Edition, Pearson Education.
3.	S. Sridhar, “Design and Analysis of Algorithms”, First Edition, Oxford University Press. 2014
4.	Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, Third Edition, Prentice-Hall, 2011.

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Semester - II

M.E.	M19CST201 - NETWORK DESIGN AND TECHNOLOGIES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the principles required for network design.
2.	To explore various technologies in the wireless domain.
3.	To study about 3G and 4G cellular networks.
4.	To understand the paradigm of Software defined networks.

UNIT - I	NETWORK DESIGN	9

Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Switched networks – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios – Applications, Quality of Service – End to end level and network level solutions. LAN cabling topologies – Ethernet Switches, Routers, Firewalls and L3 switches – Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP – Core networks, and distribution networks.

UNIT - II	WIRELESS NETWORKS	9

IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS – Bluetooth – Protocol Stack – Security – Profiles.

UNIT - III	CELLULAR NETWORKS	9

GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface – UTRAN – Core and Radio Network Mobility Management – UMTS Security.

UNIT - IV	4G NETWORKS	9

LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks – Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10) - 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Introduction to 5G.

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UNIT - V	SOFTWARE DEFINED NETWORKS	9
Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Identify the components required for designing a network.
CO2	Infer the knowledge on wireless networks.
CO3	Explain the principles of cellular networks.
CO4	Infer the features of 4G and 5G networks.
CO5	Experiment with software defined networks.

Reference Books	
1.	Erik Dahlman, Stefan Parkvall, Johan Skold, “4G: LTE/LTE-Advanced for Mobile Broadband”, Academic Press, 2013.
2.	Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015.
3.	Larry Peterson and Bruce Davie, “Computer Networks: A Systems Approach”, 5th edition, Morgan Kauffman, 2011.
4.	Martin Sauter, “From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband”, Wiley, 2014
5.	Martin Sauter, “Beyond 3G - Bringing Networks, Terminals and the Web Together : LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0”, Wiley, 2009
6.	Naveen Chilamkurti, Sherali Zeadally, Hakima Chaouchi, “Next-Generation Wireless Technologies”, Springer, 2013.
7.	Paul Goransson, Chuck Black, “Software Defined Networks: A Comprehensive Approach”, Morgan Kauffman, 2014.
8.	Savo G Glisic, “Advanced Wireless Networks – 4G Technologies”, John Wiley & Sons, 2007
9.	Thomas D. Nadeau and Ken Gray, “SDN – Software Defined Networks”, O‟Reilly Publishers, 2013
10.	Ying Dar Lin, Ren-Hung Hwang and Fred Baker, “Computer Networks : An Open Source Approach”, McGraw Hill, 2011.

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M.E.	M19CST202 - SECURITY PRACTICES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn the core fundamentals of system and web security concepts.
2.	To have through understanding in the security concepts related to networks.
3.	To deploy the security essentials in IT Sector.
4.	To be exposed to the concepts of Cyber Security and encryption Concepts.
5.	To perform a detailed study of Privacy and Storage security and related Issues.

UNIT - I	SYSTEM SECURITY	9

Building a secure organization - A Cryptography primer - detecting system Intrusion - Preventing system Intrusion - Fault tolerance and Resilience in cloud computing environments - Security web applications, services and servers.

UNIT - II	NETWORK SECURITY	9

Internet Security - Botnet Problem - Intranet security - Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security - Cellular Network Security - Optical Network Security - Optical wireless Security.

UNIT - III	SECURITY MANEGEMENT	9

Information security essentials for IT Managers- Security Management System - Policy Driven System Management - IT Security - Online Identity and User Management System - Intrusion and Detection and Prevention System.

UNIT - IV	CYBER SECURITY AND CRYPTOGRAPHY	9

Cyber Forensics - Cyber Forensics and Incidence Response - Security e-Discovery - Network Forensics - Data Encryption - Satellite Encryption - Password based authenticated Key establishment Protocols.

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UNIT - V	PRIVACY AND STORAGE SECURITY	9
Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies - privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.		
Total Instructional hours: 45		

Course Outcomes : Students will be able to	
CO1	Infer the core fundamentals of system security
CO2	Apply the security concepts related to networks in wired and wireless scenario
CO3	Utilize and Manage the security essentials in IT Sector
CO4	Explain the concepts of Cyber Security and encryption Concepts
CO5	Infer the knowledge on Privacy and Storage security.

Reference Books	
1.	John R. Vacca, “Computer and Information Security Handbook”, Second Edition, Elsevier 2013.
2.	Michael E. Whitman, Herbert J. Mattord, “Principal of Information Security”, Fourth Edition, Cengage Learning, 2012.
3.	Richard E.Smith, “Elementary Information Security”, Second Edition, Jones and Bartlett Learning, 2016.

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M.E.	M19CST203- INTERNET OF THINGS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals of Internet of Things.
2.	To learn about the basics of IOT protocols.
3.	To build a small low cost embedded system using Raspberry Pi.
4.	To apply the concept of Internet of Things in the real world scenario.

UNIT - I	INTRODUCTION TO IoT	9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology.

UNIT - II	IoT ARCHITECTURE	9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.

UNIT - III	IoT PROTOCOLS	9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus – Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security.

UNIT - IV	BUILDING IoT WITH RASPBERRY PI & ARDUINO	9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks - Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces - Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

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UNIT - V	CASE STUDIES AND REAL-WORLD APPLICATIONS	9
Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Infer the basic concepts of IoT
CO2	Explain the architecture of IoT
CO3	Make use of various protocols for IoT.
CO4	Build applications using Raspberry Pi and Arduino.
CO5	Infer the applications of IoT in real time scenario.

Reference Books	
1.	Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2.	Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internet of Things”, Springer, 2011.
3.	Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2012.
4.	Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle, “From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence”, Elsevier, 2014.
5.	Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applications and Protocols”, Wiley, 2012.

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M.E.	M19CST204 - BIG DATA ANALYTICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the competitive advantages of big data analytics.
2.	To understand the big data frameworks.
3.	To learn data analysis methods.
4.	To learn stream computing.
5.	To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

UNIT - I	INTRODUCTION TO BIG DATA	7

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.

UNIT - II	HADOOP FRAMEWORK	9

Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN.

UNIT - III	DATA ANALYSIS	13

Statistical Methods : Regression modelling, Multivariate Analysis - Classification : SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.

UNIT - IV	MINING DATA STREAMS	7

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

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UNIT - V	BIG DATA FRAMEWORKS	9
Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Infer the basics of big data analytics.
CO2	Explain the concepts of distributed file systems and Hadoop.
CO3	Utilize various statistical and data mining approaches to analyze data.
CO4	Infer the concept of analytics on real-time streaming data.
CO5	Make use of the various NoSql alternative database models.

Reference Books	
1.	Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, Wiley and SAS Business Series, 2012.
2.	David Loshin, “Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL”, and Graph", 2013.
3.	Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, Second Edition, 2007.
4.	Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, “Big Data, Big Analytics : Emerging Business Intelligence and Analytic Trends for Today's Businesses”, Wiley, 2013.
5.	P. J. Sadalage and M. Fowler, “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Addison-Wesley Professional, 2012.
6.	Richard Cotton, “Learning R – A Step-by-step Function Guide to Data Analysis”, O’Reilly Media, 2013.

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M.E.	M19CSP201- BIG DATA ANALYTICS LABORATORY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To implement Map Reduce programs for processing big data.
2.	To realize storage of big data using H base, Mongo DB.
3.	To analyse big data using linear models.
4.	To analyse big data using machine learning techniques such as SVM / Decision tree classification and clustering.

List of Experiments	
Expt. No.	**Description of the Experiments**
Hadoop	
1.	Install, configure and run Hadoop and HDFS
2.	Implement word count / frequency programs using MapReduce
3.	Implement an MR program that processes a weather dataset
R	
1.	Implement Linear and logistic Regression
2.	Implement SVM / Decision tree classification techniques
3.	Implement clustering techniques
4.	Visualize data using any plotting framework
5.	Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R.
	Total Instructional hours: 45

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Course Outcomes : Students will be able to	
CO1	Make use of Hadoop framework to process data.
CO2	Build and apply linear and logistic regression models
CO3	Make use of machine learning methods to perform data analysis
CO4	Utilize plotting framework to perform graphical data analysis
CO5	Build an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R

Reference Books	
1.	Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, Wiley and SAS Business Series, 2012.
2.	David Loshin, “Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph”, 2013.
3.	Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, Second Edition, 2007.
4.	Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, “Big Data, Big Analytics : Emerging Business Intelligence and Analytic Trends for Today’s Businesses”, Wiley, 2013.
5.	P. J. Sadalage and M. Fowler, “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Addison-Wesley Professional, 2012.
6.	Richard Cotton, “Learning R – A Step-by-step Function Guide to Data Analysis”, O’Reilly Media, 2013.

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Professional Elective - I

M.E.	M19CSE201 - ADVANCED DATABASES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the design of databases.
2.	To acquire knowledge on parallel and distributed databases and its applications.
3.	To study the usage and applications of Object Oriented and Intelligent databases.
4.	To understand the emerging databases like Mobile, XML, Cloud and Big Data.

UNIT - I	PARALLEL AND DISTRIBUTED DATABASES	9

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems - Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control – Distributed Query Processing – Case Studies.

UNIT - II	INTELLIGENT DATABASES	9

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2) - TaxonomyApplications - Design Principles for Active Rules - Temporal Databases: Overview of Temporal Databases TSQL2 - Deductive Databases - Recursive Queries in SQL - Spatial Databases - Spatial Data Types - Spatial Relationships - Spatial Data Structures - Spatial Access Methods - Spatial DB Implementation.

UNIT - III	XML DATABASES	9

XML Databases: XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity.

UNIT - IV	MOBILE DATABASES	9

Mobile Databases : Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols.

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UNIT - V	MULTIMEDIA DATABASES	9
Multidimensional Data Structures – Image Databases – Text / Document Databases – Video Databases – Audio Databases – Multimedia Database Design.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Infer the knowledge on database architecture.
CO2	Classify intelligent databases.
CO3	Interpret XML databases.
CO4	Infer the knowledge on mobile databases.
CO5	Summarize the concept of multimedia databases.

Reference Books

1. C.J. Date, A. Kannan, S. Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
2. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T. Snodgrass, V.S. Subrahmanian, Roberto Zicari, “Advanced Database Systems”, Morgan Kaufmann publishers, 2006.
3. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Sixth Edition, McGraw Hill, 2011.
4. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Sixth Edition, Pearson Education / Addison Wesley, 2010.
5. Vijay Kumar, “Mobile Database Systems”, John Wiley & Sons, 2006

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M.E.	M19CSE202 - PRINCIPLES OF PROGRAMMING LANGUAGES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand and describe syntax and semantics of programming languages.
2.	To understand Data, Data types, and Bindings.
3.	To learn the concepts of functional and logical programming.
4.	To explore the knowledge about concurrent Programming paradigms

UNIT - I	ELEMENTS OF PROGRAMMING LANGUAGES	9

Reasons for studying, concepts of programming languages, Language Evaluation Criteria, influences on Language design, Language categories. Programming Language Implementation – Compilation, Hybrid Implementation, Pure Interpretation and Virtual Machines. Describing Syntax and Semantics - Introduction - The General Problem of Describing Syntax-Formal Methods of Describing Syntax - Attribute Grammars - Describing the Meanings of Programs: Dynamic Semantics.

UNIT - II	DATA TYPES - ABSTRACTION	9

Introduction - Primitive Data Types - Character String Types - User-Defined Ordinal Type - Array types - Associative Arrays - Record Types - Tuple Types - List Types - Union Types - Pointer and Reference Types - Type Checking - Strong Typing - Type Equivalence - Theory and Data Types - Variables - The Concept of Binding - Scope - Scope and Lifetime - Referencing Environments - Named Constants - The Concept of Abstraction - Parameterized Abstract Data Types - Encapsulation Constructs - Naming Encapsulations.

UNIT - III	FUNCTIONAL PROGRAMMING	9

Introduction - Mathematical Functions - Fundamentals of Functional Programming Languages - The First Functional Programming Language: LISP - An Introduction to Scheme - Common LISP - Haskell - F# - ML : Implicit Types - Data Types - Exception Handling in ML. Functional Programming with Lists - Scheme, a Dialect of Lisp - The Structure of Lists - List Manipulation - A Motivating Example: Differentiation - Simplification of Expressions - Storage Allocation for Lists.

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UNIT - IV	LOGIC PROGRAMMING	9
Relational Logic Programming - Syntax - Basics - Facts - Rules - Syntax - Operational Semantics - Relational logic programs and SQL operations - Logic Programming - Syntax - Operational semantics - Data Structures - Meta-tools: Backtracking optimization (cuts); Unify; Meta-circular interpreters - The Origins of Prolog - Elements - of Prolog - Deficiencies of Prolog - Applications of Logic Programming.		

UNIT - V	CONCURRENT PROGRAMMING	9
Parallelism in Hardware - Streams : Implicit Synchronization - Concurrency as Interleaving - Liveness Properties - Safe Access to Shared Data - Concurrency in Ada - Synchronized Access to Shared Variables - Synthesized Attributes - Attribute Grammars - Natural Semantics - Denotational Semantics - A Calculator in Scheme - Lexically Scoped Lambda Expressions - An Interpreter - Recursive Functions.		
Total Instructional hours: 45		

Course Outcomes : Students will be able to	
CO1	Explain syntax and semantics of programming languages.
CO2	Explain data, data types, and basic statements of programming languages.
CO3	Infer the knowledge on mathematical functions and functional programming.
CO4	Develop programs in LISP, ML, and Prolog.
CO5	Make use of logic programming.
CO6	Infer the knowledge on concurrent programming.

Reference Books	
1.	Ghezzi, “Programming Languages”, 3rd Edition, John Wiley, 2008
2.	John C. Mitchell, “Concepts in Programming Languages”, Cambridge University Press, 2004.
3.	Louden, “Programming Languages”, 3rd Edition, 2012.
4.	Ravi Sethi, “Programming Languages: Concepts and Constructs”, 2nd Edition, Addison, Wesley, 1996.
5.	Robert W. Sebesta, “Concepts of Programming Languages”, 10th Edition, Pearson Education, 2002.

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M.E.	M19CSE203 - IMAGE PROCESSING AND ANALYSIS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the image processing concepts and analysis.
2.	To understand the image processing techniques.
3.	To familiarize the image processing environment and their applications.
4.	To appreciate the use of image processing in various applications.

UNIT - I	IMAGE PROCESSING FUNDAMENTALS	9

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.

UNIT - II	IMAGE ENHANCEMENT AND RESTORATION	9

Image Transforms - Discrete and Fast Fourier Transform and Discrete Cosine Transform, Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering, Noise models, Constrained and Unconstrained restoration models.

UNIT - III	IMAGE SEGMENTATION AND MORPHOLOGY	9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms - Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions - Component Labeling – Regional descriptors and Feature Selection Techniques.

UNIT - IV	IMAGE ANALYSIS AND CLASSIFICATION	9

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

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UNIT - V	IMAGE REGISTRATION AND VISUALIZATION	9
Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Infer the basic concepts of image processing.
CO2	Explain the image enhancement and restoration methds.
CO3	Make use of image segmentation and morphology.
CO4	Experiment with the concepts of image analysis and classification.
CO5	Infer the concepts of image registration and visualization.

Reference Books	
1.	Alasdair McAndrew, “Introduction to Digital Image Processing with Matlab”, Cengage Learning 2011, India.
2.	Anil J Jain, “Fundamentals of Digital Image Processing”, PHI, 2006.
3.	Kavyan Najarian and Robert Splerstor, “Biomedical signals and Image processing CRC”, Taylor and Francis, New York, 2006.
4.	Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2008, New Delhi.
5.	S.Sridhar, “Digital Image Processing”, Oxford University Press, 2011.

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M.E.	M19CSE204 - WEB ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	Understand the characteristics of web applications.
2.	Learn to Model web applications.
3.	Be aware of Systematic design methods.
4.	Be familiar with the testing techniques for web applications.

UNIT - I	INTRODUCTION TO WEB ENGINEERING	9

Motivation, Categories of Web Applications, Characteristics of Web Applications. Requirements of Engineering in Web Applications - Web Engineering - Components of Web Engineering - Web Engineering Process - Communication - Planning.

UNIT - II	WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS	9

Introduction - Categorizing Architectures - Specifics of Web Application Architectures, Components of a Generic Web Application Architecture - Layered Architectures, 2-Layer Architectures, N-Layer Architectures-Data-aspect Architectures, Database-centric Architectures - Architectures for Web Document Management - Architectures for Multimedia Data - Modeling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling, Modelling Framework-Modeling languages - Analysis Modeling for Web Apps - The Content Model - The Interaction Model - Configuration Model.

UNIT - III	WEB APPLICATION DESIGN	9

Design for WebApps - Goals - Design Process - Interactive Design - Principles and Guidelines - Workflow - Preliminaries - Design Steps - Usability - Issues - Information Design - Information Architecture - structuring - Accessing Information - Navigation Design - Functional Design - Wep App Functionality - Design Process - Functional Architecture - Detailed Functional Design.

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UNIT - IV	TESTING WEB APPLICATIONS	9
Introduction - Fundamentals - Test Specifics in Web Engineering - Test Approaches - Conventional Approaches, Agile Approaches - Testing concepts - Testing Process - Test Scheme - Test Methods and Techniques - Link Testing - Browser Testing - Usability Testing - Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, - Content Testing - User Interface testing - Usability Testing - Compatibility Testing - Component Level Testing - Navigation Testing - Configuration testing - Security and Performance Testing - Test Automation.		

UNIT - V	PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT	9
Introduction - challenges in launching the web Application - Promoting Web Application - Content Management - Usage Analysis - Web Project Management - Challenges in Web Project Management - Managing Web Team - Managing the Development Process of a Web Application - Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS - web sockets.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Infer the concepts of web engineering.
CO2	Explain the architecture and modelling of web applications.
CO3	Make use of various web designing approaches.
CO4	Utilize various methods to perform web testing.
CO5	Explain the concept of promoting and managing web applications.

Reference Books	
1.	Chris Bates, “Web Programming : Building Internet Applications”, Third Edition, Wiley India Edition, 2007.
2.	Gerti Kappel, Birgit Proll, “Web Engineering”, John Wiley and Sons Ltd, 2006.
3.	Guy W. Lecky - Thompson, “Web Programming”, Cengage Learning, 2008.
4.	John Paul Mueller, “Web Development with Microsoft Visual Studio 2005”, Wiley Dream tech, 2006.
5.	Roger S. Pressman, David Lowe, “Web Engineering”, Tata McGraw Hill Publication, 2007.

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M.E.	M19CSE205 - CLOUD COMPUTING TECHNOLOGIES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the concepts of virtualization and virtual machines.
2.	To gain expertise in server, network and storage virtualization.
3.	To understand and deploy practical virtualization solutions and enterprise solutions.
4.	To gain knowledge on the concept of virtualization that is fundamental to cloud computing.
5.	To understand the various issues in cloud computing.
6.	To be able to set up a private cloud.
7.	To understand the security issues in the grid and the cloud environment.

UNIT - I	VIRTUALIZATION	9

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines – Emulation –Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization – Management Virtualization – Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization.

UNIT - II	VIRTUALIZATION INFRASTRUCTURE	9

Comprehensive Analysis - Resource Pool – Testing Environment – Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization – Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

UNIT - III	CLOUD PLATFORM ARCHITECTURE	9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software - A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery – Architectural Design Challenges - Public Cloud Platforms : GAE, AWS – Inter-cloud Resource Management.

UNIT - IV	PROGRAMMING MODEL	9

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Developing Map Reduce Applications - Design of Hadoop file system – Setting up Hadoop Cluster - Cloud Software Environments - Eucalyptus, Open Nebula, Open Stack, Nimbus.

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UNIT - V	CLOUD SECURITY	9
Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud – Cloud Security and Trust Management.		
Total Instructional hours: 45		

Course Outcomes : Students will be able to	
CO1	Apply the concepts of storage virtualization, network virtualization and its management.
CO2	Infer the basics of virtualization infrastructure.
CO3	Identify the architecture, infrastructure and delivery models of cloud Computing.
CO4	Develop services using Hadoop and cloud software.
CO5	Apply the security models in the cloud environment.

Reference Books	
1.	Danielle Ruest, Nelson Ruest, “Virtualization: A Beginner‟s Guide”, McGraw-Hill Osborne Media, 2009.
2.	Jim Smith, Ravi Nair, “Virtual Machines: Versatile Platforms for Systems and Processes”, Elsevier / Morgan Kaufmann, 2005.
3.	John W. Rittinghouse and James F. Ransome, “Cloud Computing: Implementation, Management, and Security”, CRC Press, 2010.
4.	Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
5.	Tim Mather, Subra Kumaraswamy, and Shahed Latif, “Cloud Security and Privacy”, O’Reilly Media, Inc., 2009.
6.	Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach”, McGraw-Hill Osborne Media, 2009.
7.	Tom White, “Hadoop : The Definitive Guide”, Yahoo Press, 2012.

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Professional Elective - II

M.E.	M19CSE206 - REAL TIME SYSTEMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn real time operating system concepts, the associated issues & Techniques.
2.	To understand design and synchronization problems in Real Time System.
3.	To explore the concepts of real time databases.
4.	To understand the evaluation techniques present in Real Time System.

UNIT - I	REAL TIME SYSTEM AND SCHEDULING	9

Introduction – Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms – Fault Tolerant Scheduling.

UNIT - II	SOFTWARE REQUIREMENTS ENGINEERING	9

Requirements engineering process – types of requirements – requirements specification for real time systems – Formal methods in software specification – structured Analysis and Design – object oriented analysis and design and unified modelling language – organizing the requirements document – organizing and writing documents – requirements validation and revision.

UNIT - III	INTERTASK COMMUNICATION AND MEMORY MANAGEMENT	9

Buffering data – Time relative Buffering- Ring Buffers – Mailboxes – Queues – Critical regions – Semaphores – other Synchronization mechanisms – deadlock – priority inversion – process stack management – run time ring buffer – maximum stack size – multiple stack arrangement – memory management in task control block - swapping – overlays – Block page management – replacement algorithms – memory locking – working sets – real time garbage collection – contiguous file systems.

UNIT - IV	REAL TIME DATABASES	9

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two – phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

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UNIT - V	EVALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION	9
Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy – Software error models. Clock Synchronization – Clock, A Nonfault – Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Apply principles of real time system design techniques to develop real time Applications.
CO2	Make use of architectures and behavior of real time operating systems.
CO3	Infer the concept of inter task communication and memory management task .
CO4	Apply the Real time databases.
CO5	Summarize the Evaluation Techniques and clock Synchronization.

Reference Books	
1.	C.M. Krishna, Kang G. Shin, “Real - Time Systems”, McGraw-Hill International Editions,1997.
2.	Philip A. Laplante, “Real Time System Design and Analysis”, Prentice Hall of India, 3rd Edition, 2004.
3.	Rajib Mall, “Real-time systems: theory and practice”, Pearson Education, 2009.
4.	R.J.A Buhur, D.L Bailey, “An Introduction to Real - Time Systems”, Prentice Hall International, 1999.
5.	Stuart Bennett, “Real Time Computer Control - An Introduction”, Prentice Hall of India, 1998.
6.	Allen Burns, Andy Wellings, “Real Time Systems and Programming Languages”, Pearson Education, 2003.

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M.E.	M19CSE207 - MOBILE AND PERVASIVE COMPUTING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To learn the basic architecture and concepts till Third Generation Communication systems.
2.	To understand the latest 4G Telecommunication System Principles.
3.	To introduce the broad perspective of pervasive concepts and management.
4.	To explore the HCI in Pervasive environment.
5.	To apply the pervasive concepts in mobile environment.

UNIT - I	INTRODUCTION	9

History – Wireless communications: GSM – DECT – TETRA – UMTS – IMT – 2000 – Blue tooth, WiFi, WiMAX, 3G ,WATM.- Mobile IP protocols -WAP push architecture-Wml scripts and applications. Data networks – SMS – GPRS – EDGE – Hybrid Wireless100 Networks – ATM – Wireless ATM.

UNIT - II	OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM	9

Introduction. LTE - A System Architecture. LTE RAN. OFDM Air Interface. Evolved Packet Core. LTE Requirements. LTE - Advanced. LTE-A in Release. OFDMA – Introduction. OFDM Principles. LTE Uplink - SC - FDMA. Summary of OFDMA.

UNIT - III	PERVASIVE CONCEPTS AND ELEMENTS	9

Technology Trend Overview - Pervasive Computing: Concepts - Challenges - Middleware - Context Awareness - Resource Management - Human – Computer Interaction – Pervasive Transaction Processing - Infrastructure and Devices - Wireless Networks - Middleware for Pervasive Computing Systems - Resource Management - User Tracking- Context Management - Service Management - Data Management - Security Management – Pervasive Computing Environments - Smart Car Space - Intelligent Campus.

UNIT - IV	HCI IN PERVASIVE COMPUTING	9

Prototype for Application Migration - Prototype for Multimodalities - Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - ContextDriven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm.

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UNIT - V	PERVASIVE MOBILE TRANSACTIONS	9
Pervasive Mobile Transactions - Introduction to Pervasive Transactions - Mobile Transaction Framework - Unavailable Transaction Service - Pervasive Transaction Processing Framework - Context-Aware Pervasive Transaction Model - Context Model for Pervasive Transaction Processing - Context-Aware Pervasive Transaction Model - A Case of Pervasive Transactions - Dynamic Transaction Management - Context-Aware Transaction Coordination Mechanism - Coordination Algorithm for Pervasive Transactions - Participant Discovery - Formal Transaction Verification - Petri Net with Selective Transition.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Illustrate the Basic architecture and concepts of till Third Generation Communication systems.
CO2	Explain the latest 4G Telecommunication System Principles
CO3	Demonstrate the pervasive concepts.
CO4	Make use of HCI in Pervasive environment.
CO5	Infer the pervasive concepts in mobile environment.

Reference Books	
1.	Alan Colman, Jun Han and Muhammad Ashad Kabir, “Pervasive Social Computing Socially - Aware Pervasive Systems and Mobile Applications”, Springer, 2016.
2.	J. Schiller, “Mobile Communication”, Addison Wesley, 2000.
3.	Juha Korhonen, “Introduction to 4G Mobile Communications”, Artech House Publishers, 2014.
4.	Kolomvatsos, Kostas, “Intelligent Technologies and Techniques for Pervasive Computing”, IGI Global, 2013.
5.	M. Bala Krishna, Jaime Lloret Mauri, “Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks”, CRC 2016.
6.	Minyi Guo, Jingyu Zhou, Feilong Tang, Yao Shen, “Pervasive Computing : Concepts, Technologies and Applications”, CRC Press, 2016.

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M.E.	M19CSE208 - PARALLEL PROGRAMMING PARADIGMS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To familiarize the issues in parallel computing.
2.	To describe distributed memory programming using MPI.
3.	To understand shared memory paradigm with Pthreads and with OpenMP.
4.	To learn the GPU based parallel programming using OpenCL.

UNIT - I	FOUNDATIONS OF PARALLEL PROGRAMMING	9

Motivation for parallel programming – Need-Concurrency in computing – Basics of processes, multitasking and threads – cache – cache mappings – caches and programs – virtual memory – Instruction level parallelism – hardware multi-threading – Parallel Hardware-SIMD – MIMD – Interconnection networks – cache coherence – Issues in shared memory model and distributed memory model – Parallel Software - Caveats - coordinating processes/ threads - hybrid model – shared memory model and distributed memory model - I/O – performance of parallel programs – parallel program design.

UNIT - II	DISTRIBUTED MEMORY PROGRAMMING WITH MPI	9

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMDprograms – MPI_Send and MPI_Recv – message matching – MPI- I/O – parallel I/O – collective communication – Tree - structured communication - MPI_Reduce – MPI_Allreduce, broadcast, scatter, gather, allgather – MPI derived types – dynamic process management – performance evaluation of MPI programs - A Parallel Sorting Algorithm.

UNIT - III	SHARED MEMORY PARADIGM WITH PTHREADS	9

Basics of threads, Pthreads – thread synchronization – critical sections – busy waiting – mutex – semaphores – barriers and condition variables – read write locks with examples - Caches, cache coherence and false sharing – Thread safety-Pthreads case study.

UNIT - IV	SHARED MEMORY PARADIGM: OPENMP	9

Basics Open MP – Trapezoidal Rule-scope of variables – reduction clause – parallel for directive – loops in OpenMP – scheduling loops –Producer Consumer problem – cache issues – threads safety in OpenMP – Two- body solvers- Tree Search

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UNIT - V	GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA	9
Introduction to OpenCL – Example-OpenCL Platforms - Devices - Contexts - OpenCL programming – Built-In Functions - Programs Object and Kernel Object – Memory Objects - Buffers and Images – Event model – Command - Queue - Event Object - case study. Introduction to CUDA programming.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Infer the basics of parallel programming.
CO2	Make use of distributed memory programs using MPI framework.
CO3	Develop the shared memory parallel programs using P threads.
CO4	Develop the shared memory parallel programs using Open MP.
CO5	Infer the principles of Graphical Processing Open CL programs.

Reference Books	
1.	A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, “OpenCL programming guide”, Addison Wesley, 2011.
2.	M. J. Quinn, “Parallel programming in C with MPI and Open MP”, Tata McGraw Hill, 2003.
3.	Peter S. Pacheco, “An introduction to parallel programming”, Morgan Kaufmann, 2011.
4.	Rob Farber, “CUDA application design and development”, Morgan Haufmann, 2011.
5.	W. Gropp, E. Lusk, and A. Skjellum, “Using MPI: Portable parallel programming with the message passing interface”, Second Edition, MIT Press, 1999 OTHER WEB.

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M.E.	M19CSE209 - INFORMATION RETRIEVAL TECHNIQUES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of information retrieval with pertinence to modeling, query operations and indexing.
2.	To get an understanding of machine learning techniques for text classification and clustering.
3.	To understand the various applications of information retrieval giving emphasis to multimedia IR, web search.
4.	To understand the concepts of digital libraries.

UNIT - I	INTRODUCTION : MOTIVATION	9

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics – The impact of the web on IR – IR Versus Web Search – Components of a Search engine.

UNIT - II	MODELING	9

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking – Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing.

UNIT - III	INDEXING	9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency.

UNIT - IV	CLASSIFICATION AND CLUSTERING	9

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering – Matrix decompositions and latent semantic indexing – Fusion and Meta learning.

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UNIT - V	SEARCHING THE WEB	9
Searching the Web – Structure of the Web – IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.		
Total Instructional hours: 45		

Course Outcomes : Students will be able to	
CO1	Build an Information Retrieval system using the available tools.
CO2	Identify and design the various components of an Information Retrieval system.
CO3	Relate the information retrieval with pertinence to modeling, query operations and indexing
CO4	Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval
CO5	Construct an efficient search engine and analyze the Web content structure.

Reference Books	
1.	Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to Information Retrieval”, Cambridge University Press, First South Asian Edition, 2008.
2.	“Implementing and Evaluating Search Engines”, The MIT Press, Cambridge, Massachusetts London, England, 2010.
3.	Ricardo Baeza – Yates, Berthier Ribeiro – Neto, “Modern Information Retrieval : The concepts and Technology behind Search” (ACM Press Books), Second Edition, 2011.
4.	Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, “Information Retrieval”.

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M.E.	M19CSE210 - SOFTWARE ARCHITECTURES AND DESIGN	T	P	TU	C
		0	4	0	2

Course Objectives	
1.	To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
2.	To learn the design principles and to apply for large scale systems.
3.	To design architectures for distributed heterogeneous systems ,environment through brokerage interaction.
4.	To build design knowledge on service oriented and model driven architectures and the aspect oriented architecture.
5.	To develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services.

UNIT - I	INTRODUCTION	9

Introduction to Software Architecture - Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes. Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).

UNIT - II	OBJECT ORIENTED PARADIGM	9

Object - Oriented Paradigm - Design Principles. Data - Centered Software Architecture: Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main - Subroutine, Master - Slave, Layered, Virtual Machine. Interaction - Oriented Software Architectures: Model - View - Controller (MVC), Presentation - Abstraction - Control (PAC).

UNIT - III	DISTRIBUTED ARCHITECTURE	9

Distributed Architecture : Client-Server, Middleware, Multi-tiers, Broker Architecture – MOM, CORBA Message Broker Architecture - Service - Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architectur - Methodology of Architecture Decision, Quality Attributes.

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UNIT - IV	ARCHITECTURE OF USER INTERFACES	9
Architecture of User Interfaces containers, case study - web service. Product Line Architectures - methodologies, processes and tools. Software Reuse and Product Lines - Product Line Analysis, Design and implementation, configuration Models. Model Driven Architectures (MDA) – why MDA Model transformation and software architecture, SOA and MDA. Eclipse modeling framework.		

UNIT - V	ASPECT ORIENTED ARCHITECTURE	9
Aspect Oriented Architectures - AOP in UML, AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture &shipping – inventory, supply chain cloud service Management, semantic web services.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Outline the need of software architecture for sustainable dynamic systems.
CO2	Apply design principles for large scale systems.
CO3	Construct architectures for distributed heterogeneous systems.
CO4	Classify service oriented and model driven architectures and the aspect oriented architecture.
CO5	Develop appropriate architectures through various case studies.

Reference Books	
1.	“Essentials of software Architecture”, Ion Gorton, Second Edition, Springer - verlag, 2011.
2.	“Software Architecture Design Illuminated”, Kai Qian Jones and Bartlett Publishers Canada, 2010.

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Semester - III

M.E - CSE	M19CST301 - RESEARCH METHODOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the basics of research formulation and design.
2.	To learn the concept of data collection and analysis.
3.	To understand the concept of soft computing.
4.	To learn the concept of research ethics, IPR and scholarly publishing.
5.	To study about interpretation and report writing.

UNIT - I	RESEARCH FORMULATION AND DESIGN	9

Motivation and objectives – Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

UNIT - II	DATA COLLECTION AND ANALYSIS	9

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools,data analysis with statically package (Sigma STAT, SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT - III	SOFT COMPUTING	9

Computer and its role in research, Use of statistical software SPSS, GRETL etcin research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

UNIT - IV	RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING	9

Ethics - ethical issues, ethical committees (human & animal); IPR - intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual property rights (TRIPS); scholarly publishing - IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

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UNIT - V	INTERPRETATION AND REPORT WRITING	9
Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Understand the concept of research formulation and design.
CO2	Understand the process of data collection and analysis.
CO3	Make use of the soft computing methods.
CO4	Illustrate the principles of research ethics publication and principles of interpretation and report writing.
CO5	Understand the basics of IPR and scholarly.

Reference Books	
1.	Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2.	Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3.	Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4.	Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5.	Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

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Professional Elective - III

M.E - CSE	M19CSE301 - SECURITY OF INTERNET OF THINGS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To identify the security requirements in IoT.
2.	To know about cryptographic fundamentals for IoT.
3.	To understand the authentication credentials and access control.
4.	To learn the various types Trust models.
5.	To know the various services provided for Cloud Security.

UNIT - I	INTRODUCTION : SECURING THE INTERNET OF THINGS	9

Security Requirements in IoT Architecture - Security in Enabling Technologies - Security Concerns in IoT Applications. Security Architecture in the Internet of Things - Security Requirements in IoT - Insufficient Authentication/Authorization - Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT; Vulnerabilities – Secrecy and Secret-Key Capacity - Authentication/ Authorization for Smart Devices - Transport Encryption – Attack & Fault trees.

UNIT - II	CRYPTOGRAPHIC FUNDAMENTALS FOR IOT	9

Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes – Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – IoT Node Authentication.

UNIT - III	IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR IOT	9

Identity lifecycle – authentication credentials – IoT IAM infrastructure – Authorization with Publish / Subscribe schemes – access control

UNIT - IV	PRIVACY PRESERVATION AND TRUST MODELS FOR IOT	9

Concerns in data dissemination – Lightweight and robust schemes for Privacy protection – Trust and Trust models for IoT – self-organizing Things - Preventing unauthorized access.

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UNIT - V	CLOUD SECURITY FOR IOT	9
Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Understand the IoT Security requirements.
CO2	Learn about cryptographic fundamentals for IoT.
CO3	Know the authentication credentials and access control.
CO4	Explain the various types Trust models.
CO5	Develop enterprise architecture with Cloud Security.

Reference Books	
1.	Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren.
2.	Securing the Internet of Things Elsevier.
3.	Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations.

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M.E - CSE	M19CSE302 - DATA VISUALIZATION TECHNIQUES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To develop skills to both design and critique visualizations.
2.	To introduce visual perception and core skills for visual analysis.
3.	To understand visualization for time-series and ranking analysis.
4.	To understand visualization for distribution and correlation analysis.
5.	To understand issues and best practices in information dashboard design.

UNIT - I	CORE SKILLS FOR VISUAL ANALYSIS	9

Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

UNIT - II	TIME-SERIES, RANKING, AND DEVIATION ANALYSIS	9

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

UNIT - III	DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS	9

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

UNIT - IV	INFORMATION DASHBOARD DESIGN	9

Information dashboard – Introduction – dashboard design issues and assessment of needs – Considerations for designing dashboard - visual perception – Achieving eloquence.

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UNIT - V	ADVANCED INFORMATION DASHBOARD DESIGN	9
Advantages of Graphics - Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media – Critical Design Practices – Putting it all together - Unveiling the dashboard.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Explain principles of visual perception.
CO2	Apply core skills for visual analysis.
CO3	Apply visualization techniques for various data analysis tasks.
CO4	Know information dashboard.
CO5	Design information dashboard.

Reference Books

1.	Ben Fry, “Visualizing data: Exploring and explaining data with the processing environment”, O'Reilly, 2008.
2.	Edward R. Tufte, “The visual display of quantitative information”, Second Edition, Graphics Press, 2001.
3.	Evan Stubbs, “The value of business analytics: Identifying the path to profitability”, Wiley, 2011.
4.	Gert H. N. Laursen and Jesper Thorlund, “Business Analytics for Managers: Taking business intelligence beyond reporting”, Wiley, 2010.
5.	Nathan Yau, “Data Points: Visualization that means something”, Wiley, 2013.
6.	Stephen Few, “Information dashboard design: Displaying data for at-a-glance monitoring”, second edition, Analytics Press, 2013.
7.	Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014.

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M.E - CSE	M19CSE303 - BLOCKCHAIN TECHNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand working of blockchain systems.
2.	To interact with blockchain systems.
3.	To design, build, and deploy smart contracts and distributed applications.
4.	To integrate ideas from blockchain technology into their own projects.
5.	To know about cryptocurrency.

UNIT - I	BASICS	9

Distributed Database - Two General Problem - Byzantine General problem and Fault Tolerance - Hadoop Distributed File System - Distributed Hash Table - ASIC resistance - Turing Complete. Cryptography: Hash function - Digital Signature – ECDSA - Memory Hard Algorithm - Zero Knowledge Proof.

UNIT - II	BLOCKCHAIN	9

Introduction - Advantage over conventional distributed database - Blockchain Network - Mining Mechanism - Distributed Consensus - Merkle Patricia Tree - Gas Limit - Transactions and Fee – Anonymity – Reward - Chain Policy - Life of Blockchain application - Soft & Hard Fork - Private and Public blockchain.

UNIT - III	DISTRIBUTED CONSENSUS	9

Nakamoto consensus - Proof of Work - Proof of Stake - Proof of Burn - Difficulty Level - Sybil Attack - Energy utilization and alternate.

UNIT - IV	CRYPTOCURRENCY	9

History - Distributed Ledger - Bitcoin protocols - Mining strategy and rewards - Ethereum – Construction – DAO - Smart Contract – GHOST – Vulnerability – Attacks – Sidechain - Namecoin.

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UNIT - V	CRYPTOCURRENCY REGULATION	9
Stakeholders - Roots of Bit coin - Legal Aspects - Crypto currency Exchange - Black Market and Global Economy. Applications: Internet of Things - Medical Record Management System - Domain Name Service and future of Blockchain.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Explain distributed database with cryptographic algorithms.
CO2	Explain the basics of blockchain.
CO3	Contrast the differences between proof-of-work and proof-of-stake consensus.
CO4	Experiment with a blockchain system by sending and reading transactions.
CO5	Design, build, and deploy a distributed application.

Reference Books	
1.	Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies : A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2.	Antonopoulos, Mastering Bitcoin : Unlocking Digital Cryptocurrencies.
3.	Satoshi Nakamoto, Bitcoin : A Peer-to-Peer Electronic Cash System.
4.	Gavin Wood, “ETHEREUM : A Secure Decentralized Transaction Ledger, Yellow paper, 2014.
5.	Nicola Atzei, Massimo Bartoletti, and TizianaCimoli, A survey of attacks on Ethereum smart contracts.

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M.E - CSE	M19CSE304 - PRODUCT DESIGN AND DEVELOPMENT	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the product design and development processes with its challenges.
2.	To identify customer needs with product specification.
3.	To understand the concept generation with industrial design.
4.	To know about concept selection and theory of inventive problem solving.
5.	To be familiar with the testing and Intellectual Property.

UNIT - I	INTRODUCTION	9

Significance of product design - product design and development process - sequential engineering design method - the challenges of product development; Product Planning and Project Selection: Identifying opportunities - evaluate and prioritize projects - allocation of resources.

UNIT - II	CUSTOMER NEEDS AND PRODUCT SPECIFICATIONS	9

Identifying Customer Needs: Interpret raw data in terms of customers need - organize needs in hierarchy and establish the relative importance of needs; Product Specifications: Establish target specifications-setting final specifications.

UNIT - III	CONCEPT GENERATION AND INDUSTRIAL DESIGN	9

Concept Generation: Activities of concept generation - clarifying problem - search both internally and externally - explore the output; Industrial Design: Assessing need for industrial design - industrial design process – management - assessing quality of industrial design.

UNIT - IV	CONCEPT SELECTION AND TRIZ	9

Concept Selection: Overview - concept screening and concept scoring - methods of selection. Theory of inventive problem solving (TRIZ): Fundamentals - methods and techniques - General Theory of Innovation and TRIZ - Value engineering Applications in Product development and design - Model-based technology for generating innovative ideas.

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UNIT - V	CONCEPT TESTING AND INTELLECTUAL PROPERTY	9
Concept Testing: Elements of testing - qualitative and quantitative methods including survey - measurement of customers' response; Intellectual Property: Elements and outline - patenting procedures - claim procedure; Design for Environment: Impact - regulations from government - ISO system.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Show the product design and development processes.
CO2	Interpret customer needs and product specification.
CO3	Apply concept generation in industrial design.
CO4	Explain concept selection and theory of inventive problem solving.
CO5	Outline testing and elements of Intellectual Property.

Reference Books	
1.	Ulrich K. T, and Eppinger S.D, Product Design and Development, Tata McGraw Hill.
2.	Otto K, and Wood K, Product Design, Pearson .
3.	Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, By Semyon D. Savransky, CRC Press.
4.	Inventive thinking through TRIZ: a practical guide, By Michael A. Orloff, Springer.
5.	Systematic innovation: an introduction to TRIZ ; (theory of inventive Problem Solving), By John Terninko, AllaZusman, CRC Press.

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M.E - CSE	M19CS305 - EMBEDDED SOFTWARE DEVELOPMENT	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the architecture of embedded processor, microcontroller and peripheral devices.
2.	To interface memory and peripherals with embedded systems.
3.	To study the embedded network environment.
4.	To understand challenges in Real time operating systems.
5.	To study, analyze and design applications on embedded systems.

UNIT - I	EMBEDDED PROCESSORS	9

Embedded Computers - Characteristics of Embedded Computing Applications - Challenges in Embedded Computing System Design - Embedded System Design Process - Formalism for System Design - Structural Description - Behavioral Description - ARM Processor - Intel ATOM Processor.

UNIT - II	EMBEDDED COMPUTING PLATFORM	9

CPU Bus Configuration - Memory Devices and Interfacing - Input/output Devices and Interfacing - System Design - Development and Debugging – Emulator – Simulator - JTAG Design Example – Alarm Clock - Analysis and Optimization of Performance - Power and Program Size.

UNIT - III	EMBEDDED NETWORK ENIVIRONMENT	9

Distributed Embedded Architecture - Hardware And Software Architectures - Networks for Embedded Systems - I2C - CAN Bus - SHARC Link Supports – Ethernet – Myrinet – Internet - Network-based Design - Communication Analysis - System Performance Analysis - Hardware Platform Design - Allocation and Scheduling - Design Example - Elevator Controller.

UNIT - IV	REAL-TIME CHARACTERISTICS	9

Clock Driven Approach - Weighted Round Robin Approach - Priority Driven Approach - Dynamic versus Static Systems - Effective Release Times and Deadlines - Optimality of the Earliest Deadline First (EDF) Algorithm - Challenges in Validating Timing Constraints in Priority Driven Systems - Off-Line versus On - Line Scheduling.

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UNIT - V	SYSTEM DESIGN TECHNIQUES	9
Design Methodologies - Requirement Analysis – Specification - System Analysis and Architecture Design - Quality Assurance - Design Examples - Telephone PBX - Ink jet printer - Personal Digital Assistants - Set-Top Boxes.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Understand different architectures of embedded processor, microcontroller and peripheral devices.
CO2	Outline memory and peripherals with embedded systems.
CO3	Illustrate embedded network environment.
CO4	Classify challenges in Real time operating systems.
CO5	Design and analyze applications on embedded systems.

Reference Books	
1.	Adrian McEwen, Hakim Cassimally, “Designing the Internet of Things”, Wiley Publication, First edition, 2013.
2.	Andrew N Sloss, D. Symes, C. Wright, “Arm system developers guide”, Morgan Kauffman/ Elsevier, 2006.
3.	Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-on-Approach”, VPT First Edition, 2014.
4.	C.M. Krishna and K. G. Shin, “Real-Time Systems”, McGraw-Hill, 1997.
5.	Frank Vahid and Tony Givargis, “Embedded System Design: A Unified Hardware/Software Introduction”, John Wiley & Sons.
6.	Jane.W.S. Liu, “Real-Time systems”, Pearson Education Asia.
7.	Michael J. Pont, “Embedded C”, Pearson Education , 2007.
8.	Muhammad Ali Mazidi ,SarmadNaimi , SepehrNaimi, "The AVR Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, First edition, 2014.
9.	Steve Heath, “Embedded System Design”, Elsevier, 2005.
10.	Wayne Wolf, “Computers as Components: Principles of Embedded Computer System Design”, Elsevier, 2006.

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Professional Elective - IV

M.E - CSE	M19CS306 - BIO INFORMATICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To get exposed to the fundamentals of bioinformatics.
2.	To learn bio-informatics algorithm and phylogenetic concept.
3.	To understand open problems and issues in replication and molecular clocks.
4.	To learn assemble genomes and corresponding theorem.
5.	To study and exposed to the domain of human genomics.

UNIT - I	INTRODUCTION AND FUNDAMENTALS	9

Fundamentals of genes,genomics, molecular evolution – genomic technologies – beginning of bioinformatics - genetic data –sequence data formats – secondary database – examples – data retrieval systems – genome browsers.

UNIT - II	BIOINFORMATICS ALGORITHM AND ANALYSIS	9

Sequence alignment and similarity searching in genomic databases: BLAST and FASTA – additional bioinformatics analysis involving nucleic acid sequences-additional bioinformatics analysis involving protein sequences – Phylogenetic Analysis.

UNIT - III	DNA REPLICATION AND MOLECULAR CLOCKS	9

Beginning of DNA replication – open problems – multiple replication and finding replication – computing probabilities of patterns in a string - the frequency array - converting patterns - solving problems - finding frequents words - Big - O notation – case study - The Tower of Hanoi problem.

UNIT - IV	ASSEMBLE GENOMES AND SEQUENCES	9

Methods of assemble genomes – string reconstruction – De Bruijn graph – Euler's theorem – assembling genomes – DNA sequencing technologies – sequence antibiotics – Brute Force Algorithm – Branch and Bound algorithm – open problems – comparing biological sequences - Case Study – Manhattan tourist Problem.

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UNIT - V	HUMAN GENOME	9
Human and mouse genomes - random breakage model of chromosome evolution – sorting by reversals – greedy heuristic approach – break points - rearrangements in tumor and break point genomes - break point graps - synteny block construction - open problems and technologies.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Explain the basics of genomics.
CO2	Contrast efficient algorithm and issues.
CO3	Apply the replication and molecular clocks in bioinformatics.
CO4	Experiment with genomes and sequences.
CO5	Illustrate the Microarray technologies for genome expression.

Reference Books	
1.	Ion Mandoiu and Alexander Zelikovsky , “Computational Methods for Next Generation Sequencing Data Analysis”, Wiley series, 2016.
2.	Istvan Miklos, RenyiInstitutue, “Introduction to algorithms in bioinformatics”, Springer 2016.
3.	Philip Compeau and Pavelpevzner, “Bioinformatics Algorithms: An Active Learning Approach”, Second edition volume I , Cousera, 2015.
4.	SupratimChoudhuri, “Bioinformatics for Beginners”, Elsevier, 2014.

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M.E - CSE	M19CS307 - INFORMATION STORAGE MANAGEMENT	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand various storage technologies.
2.	To understand the storage architectures.
3.	To learn to establish & manage data center.
4.	To learn network based storage techniques.
5.	To learn security aspects of storage & data center.

UNIT - I	STORAGE TECHNOLOGY	9

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities.

UNIT - II	STORAGE SYSTEMS ARCHITECTURE	9

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,Iligh-level architecture and working of an intelligent storage system.

UNIT - III	INTRODUCTION TO NETWORKED STORAGE	9

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments.

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UNIT - IV	INFORMATION AVAILABILITY & MANAGING DATACENTERS	9
List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime - Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center.		

UNIT - V	SECURING STORAGE AND STORAGE VIRTUALIZATION	9
Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.		
Total Instructional hours: 45		

Course Outcomes : Students will be able to	
CO1	Select from various storage technologies to suit for required application.
CO2	Explain different storage architectures.
CO3	Classify various network storage techniques.
CO4	Organize available information and disaster recovery system for data center.
CO5	Apply security measures to safeguard storage & farm.

Reference Books	
1.	EMC Corporation, “Information Storage and Management: Storing, Managing, and Protecting Digital Information”, Wiley, India, 2010
2.	Marc Farley, “Building Storage Networks”, Tata McGraw Hill, Osborne, 2001.
3.	Robert Spalding, “Storage Networks: The Complete Reference”, Tata McGraw Hill, Osborne, 2003.

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M.E - CSE	M19CSE308 - BIO-INSPIRED COMPUTING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To Learn bio-inspired theorem and algorithms.
2.	To Understand random walk and simulated annealing.
3.	To Learn genetic algorithm and differential evolution.
4.	To Learn swarm optimization and ant colony for feature selection.
5.	To understand bio-inspired application in image processing.

UNIT - I	INTRODUCTION	9

Introduction to algorithm - Newton's method - optimization algorithm - No-Free - Lunch Theorems - Nature - Inspired Mataheuristics - Analysis of Algorithms - Nature Inspires Algorithms - Parameter tuning and parameter control.

UNIT - II	RANDOM WALK AND ANEALING	9

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization - Eagle strategy- Annealing and Boltzmann Distribution - parameters - SA algorithm - Stochastic Tunnelling.

UNIT - III	GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION	9

Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA varients - schema theorem - convergence analysis - introduction to differential evolution - varients - choice of parameters - convergence analysis - implementation.

UNIT - IV	SWARM OPTIMIZATION AND FIREFLY ALGORITHM	9

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - varients - Ant colony optimization toward feature selection.

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UNIT - V	APPLICATION IN IMAGE PROCESSING	9
Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine-Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine - Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Develop and apply bio-inspired algorithms.
CO2	Explain the random walk and simulated annealing.
CO3	Identify and apply genetic algorithms.
CO4	Explain swarm intelligence and ant colony for feature selection.
CO5	Apply bio-inspired techniques in image processing.

Reference Books

1. Eiben, A.E., Smith, James E, “Introduction to Evolutionary Computing”, Springer, 2015.
2. Helio J.C. Barbosa, “Ant Colony Optimization - Techniques and Applications”, Intech, 2013.
3. Xin-She Yang, Joao Paulo papa, “Bio-Inspired Computing and Applications in Image Processing”, Elsevier, 2016
4. Xin-She Yang, “Nature Inspired Optimization Algorithm”, Elsevier First Edition, 2014.

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M.E - CSE	M19CSE309 - MOBILE APPLICATION DEVELOPMENT	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	Understand system requirements for mobile applications.
2.	Generate suitable design using specific mobile development frameworks.
3.	Generate mobile application design.
4.	Implement the design using specific mobile development frameworks.
5.	Deploy the mobile applications in marketplace for distribution.

UNIT - I	INTRODUCTION	9

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.

UNIT - II	BASIC DESIGN	9

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

UNIT - III	ADVANCED DESIGN	9

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT - IV	ANDROID	9

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

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UNIT - V	IOS	9
Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.		
		Total Instructional hours: 45

Course Outcomes : Students will be able to	
CO1	Show the requirements for mobile applications.
CO2	Explain the challenges in mobile application design and development.
CO3	Develop design for mobile applications for specific requirements.
CO4	Build applications using Android SDK.
CO5	Build applications using Objective C and iOS.

Reference Books	
1.	Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, DreamTech, 2012.
2.	David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS 6”
3.	“Development : Exploring the iOS SDK”, Apress, 2013.
4.	James Dovey and Ash Furrow, “Beginning Objective C”, Apress, 2012.
5.	Jeff McWherter and Scott Gowell, “Professional Mobile Application Development”, Wrox, 2012.
6.	Reto Meier, “Professional android Development”, Wiley-India Edition, 2012.

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M.E - CSE	M19CSE310 - SOCIAL NETWORK ANALYSIS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the components of the social network.
2.	To model and visualize the social network.
3.	To mine the users in the social network.
4.	To understand the evolution of the social network.
5.	To know the applications in real time systems.

UNIT - I	INTRODUCTION	9

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

UNIT - II	MODELING AND VISUALIZATION	9

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality - Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations - Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications – Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

UNIT - III	MINING COMMUNITIES	9

Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

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UNIT - IV	EVOLUTION	9
Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.		

UNIT - V	APPLICATIONS	9
A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection.		
	Total Instructional hours: 45	

Course Outcomes : Students will be able to	
CO1	Outline the internals components of the social network.
CO2	Model and visualize the social network.
CO3	Experiment with the behavior of the users in the social network.
CO4	Analyze the possible next outcome of the social network.
CO5	Apply social network in real time applications.

Reference Books	
1.	Ajith Abraham, Aboul Ella Hassanien, VáclavSnášel, “Computational Social Network Analysis: Trends, Tools and Research Advances”, Springer, 2012.
2.	BorkoFurht, “Handbook of Social Network Technologies and Applications”, Springer, 1st edition, 2011.
3.	Charu C. Aggarwal, “Social Network Data Analytics”, Springer, 2014 .

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4.	Giles, Mark Smith, John Yen, “Advances in Social Network Mining and Analysis”, Springer, 2010.
5.	GuandongXu ,Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, Springer, 1st edition, 2012.
6.	Peter Mika, “Social Networks and the Semantic Web”, Springer, 1st edition, 2007.
7.	Przemyslaw Kazienko, NiteshChawla, “Applications of Social Media and Social Network Analysis”, Springer, 2015.

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M.E - CSE	M19CSP301 - PROJECT WORK (PHASE - I)	T	P	TU	C
		0	12	0	6

Course Objectives	
1.	To enable a student to do an individual project work which may involve design, modelling, simulation and/or fabrication.
2.	To analyse a problem both theoretically and practically.
3.	To motivate the students to involve in research activities leading to innovative solutions for industrial and societal problems.

Course Description

Project work shall be carried out by each and every individual student under the supervision of a faculty of this department. A student may however, in certain cases, be permitted to work for the project in association with other departments or in an Industrial / Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization. The student shall meet the supervisor periodically and attend the periodic reviews for evaluating the progress.

Project work will be carried out in two phases, Phase - I during the third semester and Phase - II during the final semester. Phase - II shall be pursued for 24 periods per week. In phase II also, there will be three reviews for continuous internal assessment and one final review and viva voce at the end of the semesters. The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

Course Outcomes : Students will be able to	
CO1	Identify the problem by applying acquired knowledge
CO2	Construct and organize executable project modules through proper designing.
CO3	Choose efficient tools for implementation of the designed modules.
CO4	Analyze and categorize the outcomes of the implementation and derive inferences.
CO5	Examine the completed task and compile the project report.

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M.E - CSE	M19CSP401 - PROJECT WORK (PHASE - II)	T	P	TU	C
		0	24	0	12

Course Objectives	
1.	To enable a student to do an individual project work which may involve design, modelling, simulation and/or fabrication.
2.	To analyse a problem both theoretically and practically.
3.	To motivate the students to involve in research activities leading to innovative solutions for industrial and societal problems.

Course Description

Project work shall be carried out by each and every individual student under the supervision of a faculty of this department. A student may however, in certain cases, be permitted to work for the project in association with other departments or in an Industrial / Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization. The student shall meet the supervisor periodically and attend the periodic reviews for evaluating the progress.

Project work will be carried out in two phases, Phase - I during the third semester and Phase - 2 during the final semester. Phase - II shall be pursued for 24 periods per week. In phase - II also, there will be three reviews for continuous internal assessment and one final review and viva voce at the end of the semesters. The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

Course Outcomes : Students will be able to	
CO1	Design and develop the project, creativity and choose the most appropriate option for the Phase - II project.
CO2	Effectively communicate technical project information in writing / Seminar Presentation / Technical Discussion.
CO3	Apply modern engineering tools for simulation, analysis and Solution.
CO4	Present the findings of the project by attending conference and communicate to journals for publication.
CO5	Engage in continuously learning the new practices, principles, and techniques using Computational solutions.

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