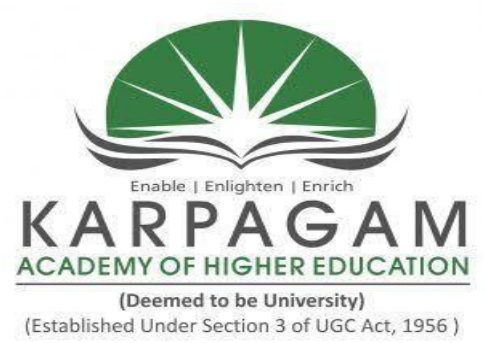
M.E. COMPUTER SCIENCE AND ENGINEERING

SYLLABI 2025-2026

(CHOICE BASED CREDIT SYSTEM)

Department of Computer Science and Engineering

FACULTY OF ENGINEERING



KARPAGAM ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act 1956)

(Accredited with A+ Grade by NAAC in the Second Cycle)

Pollachi Main Road, Eachanari Post

Coimbatore-641 021

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Coimbatore – 641 021. INDIA

FACULTY OF ENGINEERING

POST–GRADUATE PROGRAMME
REGULAR PROGRAMME
REGULATIONS 2025-2026
(CHOICE BASED CREDIT SYSTEM)

These Regulations are effective from the academic year 2025-2026 and applicable to the students admitted to M. E. / M. Tech. Programmes during the academic year 2025- 2026 and onwards.

1. PROGRAMMES OFFERED, MODE OF STUDY AND ADMISSION REQUIREMENTS.

1.1 PROGRAMMES OFFERED:

M. E. and M. Tech.

The various P.G. Programmes offered by the Karpagam Academy of Higher Education are listed in Table 1.

Table – 1

M. E./M. TECH. DEGREE (REGULAR) PROGRAMMES

Sl. No.	Name of the Programme
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING	
1.	M.E Computer Science and Engineering
DEPARTMENT OF CIVIL ENGINEERING	
1.	M.E Structural Engineering.
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING	
1.	M.E. Power Systems Engineering
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING	

1.	M.E VLSI Design
DEPARTMENT OF MECHANICAL ENGINEERING	
1.	M.E CAD/CAM Robotics

1.2 MODE OF STUDY:

1.2.1 Full–Time:

Candidates admitted under 'Full–Time' should be available in the Karpagam Academy of Higher Education during the complete working hours for curricular, co–curricular and extra– curricular activities assigned to them.

1.2.2 Change from one programme to another programme is not permitted.

1.3 ADMISSION REQUIREMENTS:

Candidates for admission to the Master's Degree Programme shall be required to have passed an appropriate Degree Examination of any University accepted by the Board of Management of Karpagam Academy of Higher Education as equivalent thereto. Admission shall be offered only to the candidates who possess the qualification prescribed against each course, given in the Table–2.

Table – 2

M. E. / M.TECH. PROGRAMMES QUALIFICATIONS FOR ADMISSION

S. No.	Degree and branch of study	Qualification for Admission
1.	M.E Computer Science and Engineering	B.E./B. Tech. – Computer Science and Engineering/ Information Technology/ Artificial Intelligence and Data Science/ Cyber Security/ Computer Science and Business System/ Computer Science and Design
2.	M.E Structural Engineering.	B.E./B. Tech. – Civil Engineering
3.	M. E. Power Systems Engineering	B. E./B.Tech. – Electrical and Electronics Engineering / Electronics and Communication Engineering
4.	M.E VLSI Design	B.E/B.Tech. – Electrical and Electronics Engineering / Electronics and Communication Engineering
5.	M.E CAD/CAM Robotics	B.E / B.Tech Mechanical Engineering

2 DURATION OF THE PROGRAMMES:

2.1 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.	4	8

2.2 Each semester shall normally consist of 90 working days or 360 hours for full–time mode of study. The Dean and HOD shall ensure that every teacher imparts instruction as per the number of periods specified in the syllabus and that the teacher teaches the full content of the specified syllabus for the course being taught.

2.3 The prescribed credits required for the award of degree shall be within the limits specified below.

PROGRAMME	PRESCRIBED CREDIT RANGE
M. E./M. Tech.	**65 to 75**

2.4 Credits will be assigned to the courses for different modes of study as given below:

No. of credits per lecture period per week	1
No. of credits per tutorial period per week	1
No. of credits for 3 periods of laboratory course per week	2
No. of credits for 3 periods of project work per week	2

3. STRUCTURE OF THE PROGRAMME

3.1 Every programme will have a curriculum and syllabi consisting of core theory courses, elective courses, seminars / practical courses and project work.

3.1.1 The elective courses from the curriculum are to be chosen with prior approval from the Head of the Department.

3.1.2 The medium of instruction for all courses, examinations, seminar presentations and project thesis shall be English**.**

3.1.3 Choice Based Credit System is implemented offering choice in professional core and professional electives.

3.2 MAXIMUM MARKS

3.2.1 The maximum marks assigned to different courses shall be as given below:

Each of the theory and practical course (excluding project work) shall carry maximum of 100 marks of which 40 marks will be through Continuous Internal Assessment (CIA) and 60 marks through End Semester Examination (ESE).

3.3 PROJECT WORK

The project work for M. E./ M. Tech. consists of two Phases, Phase– I and Phase – II. Phase – I is to be undertaken during III semester and Phase – II during IV semester.

All the students are advised to do their project work within the campus. However, as a special case, if a student is able to get a project from a government organization or private or public sector company with a turnover of about Rs.50 crore, he/she may be permitted to do his/her project work in that institution/research organization/industry.

4. EVALUATION OF PROJECT WORK

The evaluation of Project Work for Phase I & Phase II shall be done independently in the respective semesters. The total marks for project work including Phase I and II are 400. The project work pertained to Phase I is evaluated through Continuous Internal Assessment only. No End Semester Examination will be conducted for the Phase I. The maximum internal marks for Phase I is 100. For Phase – II, the maximum internal mark is 120 and the maximum End Semester Examination mark is 180. The total marks for Phase – II is 300. The overall passing minimum is 50%.

4.1 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 CoE through the HoD and the Dean.

4.2 The evaluation of the Project work Phase – I will be purely internal by forming a committee by HoD / Dean. During CIA of Phase – I, there will be a Viva–Voce Examination by a team consisting of the Supervisor, and an Internal Examiner (other than the Supervisor). The evaluation of the Project work Phase – II will be based on the project report submitted in Phase – II and a Viva–Voce Examination by a team consisting of the Supervisor, an Internal Examiner and an External Examiner for each programme. The External Examiner shall be appointed by the Karpagam Academy of Higher Education for Phase – II evaluation.

4.3 If a candidate fails to submit the project report on or before the specified deadline, he/she is deemed to have failed in the project work and shall re–enroll for the same in the subsequent semester.

4.4 If a candidate fails in the Viva–Voce examinations of Phase–I, he/she has to resubmit the project report within 30 days from the date of declaration of the results. If he/she fails in the Viva–Voce examination of Phase–II of project work, he/she shall resubmit the project report within 60 days from the date of declaration of the results. For this purpose, the same Internal and External Examiner shall evaluate the resubmitted report.

4.5 Every candidate shall publish a paper of his or her findings in a peer reviewed journal or present in an International Conference or apply for a patent out of his / her project work. Reprints of the journal publication / acceptance letter from the journal publisher or Proceedings of the International conference/ acceptance letter from the Conference Organizer or application of patent shall be attached to the report of the project work. Such acknowledgements shall be sent to the Controller of Examinations along with the evaluation marks by the team of examiners without which the thesis shall not be accepted.

4.6 A copy of the approved project report after the successful completion of Viva– Voce Examination shall be kept in the respective department as well as in the Karpagam Academy of Higher Education library.

5 REQUIREMENTS FOR COMPLETION OF THE SEMESTER

5.1 A candidate will be permitted to take the End Semester Examination of any semester, if

i) the candidate secures not less than 75% of attendance during the semester and

ii) the conduct of the candidate has been satisfactory

5.2 A candidate who has secured attendance between 65% and 74% (both included), due to medical reasons (Hospitalization / Accident / Specific Illness) or due to participation in Karpagam Academy of Higher Education / District / State / National / International level sports or due to participation in Seminar / Conference / Workshop / Training Programme /Voluntary Service / Extension activities or similar programmes with prior

permission from the Registrar shall be given exemption from prescribed attendance requirements and shall be permitted to take the examination on the recommendation of the concerned Head of the Department and Dean to condone the lack of attendance. The Head of the Department has to verify and certify the genuineness of the case before recommending to the Dean.

5.3 However, a candidate who has secured attendance less than 65% in the current semester shall not be permitted to appear for the current ESE. But he/she will be permitted to appear for his/her arrear examination if any and he/she has to re do the course by rejoining the semester in which attendance is less than 65% with proper approval of the "Students' Affairs Committee" and Registrar.

6 CLASS ADVISORS

To help the students in planning their courses of study and for general advice on the academic programme, the Head of the Department will attach a certain number of students to a teacher of the Department who shall function as Class Advisor for those students throughout their period of study. Such Class Advisors shall advise the students and monitor the courses undergone by the students, check the attendance and progress of the students attached to him/her and counsel them periodically. If necessary, the Class Advisormay display the cumulative attendance particulars in the Department Notice Board.

7 CLASS COMMITTEE

7.1. Every class shall have a class committee consisting of teachers of the class concerned, student representatives [two boys and two girls] and the concerned Head of the Department. It is like the 'Quality Circle' with the overall goal of improving the teaching–learning process. The functions of the class committee include

- Solving problems experienced by students in the class room and in the laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein particularly Clause 2 and 3 which should be displayed on department Notice–Board.
- Informing the student representatives, the details of Regulations regarding weightage used for each assessment.

- Informing the student representatives, the academic schedule including thedates of assessments and the syllabus coverage for each assessment.
- In the case of practical courses (laboratory / project work, etc.) the breakup of marks for each experiment / exercise / module of work, should be clearly discussed in the class committee meeting and informed to the students.
- Analyzing the performance of the students of the class after each test and finding the ways and means of solving problems, if any.
- Identifying the weak students, if any, and requesting the teachers concerned to provide some additional academic support to them.

7.2 The class committee shall be constituted within the first week of each semester.

7.3 At least 4 student representatives (usually 2 boys and 2 girls) shall be included in the class committee.

7.4 The Chairperson of the Class Committee may convene the meeting of the class committee.

7.5 The Dean may participate in any Class Committee of the Faculty.

7.6 The Chairperson is required to prepare the minutes of every meeting, submit the same to Dean within two days of the meeting and arrange to circulate it among the students and teachers concerned. If there are some points in the minutes requiring action by the Management, the same shall be brought to the notice of the Registrar by the HOD through the Dean.

7.7 The first meeting of the Class Committee shall be held within one week from the date of commencement of the semester, in order to inform the students about the nature and weightage of assessments within the framework of the regulations. Two or three subsequent meetings may be held in a semester at suitable intervals. During these meetings the student members representing the entire class, shall meaningfully interact and express their opinions and suggestions of the other students of the class in order to improve the effectiveness of the teaching–learning process.

8. COURSE COMMITTEE FOR COMMON COURSES

Each common theory course offered to more than one discipline or group, shall have a“Course Committee” comprising all the teachers handling the common course with one of

them nominated as Course Coordinator. The nomination of the Course Coordinator shall be made by the Dean depending upon whether all the teachers teaching the common course belong to a single department or to several departments. The 'Course Committee' shall meet in order to arrive at a common scheme of evaluation for the test and shall ensurea uniform evaluation of the tests. Where ever feasible, the Course Committee may also prepare a common question paper for the Internal Assessment test(s).

9. PROCEDURE FOR AWARDING MARKS FOR INTERNAL ASSESSMENT

9.1 Every teacher is required to maintain an 'ATTENDANCE AND ASSESSMENT RECORD' which consists of attendance marked in each theory or practical or project work class, the test marks and the record of class work (topic covered), separately for each course.

9.2 Continuous Internal Assessment (CIA):

The performance of students in each subject will be continuously assessed by the respective teachers as per the guidelines given below:

THEORY COURSES:

S. No.	CATEGORY	MAXIMUM MARKS
1.	Paper Presentation *****	15
2.	Attendance	5
3.	Test – I #	10
4.	Test – II #	10
	TOTAL	40

***** One refereed journal paper related to the subject and approved by the teacher should be critically presented. The Paper Presentation should be evaluated by a committee and marks should be entered in Automation software on or before 60th working day of the semester.

The test scripts should be evaluated and marks should be entered in Automation software on or before 4th working day after the last test.

PATTERN OF TEST QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	60
Duration	2 Hours
Part- A	1 to 9 Two Mark Questions, uniformly covering the two units of the syllabus. All the 9 Questions are to be answered. (**9 x 2 =18Marks)**.
Part- B	Question 10 to 12 will be of either-or type, covering two units of the syllabus. Each Question may have subdivision. (**3 x 14 =42 Marks)**.

PRACTICAL COURSES:

S. No	CATEGORY	MAXIMUM MARKS
1.	Attendance	5
2.	Observation work	5
3.	Record work	5
4.	Model examination	15
5.	Viva – voce [Comprehensive]	10
	TOTAL	40

Every practical exercise / experiment shall be evaluated based on the conduct of exercise/ experiment and records maintained.

9.3 ATTENDANCE

MARKS DISTRIBUTION FOR ATTENDANCE

S. No.	Attendance %	Marks
1	91 and above	5.0
2	81-90	4.0
3	76-80	3.0

10. REQUIREMENTS FOR APPEARING FOR END SEMESTER EXAMINATION (ESE)

A candidate shall normally be permitted to appear for the ESE of any semester commencing from I semester if he/she has satisfied the semester completion requirements (Subject to Clause 5) and has registered for examination in all courses of the semester. Registration is mandatory for Semester Examinations as well as supplementary examinations failing which the candidate will not be permitted to move to the higher semester.

A candidate already appeared for a subject in a semester and passed the examination is not entitled to reappear in the same subject for improvement of grade.

11. END SEMESTER EXAMINATION

ESE will be held at the end of each semester for each subject, for 100 marks, later scaled down to 60 marks.

PATTERN OF ESE QUESTION PAPER:

INSTRUCTION	REMARKS
Maximum Marks	100 marks for all Semester Examinations.
Duration	3 Hours
Part - A	Question 1 to 10 Two Mark Questions, uniformly covering the Five units of the syllabus. All the 10 Questions are to be answered. (**10 *2= 20Marks)**.
Part- B	Question 11 to 15 will be of either-or type, covering the Five units of the syllabus. Each Question may have subdivision. **(5*16=80 Marks)**

12. PASSING REQUIREMENTS

12.1 Passing minimum: The passing minimum for CIA is 20 (i.e. out of 40 marks). The passing minimum for End Semester Examination is 30 (i.e. out of 60 marks).

The overall passing minimum for theory/laboratory course is 50 (Sum of his/her score in internal and external examination) out of 100 marks.

12.2 If the candidate fails to secure a pass in a particular course ESE, it is mandatory that candidate shall register and reappear for the examination in that course during the subsequent semester when examination is conducted in that course. Further, the candidate should continue to register and reappear for the examination till a pass is secured in such supplementary exam within the stipulated maximum duration of the programme (Clause 2.1).

The CIA marks obtained by the candidate in his/her first or subsequent appearance where he/she secures a pass shall be retained by the office of the Controller of Examinations and

considered valid for all remaining attempts till the candidate secures a pass in his/her ESE.

12.3 If a candidate fails to secure a pass in a particular course CIA, it is mandatory that candidate shall register and reappear for the CIA in that course during the subsequent semester when CIA is conducted in that course by the faculty member assigned for that particular course during that semester by the concerned HOD. Further, the candidate shouldcontinue to register and reappear for the CIA till a pass is secured in such supplementary exam within the stipulated maximum duration of the programme (Clause 2.1).

13. AWARD OF LETTER GRADES

13.1 All assessments of a course will be done on absolute mark 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:

Letter grade	Marks Range	Grade Point	Description
O	91 - 100	10	OUTSTANDING
A+	81- 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66- 70	7	GOOD
B	61 – 65	6	ABOVE AVERAGE
C	55 - 60	5	AVERAGE
D	50 - 54	4	PASS
RA	<50	-	REAPPEARANCE
AAA		0	ABSENT

13.2 GRADE SHEET

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

i) The list of courses enrolled during the semester and the grade scored.

ii) The Grade Point Average (**GPA**) for the semester and

iii) The Cumulative Grade Point Average (**CGPA**) of all courses enrolled from first semester onwards.

GPA is the ratio of the sum of the products of the number of Credits (**C**) of courses enrolled and the Grade Points (**GP**) corresponding to the grades scored in those courses, taken for all the courses to the sum of the number of credits of all the courses in the semester.

CGPA will be calculated in a similar manner, considering all the courses enrolled from first semester. **RA** grade will be excluded for calculating **GPA** and **CGPA**.

$$GPA = \frac{\text{Sum of } [C * GP]}{\text{Sum of } C}$$

13.3 REVALUATION

A candidate can apply for revaluation of his/her semester examination answer paper in a theory course, within 2 weeks from the declaration of results, on payment of a prescribed fee through proper application to the Controller of Examinations through the Head of the Department and Dean. A candidate can apply for revaluation of answer scripts for not exceeding 5 subjects at a time. The Controller of Examinations will arrange for the revaluation and the results will be intimated to the candidate through the Head of the Department and Dean. Revaluation is not permitted for Supplementary examination, Practical examination and Project Work.

14. ELIGIBILITY FOR AWARD OF DEGREE

A student shall be declared to be eligible for award of Degree if he/she has

- Successfully gained required number of total credits as specified in the curriculum corresponding to his/her programme within the stipulated time.
- No disciplinary action is pending against him/her.

The award of degree must be approved by the Board of Management of Karpagam Academy of Higher Education.

15. CLASSIFICATION OF THE DEGREE AWARDED

15.1 A candidate who qualifies for the award of the Degree (vide Clause 14) having passed the examination in all the courses in his/her first appearance within the specified minimum number of semesters (vide Clause 2.1) securing a CGPA of not less than 8.0 shall be declared to have passed the examination in First Class with Distinction.

15.2 A candidate who qualifies for the award of the Degree (vide Clause 14) having passed the examination in all the courses within the specified minimum number of semesters (vide Clause 2.1) plus one semester securing CGPA of not less than

6.5shall be declared to have passed the examination in First Class. For this purpose, the withdrawal from examination (vide Clause 16) will not be construed as an appearance. Further, the authorized break of study (vide Clause 18) will not be counted for the purpose of classification.

15.3 All other candidates (not covered in Clauses 15.1 and 15.2) who qualify for the award of the degree (vide Clause 14) shall be declared to have passed the examination in **Second Class**.

16. PROVISION FOR WITHDRAWAL FROM END–SEMESTER EXAMINATION

16.1 A candidate may for valid reasons and on prior application, be granted permission to withdraw from appearing for the examination of any one course or consecutive examinations of more than one course in a semester examination. Withdrawal application shall be valid only if the candidate is otherwise eligible to write the examination.

16.2 Such withdrawal shall be permitted only once during the entire period of study of the degree programme.

16.3 Withdrawal application is valid only if it is made within 10 days prior to the commencement of the examination in that course or courses and recommended by the Head of the Department and Dean and approved by the Registrar.

16.3.1 Notwithstanding the requirement of mandatory TEN days' notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

16.4 Withdrawal shall not be construed as an appearance for the eligibility of a candidate for First Class with Distinction. This provision is not applicable to those who seek withdrawal during IV semester.

16.5 Withdrawal from the ESE is **NOT** applicable to supplementary courses.

16.6 The candidate shall reappear for the withdrawn courses during the examination conducted in the subsequent semester.

17. PROVISION FOR AUTHORISED BREAK OF STUDY

17.1 Break of Study shall be granted only once for valid reasons for a maximum of one year during the entire period of study of the degree programme. However, in extraordinary situation the candidate may apply for additional break of study not exceeding another one year by paying prescribed fee for break of study. If a candidate intends to temporarily

discontinue the programme in the middle of the semester for valid reasons and to rejoin the programme in a subsequent year, permission may be granted based on the merits of the case provided he/she applies to the Registrar, but not later than the last date for registering for the ESE of the semester in question, through the Head of the Department and Dean stating the reasons thereof and the probable date of rejoining the programme.

17.2 The candidate thus permitted to rejoin the programme after the break shall be governed by the curriculum and regulations in force at the time of rejoining. Such candidates may have to do additional courses, if any as per the curriculum and regulations in force at that period of time.

17.3 The authorized break of study (for a maximum of one year) will not be counted for the duration specified for passing all the courses for the purpose of classification (vide Clause15). However, additional break of study granted will be counted for the purpose of classification.

17.4 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 2.1 irrespective of the period of break of study (vide Clause 18.1) in order that he/she may be eligible for the award of the degree.

17.5 If any student is detained for want of requisite attendance, progress and good conduct, the period spent in that semester shall not be considered as permitted 'Withdrawal' or 'Break of Study' Clause 16 and 18 respectively is not applicable for this case.

18. SPECIAL SUPPLEMENTARY ESE

After the publication of IV semester results, if a student has an arrear in any theory course of the entire programme, he/she will be permitted to apply within 15 days of the publication of results, and appear for a special supplementary examination.

19. DISCIPLINE

Every student is required to observe disciplined and decorous behavior both inside and outside the Karpagam Academy of Higher Education and not to indulge in any activity which will tend to bring down the prestige of the Karpagam Academy of Higher Education. The erring student will be referred to the Disciplinary Committee constituted by the Karpagam Academy of Higher Education, to inquire into acts of indiscipline and recommend to the Karpagam Academy of Higher Education about the disciplinary action to be taken.

If a student indulges in malpractice in any of the CIA/ESE he/she shall be liable for punitive action as prescribed by the Karpagam Academy of Higher Education from time to time.

20. REVISION OF REGULATION AND CURRICULUM

The Karpagam Academy of Higher Education may from time to time revise, amend or change the Regulations, Scheme of Examinations and syllabi if found necessary on the recommendations of Board of Studies, Academic Council and Board of Management of Karpagam Academy of Higher Education.

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(Deemed to be University)
(Established Under Section 3 of UGC Act 1956)
Accredited with A+ Grade by NAAC in the Second cycle
FACULTY OF ENGINEERING
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
POST-GRADUATE PROGRAMME

List of PEOs, POs and PSOs

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. To equip graduates to pursue research, succeed in academia or industries related to Computer Science and Engineering or thrive as entrepreneurs.
2. To ensure that graduates possess the ability and mind-set to acquire new skills and adapt to emerging technological advancements.
3. To ensure that graduates will be professional, follow ethics in their work and contributing for the benefits to the society.

PROGRAMME OUTCOMES (POs)

1. Independently carry out research / investigation, identify problems and develop solutions tosolve practical problems.
2. Write and present a substantial technical report / document.
3. Demonstrate a degree of mastery over the area as per the specialization of the program.
4. Use research-based knowledge, method, appropriate techniques, resources and tools to solve complex engineering issues.
5. Ensure development of socially relevant and ecofriendly indigenous products by applying technical knowledge, ethical principles and engineering practices.
6. Recognize the need for independent, life-long learning and engage in the broadest context of technological change.

PROGRAM SPECFIC OUTCOMES (PSOs):

1. Design and analyze software systems by applying the knowledge acquired in the field of Computer Science and Engineering
2. Develop innovative, research-oriented methodologies to address gaps using emerging technologies, apply ethical principles and committing to professional and social responsibilities.

MAPPING:

PEO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
PEO I	3	3	3	3	1	2	3	3
PEO II	3	2	3	2	1	2	3	2
PEO III	2	2	2	2	1	2	3	2

Contribution 1: Reasonable 2: Significant 3: Strong

Credit Distribution:

S.No	Course Category	Credit Distribution	Percentage
1	**Humanities and Science**	**7**	**10.1**
2	**Professional Core**	**29**	**42.0**
3	**Professional Elective**	**15**	**21.8**
4	**Project Work**	**18**	**26.1**
Total		**69**	**100**

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FACULTY OF ENGINEERING
PG PROGRAM (CBCS) – M.E – CSE (FULL TIME)
(2025-2026 Batch and onwards)

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER I												
25MECC101	Applied Mathematics	HS	1,3,4,6	1	3	1	0	4	40	60	100	1
25MECS102	Advanced Data Structures and Algorithms	PC	1,3,4,6	1	3	0	0	3	40	60	100	3
25MECS103	Advanced Operating Systems	PC	1,3,4,6	1	3	0	0	3	40	60	100	5
25MECS104	Advanced Database Technology	PC	1,3,4,6	1	3	0	0	3	40	60	100	7
25MECS105	Network Technologies	PC	1,3,4,6	1	3	0	0	3	40	60	100	9
25MECS111	Advanced Data Structures Laboratory	PC	1,2,3,4,6	1	0	0	4	2	40	60	100	11
25MECS112	Advanced Database Technology Laboratory	PC	1,2,3,4,6	1	0	0	4	2	40	60	100	13
SEMESTER TOTAL					**15**	**1**	**8**	**20**	**280**	**420**	**700**	

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
SEMESTER II												
25MECS201	Internet of Things	PC	1,3,4,5,6	2	3	0	0	3	40	60	100	15
25MECS202	Machine Learning	PC	1,3,4,6	2	3	0	0	3	40	60	100	17
25MECS203	Advanced Software Engineering	PC	1,2,3,4,5,6	1	3	0	0	3	40	60	100	19
25MECS2E*	Professional Elective I	PE			3	0	0	3	40	60	100	29-40
25MECS2E*	Professional Elective II	PE			3	0	0	3	40	60	100	41-55
25MECS211	Machine Learning Laboratory	PC	1,2,3,4,5,6	2	0	0	4	2	40	60	100	21
25MECS212	Software Engineering Laboratory	PC	1,2,3,4,5,6	1	0	0	4	2	40	60	100	24

SEMESTER TOTAL					**15**	**0**	**8**	**19**	**280**	**420**	**700**	
Course Code	**Name of the course**	**Category**	**Outcomes**		**Instruction hours/week**			**Credits**	**Maximum Marks**			**Page No**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									40	**60**	**100**	
SEMESTER III												
25MECS301	Research Methodology and IPR	HS	1,2,3,4,5,6	2	3	0	0	3	40	60	100	26
25MECS3E*	Professional Elective III	PE			3	0	0	3	40	60	100	56-67
25MECS3E*	Professional Elective IV	PE			3	0	0	3	40	60	100	68-80
25MECS3E*	Professional Elective V	PE			3	0	0	3	40	60	100	81-92
25MECS391	Project Work Phase I	PW	1,2,3,4,5,6	2	0	0	12	6	40	60	100	94
SEMESTER TOTAL					**12**	**0**	**12**	**18**	**200**	**300**	**500**	
Course Code	**Name of the course**	**Category**	**Outcomes**		**Instruction hours/week**			**Credits**	**Maximum Marks**			**Page No**
			PO	**PSO**	**L**	**T**	**P**		**CIA**	**ESE**	**Total**	
									40	**60**	**100**	
SEMESTER IV												
25MECS491	Project Work and Viva Voce Phase II	PW	1,2,3,4,5,6	2	0	0	24	12	120	180	300	95
SEMESTER TOTAL					**0**	**0**	**24**	**12**	**120**	**180**	**300**	
TOTAL					**42**	**1**	**52**	**69**	**880**	**1320**	**2200**	

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
FACULTY OF ENGINEERING
PG PROGRAM (CBCS) – M.E –CSE (FULL TIME)
(2025–2026 Batch and onwards)

LIST OF PROFESSIONAL ELECTIVES

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
PROFESSIONAL ELECTIVE-I												
25MECS2E01	Database Administration and Tuning	PE	1,3,4,6	1	3	0	0	3	40	60	100	29
25MECS2E02	Cloud Computing Technologies	PE	1,3,4,6	2	3	0	0	3	40	60	100	31
25MECS2E03	Ethical Hacking	PE	1,3,4,5,6	2	3	0	0	3	40	60	100	33
25MECS2E04	Optimizations for Machine Learning	PE	1,3,4,6	2	3	0	0	3	40	60	100	35
25MECS2E05	Multimedia Systems and Applications	PE	1,3,4,6	1	3	0	0	3	40	60	100	37
25MECS2E06	Full Stack Web Application Development	PE	1,3,4,5,6	2	3	0	0	3	40	60	100	39
PROFESSIONAL ELECTIVE-II												
25MECS2E07	Data Warehousing and Data Mining Techniques	PE	1,3,4,5,6	2	3	0	0	3	40	60	100	41
25MECS2E08	Virtualization Techniques	PE	1,3,4,6	2	3	0	0	3	40	60	100	44
25MECS2E09	Social Network Security	PE	1,3,4,5,6	2	3	0	0	3	40	60	100	47
25MECS2E10	Deep Learning	PE	1,2,3,4,6	2	3	0	0	3	40	60	100	49
25MECS2E11	Digital Image and Video Processing	PE	1,3,4,6	2	3	0	0	3	40	60	100	52
25MECS2E12	Web Content Design and Management	PE	1,3,4,5,6	1	3	0	0	3	40	60	100	54
PROFESSIONAL ELECTIVE-III												
25MECS3E01	Data Science	PE	1,3,4,5,6	2	3	0	0	3	40	60	100	56
25MECS3E02	Parallel Algorithms	PE	1,3,4,6	1	3	0	0	3	40	60	100	58
25MECS3E03	Cyber Physical System	PE	1,3,4,5,6	2	3	0	0	3	40	60	100	60
25MECS3E04	Soft Computing	PE	1,3,4,6	2	3	0	0	3	40	60	100	62
25MECS3E05	Game Theory	PE	1,3,4,6	2	3	0	0	3	40	60	100	64
25MECS3E06	Web Analytics	PE	1,3,4,6	2	3	0	0	3	40	60	100	66

Course Code	Name of the course	Category	Outcomes		Instruction hours/week			Credits	Maximum Marks			Page No
			PO	PSO	L	T	P		CIA	ESE	Total	
									40	60	100	
PROFESSIONAL ELECTIVE-IV												
25MECS3E07	Big Data Mining and Analytics	PE	1,3,4,6	2	3	0	0	3	40	60	100	68
25MECS3E08	Software Defined Networks	PE	1,3,4,6	2	3	0	0	3	40	60	100	70
25MECS3E09	Social Network Analysis	PE	1,3,4,5,6	2	3	0	0	3	40	60	100	72
25MECS3E10	Statistical Natural Language Processing	PE	1,3,4,6	2	3	0	0	3	40	60	100	75
25MECS3E11	Visualization Techniques	PE	1,3,4,6	2	3	0	0	3	40	60	100	77
25MECS3E12	Mobile Application Development	PE	1,3,4,5,6	2	3	0	0	3	40	60	100	79
PROFESSIONAL ELECTIVE-V												
25MECS3E13	High performance Computing for Bigdata	PE	1,3,4,6	2	3	0	0	3	40	60	100	81
25MECS3E14	Security and Privacy in cloud	PE	1,3,4,5,6	2	3	0	0	3	40	60	100	83
25MECS3E15	Blockchain Technologies	PE	1,3,4,5,6	2	3	0	0	3	40	60	100	85
25MECS3E16	Speech Processing and Synthesis	PE	1,3,4,6	2	3	0	0	3	40	60	100	87
25MECS3E17	Mixed Reality	PE	1,3,4,6	2	3	0	0	3	40	60	100	89
25MECS3E18	Devops and Microservices	PE	1,3,4,6	2	3	0	0	3	40	60	100	91

25MECC101 **APPLIED MATHEMATICS** **4H-4C**

Instruction Hours/week: L:3 T:1 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Encourage students to develop a working knowledge and proficiency in Linear Systems fundamentals.
- To enable students to understand the concepts of Linear Programming principles.
- To understand the basics of trees and facilitate application of Graph Theory concepts.

COURSE OUTCOMES

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

- Make use of vector spaces and linear transformations associated with engineeringapplications. K3
- Solve transportation problem using linear programming. K3
- Apply graph theory to solve engineering problems. K3
- Discuss spanning tree and its applications. K2
- Explain about fuzzy logic techniques which are needed for Engineers in physical scenario. K2

UNIT I LINEAR SYSTEMS 9

Vector spaces and subspaces – Linear combination, Span, Linear independence and dependence – Null space, Column space and Row space – Basis and dimension of a vector space – Rank and Nullity. Linear transformation: Introduction to linear transformations – General Linear Transformations – Kernel and Range – Change of basis – Eigen values and Eigen vectors – Diagonalisation, Quadratic forms.

UNIT II LINEAR PROGRAMMING 9

Basic concepts – Graphical and Simplex methods –Transportation problem – Assignment problem.

UNIT III GRAPH THEORY 9

Graphs – Pats, cycles and trials – Vertex, degree and counting – Connectivity and Paths.

UNIT IV TREES 9

Basic properties – Spanning trees and Enumeration – Optimization and trees.

UNIT V FUZZY LOGIC **9**

Classical logic – Multivalued logics – Fuzzy propositions – Fuzzy Quantifiers.

Total: 45+15 Hours

REFERENCES

1. Dr. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi., 2015.
2. Gupta, P.K.and Hira, D.S. Problems in Operations Research S. Chand & Co., New Delhi., 2012.
3. Kenneth H Rosen, Discrete Mathematics and its Applications with Combinations and Graph theory Tata McGraw - Hill Pub. Co. Ltd, New Delhi.2012.
4. George J Klir and Tina A. Folger Fuzzy sets, Uncertainty and Information Prentice Hall of India Pvt Ltd., New Delhi.2007.
5. Howard Anton Elementary Linear Algebra John Wiley & Sons, New Delhi. 2010.
6. David C Lay, Linear Algebra and Its Applications Pearson Education, New Delhi. 2009.
7. Douglas. B. West Introduction to Graph theory Prentice Hall of India Pvt Ltd. New Delhi,2018.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	2	-
CO2	3	-	2	2	-	2	2	-
CO3	3	-	2	2	-	2	2	-
CO4	2	-	1	1	-	1	1	-
CO5	2	-	1	1	-	1	1	-
Average	2.6	-	1.6	1.6	-	1.6	1.6	

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25MECS102 ADVANCED DATA STRUCTURES AND ALGORITHMS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Develop in problem-solving methodologies in data structures.
- Build specialized knowledge in Heap data structures.
- Utilize non-linear data structures effectively.

COURSE OUTCOMES

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

- Develop asymptotic notations for solving computing problems. K3
- Build AVL tree data structures to solve computing problems. K3
- Apply heap data structure to solve a real-world application. K3
- Analyze R-trees for solving multimedia applications. K4
- Examine randomized algorithm for problem solving. K4

UNIT – I ALGORITHM ANALYSIS 9

Mathematical Induction - Asymptotic Notations – Properties of Big-oh Notation – Conditional Asymptotic Notation – Algorithm Analysis – Amortized Analysis – NP-Completeness – NP-Hard – Recurrence Equations – Solving Recurrence Equations.

UNIT II HIERARCHICAL DATA STRUCTURES 9

Binary Search Trees – Counting Binary Trees -AVL Trees – Red-Black trees – Multi-way Search Trees –B-Trees – Splay Trees – Tries.

UNIT III HEAP STRUCTURES 9

Min/Max heaps – Deaps – Leftist Heaps – Binomial Heaps – Fibonacci Heaps – Skew Heaps – Lazy-Binomial Heaps.

UNIT IV MULTIMEDIA STRUCTURES 9

Segment Trees – k-d Trees – Point Quad Trees – MX-Quad Trees – R-Trees – TV-Trees.

UNIT V ALGORITHMS 9

Huffman Coding – Convex Hull – Tree Vertex Splitting – Activity Networks – Flow ShopScheduling – Introduction to Randomized Algorithms.

Total: 45 Hours

REFERENCES

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Pearson Education, NewYork, 2014.
2. Aho, Hopcroft, Ullman, Data Structures and Algorithms, Pearson Education, New York. 2009.
3. Horowitz, Sahni, Rajasekaran Computer Algorithms Galgotia 2007.
4. Tanenbaum A.S., Langram Y, Augestien M.J Data Structures using C & C++ PrenticeHall of India, New Delhi, 2008.
5. E. Horowitz, S.Sahni and Dinesh Mehta, Fundamentals of Data structures in C++,University Press 2007.
6. E. Horowitz, S. Sahni and S. Rajasekaran, Computer Algorithms/C++, University Press, 2007.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	2	-
CO2	3	-	2	2	-	2	2	-
CO3	3	-	2	2	-	2	2	-
CO4	3	-	3	3	-	2	2	-
CO5	3	-	3	3	-	2	2	-
Average	**3**	**-**	**2.4**	**2.4**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25MECS103 ADVANCED OPERATING SYSTEMS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Gain insight into modern operating system design and implementation.
- Acquire knowledge of distributed systems, focusing on distributed algorithms, consistency, and fault tolerance.
- Understand the principles of virtualization and containerization, emphasizing their significance in modern computing environments.

COURSE OUTCOMES

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

- Identify the working of Theoretical Foundations of OS. K3
- Apply the principles of Distributed Deadlock Detection resource management. K3
- Analyze the concepts of distributed shared memory and scheduling mechanisms. K4
- Examine the working of Data security to file System. K4
- Compare multiprocessor operating systems and database operating systems. K4

UNIT I INTRODUCTION 9

Architectures of Distributed Systems - System Architecture types - issues in distributed operating systems - communication networks – communication primitives. Theoretical Foundations - inherent limitations of a distributed system – lamport's logical clocks – vector clocks – causal ordering of messages – global state – cuts of a distributed computation – termination detection. Distributed Mutual Exclusion – introduction – the classification of mutual exclusion and associated algorithms – a comparative performance analysis.

UNIT II DISTRIBUTED DEADLOCK DETECTION AND RESOURCE MANAGEMENT 9

Distributed Deadlock Detection -Introduction - deadlock handling strategies in distributed systems issues in deadlock detection and resolution – control organizations for distributed deadlock detection – centralized and distributed deadlock detection algorithms –hierarchical deadlock detection algorithms. Agreement protocols – introduction-the system model, a classification of agreement problems, solutions to the Byzantine agreement problem, applications of agreement algorithms. Distributed resource management: introduction-architecture – mechanism for building distributed file systems – design issues – log structured file systems.

UNIT III DISTRIBUTED SHARED MEMORY AND SCHEDULING 9

Distributed shared memory-Architecture– algorithms for implementing DSM – memory coherence and

protocols – design issues. Distributed Scheduling – introduction – issues in load distributing – components of a load distributing algorithm – stability – load distributing algorithms – performance comparison – selecting a suitable load sharing algorithm – requirements for load distributing -task migration and associated issues. Failure Recovery and Fault tolerance: introduction– basic concepts – classification of failures – backward and forward error recovery, backward error recovery- recovery in concurrent systems – consistent set of checkpoints – synchronous and asynchronous check pointing and recovery – check pointing for distributed database systems- recovery in replicated distributed databases.

UNIT IV DATA SECURITY **9**

Protection and security -preliminaries, the access matrix model and its implementations. - safety in matrix model- advanced models of protection. Data security – cryptography: Model of cryptography, conventional cryptography- modern cryptography, private key cryptography, data encryption standard- public key cryptography – multiple encryption – authentication in distributed systems.

UNIT V MULTIPROCESSOR AND DATABASE OPERATING SYSTEM **9**

Multiprocessor operating systems - basic multiprocessor system architectures – interconnection networks for multiprocessor systems – caching – hypercube architecture. Multiprocessor Operating System - structures of multiprocessor operating system, operating system design issues- threads- process synchronization and scheduling. Database Operating systems :Introduction- requirements of a database operating system Concurrency control : theoretical aspects – introduction, database systems – a concurrency control model of database systems- the problem of concurrency control – serializability theory- distributed database systems, concurrency control algorithms – introduction, basic synchronization primitives, lock based algorithms-timestamp based algorithms, optimistic algorithms – concurrency control algorithms: data replication.

Total: 45 Hours

REFERENCES

1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2001
2. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003
3. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2014.
4. Andrew S.Tanenbaum, "Distributed operating system", Pearson education, 2017.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	2	-
CO2	3	-	2	2	-	2	2	-
CO3	3	-	2	2	-	2	2	-
CO4	3	-	3	3	-	2	2	-
CO5	3	-	3	3	-	2	2	-
Average	**3**	**-**	**2.4**	**2.4**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25MECS104 ADVANCED DATABASE TECHNOLOGY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Infer the fundamental components of relational database management systems.
- Acquire proficiency in the basic concepts of relational data modeling, entity-relationship modeling, relational database design, relational algebra, and SQL.
- Understand query processing in distributed database systems and summarize the key principles involved.

COURSE OUTCOMES

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

- Apply Entity relationship model for various real time problems. K3
- Build distributed database architecture and open database connectivity to a given problem. K3
- Analyze XML schema and XML query. K4
- Examine NoSQL databases to schema design, indexing and data modeling. K4
- Inspect Database security and privacy issues using access control methods. K4

UNIT I RELATIONAL DATA MODEL **9**

Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization.

UNIT II DISTRIBUTED ARCHITECTURE **9**

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.

UNIT III XML DATABASES **9**

Structured, semi structured, and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – XML Documents and Databases - XML Querying – XPath – Xquery.

UNIT IV NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS **9**

NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics –

NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key- Value Distributed Data Store – Wide Column NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher QueryLanguage of Neo4j – Big Data – MapReduce – Hadoop – YARN.

UNIT V DATABASE SECURITY **9**

Database Security Issues – Discretionary Access Control Based on Granting and Revoking Privileges – Mandatory Access Control and Role-Based Access Control for Multilevel Security – SQL Injection – Statistical Database Security – Flow Control – Encryption and Public Key Infrastructures – Preserving Data Privacy – Challenges to Maintaining Database Security – Database Survivability – Oracle Label-Based Security.

Total: 45 Hours

REFERENCES

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition,Pearson Education 2016.
2. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts",Seventh Edition, McGraw Hill, 2019.
3. C.J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems, EighthEdition, Pearson Education, 2006.
4. Raghu Ramakrishnan, Johannes Gehrke "Database Management Systems", FourthEdition, McGraw Hill Education, 2015.
5. Harrison, Guy, "Next Generation Databases, NoSQL and Big Data" , First Edition,Apress publishers, 2015.
6. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach toDesign, Implementation and Management", Sixth Edition, Pearson Education, 2015.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	2	-
CO2	3	-	2	2	-	2	2	-
CO3	3	-	3	2	-	2	2	-
CO4	3	-	3	3	-	2	2	-
CO5	3	-	3	3	-	2	2	-
Average	**3**	**-**	**2.6**	**2.4**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25MECS105 **NETWORK TECHNOLOGIES** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Understand the fundamental principles of networking.
- Investigate diverse technologies within the wireless domain.
- Infer the intricacies of 4G and 5G cellular networks.

COURSE OUTCOMES

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

- Apply the basic concepts of networks and IP addressing. K3
- Identify wireless access techniques for a Scenario. K3
- Compare 4G and 5G cellular networks. K4
- Examine paradigm of Software defined networks. K4
- Analyze the concept of network virtualization. K4

UNIT I NETWORKING CONCEPTS 9

Peer To Peer Vs Client-Server Networks. Network Devices. Network Terminology. Network Speeds. Network throughput, delay. Osi Model. Packets, Frames, And Headers. Collision And Broadcast Domains. LAN Vs WAN. Network Adapter. Hub. Switch. Router. Firewall, IP addressing.

UNIT II WIRELESS NETWORKS 9

Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee.

UNIT III MOBILE DATA NETWORKS 9

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 – Concepts of 5G – channel access –air interface -Cognitive Radio-spectrum management – C-RAN architecture - Vehicular communications-protocol – Network slicing – MIMO, mmWave, Introduction to 6G.

UNIT IV SOFTWARE DEFINED NETWORKS **9**

SDN Architecture. Characteristics of Software-Defined Networking. SDN- and NFV-Related Standards. SDN Data Plane. Data Plane Functions. Data Plane Protocols. OpenFlow Logical Network Device. Flow Table Structure. Flow Table Pipeline. The Use of Multiple Tables. Group Table. OpenFlow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface. Northbound Interface. Routing. ITU-T Model. Open Daylight. Open Daylight Architecture. Open Daylight Helium. SDN Application Plane Architecture. Northbound Interface. Network Services Abstraction Layer. Network Applications. User Interface.

UNIT V NETWORK FUNCTIONS VIRTUALIZATION **9**

Motivation-Virtual Machines –NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFVUse Cases- NFV and SDN –Network virtualization – VLAN and VPN.

Total: 45 Hours

REFERENCES

1. James Bernstein, “Networking made Easy”, 2018.
2. Houda Labiod, Costantino de Santis, Hossam Afifi “Wi-Fi, Bluetooth, Zigbee and WiMax”, Springer 2007.
3. Erik Dahlman, Stefan Parkvall, Johan Skold, 4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2013.
4. Saad Z. Asif – “5G Mobile Communications Concepts and Technologies” CRCpress – 2019.
5. William Stallings – “Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud”1st Edition, Pearson Education, 2016.
6. Thomas D. Nadeau and Ken Gray, SDN – Software Defined Networks,O‟ Reilly Publishers, 2013.
7. Guy Pujolle, “Software Networks”, Second Edition, Wiley-ISTE, 2020.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	2	-
CO2	3	-	2	2	-	2	2	-
CO3	3	-	3	2	-	2	2	-
CO4	3	-	3	3	-	2	2	-
CO5	3	-	3	3	-	2	2	-
Average	**3**	**-**	**2.6**	**2.4**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

25MECS111 ADVANCED DATA STRUCTURES LABORATORY 4H-2C

Instruction Hours/week: L:0 T:0 P:4 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Cultivate skills in designing and writing programs to implement these algorithms effectively.
- Implement iterative, recursive, hill climbing and dynamic programming algorithms proficiently.
- Develop the fundamental tools of program design through structured problem-solving algorithms.

COURSE OUTCOMES

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

- Make use of non-primitive data types for a given problem. K3
- Build linked list applications. K3
- Examine algorithms using dynamic programming and recursive backtracking techniques. K4
- Analyze randomized algorithms to hashing applications. K4
- Analyze Trees, Heaps and sorting algorithms using recursion. K4

LIST OF EXPERIMENTS

1. Linked lists
2. Multi stacks
3. Double Ended Queue (Deques) & Circular Queues
4. Min Heap
5. Deaps
6. Leftist Heap
7. AVL Tree
8. B Tree
9. Quick Sort
10. Greedy algorithm
11. Knapsack using Dynamic Programming
12. Graph coloring using backtracking

Total: 60 Hours

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	1	2	2	-	2	2	-
CO2	3	1	2	2	-	2	2	-
CO3	3	1	3	3	-	2	2	-
CO4	3	1	3	3	-	2	2	-
CO5	3	1	3	3	-	2	2	-
Average	**3**	**1**	**2.6**	**2.6**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25MECS112 ADVANCED DATABASE TECHNOLOGY LABORATORY 4H-2C

Instruction Hours/week: L:0 T:0 P:4 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Provide hands-on exposure to advanced database technologies like structured and unstructured databases.
- Complex database systems utilizing advanced database technologies.
- Introduce techniques for data analysis, data mining, and data visualization using advanced database technologies.

COURSE OUTCOMES

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

- Apply data definition and data manipulation language and its syntaxes. K3
- Develop solution for distributed database applications. K3
- Build relational database using PHP and Python. K3
- Build XML application using relational data base. K3
- Make use of MongoDB and DynamoDB to improve the query performance. K3

LIST OF EXPERIMENTS

1. Data Definition Language
    - Create, Alter and Drop
    - Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints
    - Creating Views
2. Data Manipulation Language
    - Insert, Delete, Update
    - Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join
    - Aggregate Functions
    - Set Operations
    - Nested Queries
3. Transaction Control Language
    - Commit, Rollback and Save Points

4. Distributed Database Design and Implementation
5. Row Level and Statement Level Triggers
6. Accessing a Relational Database using PHP, Python and R
7. Creating XML Documents, Document Type Definition and XML Schema
8. Using a Relational Database to store the XML documents as text
9. Using a Relational Database to store the XML documents as data element
10. Creating or publishing customized XML documents from pre-existing relational databases
11. Extracting XML Documents from Relational Databases
12. XML Querying
13. Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed DataStore Hbase and Neo4j.
14. Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j

Total: 60 Hours

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	1	2	2	-	2	2	-
CO2	3	1	2	2	-	2	2	-
CO3	3	1	2	2	-	2	2	-
CO4	3	1	2	2	-	2	2	-
CO5	3	1	2	2	-	2	2	-
Average	**3**	**1**	**2**	**2**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25MECS201 **INTERNET OF THINGS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Infer the architectural overview of IoT systems.
- Acquire knowledge of the IoT reference architecture and real-world design constraints.
- Understand the various levels of IoT protocols and basics of cloud architecture.

COURSE OUTCOMES

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

- Apply IoT principles and its technologies. K3
- Develop IoT sensors using different hardware platforms. K3
- Experiment with the IoT Protocols to a applications. K3
- Utilize basic principles of cloud computing in IOT arena. K3
- Apply an application using the IoT with raspberry Pi. K3

UNIT I INTRODUCTION **9**

Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications– Structure of IoT– IoT Map Device- IoT System Management with NETCONF-YANG.

UNIT II IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS **9**

IETF architecture for IoT - IoT reference architecture -First Generation – Description& Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics.

UNIT III IoT PROTOCOLS AND TECHNOLOGY **9**

SCADA and RFID Protocols - BACnet Protocol -Zigbee Architecture - 6LowPAN - CoAP –Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module.

UNIT IV CLOUD ARCHITECTURE BASICS **9**

The Cloud types; IaaS, PaaS, SaaS. - Development environments for service development; Amazon, Azure, Google App cloud platform in industry.

UNIT V IOT PROJECTS ON RASPBERRY PI **9**

Building IOT with RASPBERRY PI- Creating the sensor project - Preparing Raspberry Pi - Clayster libraries – Hardware Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data.

Total: 45 Hours

REFERENCES

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach,Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), Architecting theInternet of Things, Springer, 2011.
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015.
4. Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research andInnovation to Market Deployment', River Publishers, 2014.
5. N. Ida, Sensors, Actuators and Their Interfaces: A MultidisciplinaryIntroduction,2nd Edition Scitech Publishers, 2014.
6. Rees G. (2009) Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009).

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CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	1	2	-	2
CO2	3	-	2	2	1	2	-	2
CO3	3	-	2	2	1	2	-	2
CO4	3	-	2	2	1	2	-	2
CO5	3	-	2	2	1	2	-	2
Average	**3**	**-**	**2**	**2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

25MECS202 MACHINE LEARNING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Understand mathematical foundations of machine learning, including the types of problems addressed by machine learning algorithms.
- Investigate supervised learning techniques, with a focus on ensemble methods, to effectively train models on labeled data.
- Infer aspects of unsupervised learning and reinforcement learning, understanding how these approaches can be applied in real-world scenarios to derive insights and make decisions.

COURSE OUTCOMES

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

- Apply the concepts of machine learning and its types. K3
- Develop the ensemble methods using the supervised learning. K3
- Experiment with Probabilistic Discriminative and Generative algorithms for anapplication. K3
- Analyze the sequence model for probabilistic methods for learning Markov models. K4
- Examine the issues in neural networks and deep learning. K4

UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATIONS 9

What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages and Challenges -Types of Machine Learning Problems – Mathematical Foundations Linear Algebra and Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability - Vector Calculus and Optimization - Decision Theory - Information theory.

UNIT II SUPERVISED LEARNING 9

Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting - Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods –Decision Trees –ID3 – CART Ensemble Methods- Random Forest - Evaluation of Classification Algorithms.

UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING 9

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction –Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements -Model based Learning –Temporal Difference Learning.

UNIT IV PROBABILISTIC METHODS FOR LEARNING **9**

Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models.

UNIT V NEURAL NETWORKS AND DEEP LEARNING **9**

Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases.

Total: 45 Hours

REFERENCES

1. Stephen Marsland, "Machine Learning: An Algorithmic Perspective", Chapman & Hall/CRC,2nd Edition, 2014.
2. Kevin Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012
3. Ethem Alpaydin, "Introduction to Machine Learning", Third Edition, AdaptiveComputation and Machine Learning Series, MIT Press, 2014
4. Tom M Mitchell, "Machine Learning", McGraw Hill Education, 2013.
5. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense ofData", First Edition, Cambridge University Press, 2019.
6. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: FromTheory to Algorithms", Cambridge University Press, 2015
7. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
8. Hal Daumé III, "A Course in Machine Learning", 2017 (freely available online)
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2017 (freely available online)
10. Aurélien Géron, Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	3	2	-	2	-	2
CO5	3	-	3	2	-	2	-	2
Average	**3**	**-**	**2.4**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25MECS203 **ADVANCED SOFTWARE ENGINEERING** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Understand the significance of software development process models and theirrationale.
- Recognize the importance of architectural design in software development.
- Familiarize oneself with the essential dimensions of dependability and understandtheir implications in software engineering.

COURSE OUTCOMES

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

- Identify the prescriptive process models and scenario based modeling. K3
- Develop the design model using the design concepts. K3
- Build the system security using the security requirements. K3
- Analyze importance of having a good Software Architecture. K4
- Categorize levels of Software testing for a given applications. K4

UNIT I SOFTWARE PROCESS & MODELING9

Prescriptive Process Models – Agility and Process – Scrum – XP – Kanban – DevOps – Prototype Construction – Prototype Evaluation – Prototype Evolution – Modelling – Principles – Requirements Engineering – Scenario-based Modelling – Class-based Modelling – Functional Modelling – behavioural Modelling.

UNIT II SOFTWARE DESIGN 9

Design Concepts – Design Model – Software Architecture – Architectural Styles – Architectural Design – Component-Level Design – User Experience Design – Design for Mobility – Pattern-Based Design.

UNIT III SYSTEM DEPENDABILITY AND SECURITY 9

Dependable Systems – Dependability Properties – Sociotechnical Systems – Redundancy and Diversity – Dependable Processes – Formal Methods and Dependability – Reliability Engineering – Availability and Reliability – Reliability Requirements – Fault-tolerant Architectures – Programming for Reliability – Reliability Measurement – Safety Engineering-Safety-critical Systems – Safety Requirements – Safety Engineering Processes – Safety Cases – Security Engineering – Security and Dependability – Safety and Organizations-Security Requirements – Secure System Design – Security Testing and Assurance – Resilience Engineering – Cybersecurity – Sociotechnical Resilience – Resilient Systems Design.

UNIT IV SERVICE-ORIENTED SOFTWARE ENGINEERING 9

Service-oriented Architecture – RESTful Services – Service Engineering – Service Composition –Systems Engineering – Sociotechnical Systems – Conceptual Design – System Procurement – System Development – System Operation and Evolution – Real-time Software Engineering – Embedded System Design – Architectural Patterns for Real-time Software – Timing Analysis – Real-time Operating Systems.

UNIT V SOFTWARE CONFIGURATION MANAGEMENT 9

Software Testing Strategy – Unit Testing – Integration Testing – Validation Testing – System Testing – Debugging – White-Box Testing – Basis Path Testing – Control Structure Testing –Black-Box Testing – Software Configuration Management (SCM) – SCM Repository – SCM Process – Configuration Management for Web and Mobile Apps.

Total: 45 Hours

REFERENCES

1. Software Engineering: A Practitioner's Approach, 9th Edition. Roger Pressmanand Bruce Maxim, McGraw-Hill 2019.
2. Software Engineering, 10th Edition, Ian Somerville, Pearson Education Asia 2016.
3. Software Architecture in Practice, 3rd Edition, Len Bass, Paul Clements and RickKazman, Pearson India 2018
4. An integrated approach to Software Engineering, 3rd Edition, Pankaj Jalote, Narosa Publishing House, 2018
5. Fundamentals of Software Engineering, 5th Edition, Rajib Mall, PHI LearningPrivate Ltd,2018.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	1	2	2	1	2	2	-
CO2	3	1	2	2	1	2	2	-
CO3	3	1	2	2	1	2	2	-
CO4	3	1	3	3	1	2	2	-
CO5	3	1	2	2	1	2	2	-
Average	**3**	**1**	**2.2**	**2.2**	**1**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25MECS211 MACHINE LEARNING LABORATORY 4H-2C

Instruction Hours/week: L:0 T:0 P:4 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Develop a comprehensive understanding of the concepts and mathematical foundations underlying machine learning, along with the diverse range of problems addressed by machine learning algorithms.
- Provide hands-on exposure various supervised learning techniques, with a focus on ensemble methods, to effectively train models using labeled data and improve predictive accuracy.
- Gain insight into different aspects of unsupervised learning and reinforcement learning, exploring how these approaches uncover patterns in unlabeled data and make sequential decisions based on feedback.

COURSE OUTCOMES

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

- Develop a model using linear regression. K3
- Build binary classification model for solving problems. K3
- Apply Nearest Neighbors for classification. K3
- Analyze training set and validation set data results. K4
- Compare k-means and Naïve Bayes Classifier algorithm for problem solving. K4

LIST OF EXPERIMENTS

1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyper parameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?"(use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.
3. Classification with Nearest Neighbors. In this question, you will use the scikit- learn's KNNclassifier to classify real vs. fake news headlines. The aim of this question is for you to read the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset
4. In this exercise, you'll experiment with validation sets and test sets using the dataset. Splitatraining set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with atest set to determine whether your trained model is overfitting. Detect and fix a commontraining problem.

5. Implement the k-means algorithm using:
   https://archive.ics.uci.edu/ml/datasets/Codon+usage dataset
6. Implement the Naïve Bayes Classifier using:
   https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset.
7. Project - (in Pairs) Your project must implement one or more machine learning algorithms and apply them to some data Your project may be a comparison of several existing algorithms, or it may propose anew algorithm in which case you still must compare it to at least one other approach.
    1. You can either pick a project of your own design, or you can choosefrom the set of pre-defined projects.
    2. You are free to use any third-party ideas or code that you wish as long as itis publicly available.
    3. You must properly provide references to any work that is not your own in the write-up.
    4. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also brieflydescribe software you will need to write, and papers (2-3) you plan toread.

List of Projects (datasets available)

1. Sentiment Analysis of Product Reviews
2. Stock Prediction
3. Sales Forecasting
4. Music Recommendation
5. Handwriting Digit Classification
6. Fake News Detection
7. Sports Prediction
8. Object Detection
9. Disease Prediction

Total: 60 Hours

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	1	2	2	1	2	-	2
CO2	3	1	2	2	1	2	-	2
CO3	3	1	3	2	1	2	-	2
CO4	3	1	3	2	1	2	-	2
CO5	3	1	3	2	1	2	-	2
Average	**3**	**1**	**2.6**	**2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

25MECS212 SOFTWARE ENGINEERING LABORATORY 4H-2C

Instruction Hours/week: L:0 T:0 P:4 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Infer cutting-edge insights into Software Engineering and UML through an interactive online platform.
- Utilize case studies to exemplify the practical applications of various Software Engineering concepts.
- Solve real-world problems by providing them with a structured scope.

COURSE OUTCOMES

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

- Identify the requirements and use cases the client wants for the software Development. K3
- Develop project plan with assessments of the project, schedule and available resource. K3
- Build project plan with risk management and specify the requirements of mid-rangesoftware architecture. K3
- Analyze software design based on the requirement specification for softwareimplementations. K4
- Examine the costs of a project with the help of assessment methods. K4

LIST OF EXPERIMENTS

1. Write a Problem Statement to define a title of the project with bounded scope of project
2. Select relevant process model to define activities and related task set for assigned project
3. Prepare broad SRS (Software Requirement Specification) for the above selected projects
4. Prepare USE Cases and Draw Use Case Diagram using modelling Tool
5. Develop the activity diagram to represent flow from one activity to another for software development
6. Develop data Designs using DFD Decision Table & ER Diagram.
7. Draw class diagram, sequence diagram, Collaboration Diagram, State Transition Diagramfor the assigned project
8. Write Test Cases to Validate requirements of assigned project from SRS Document
9. Evaluate Size of the project using function point metric for the assigned project
10. Estimate cost of the project using COCOMO and COCOCMOII for the assigned project
11. Use CPM/PERT for scheduling the assigned project
12. Use timeline Charts or Gantt Charts to track progress of the assigned project.

Total: 60 Hours

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	1	2	2	1	2	2	-
CO2	3	1	2	2	1	2	2	-
CO3	3	1	2	2	1	2	2	-
CO4	3	1	3	3	1	2	2	-
CO5	3	1	3	3	1	2	2	-
Average	**3**	**1**	**2.4**	**2.4**	**1**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS301 RESEARCH METHODOLOGY AND IPR 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Acquire proficiency in research methodology and pedagogy, focusing on effective strategiesfor conducting research and imparting knowledge.
- Facilitate student engagement in research activities, fostering their development as active participants in the research process.
- Understand the data collection techniques for research purposes, emphasizing the importanceof accurate and ethical data gathering methods.

COURSE OUTCOMES

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

- Build qualitative research process and surveys. K3
- Categorize the sampling methods and data preparation process in research. K4
- Apply the process of Multivariate analysis for report generation. K3
- Utilize IPR laws for protecting an application. K3
- Analyze the benefits of patent and E-filing. K4

UNIT I RESEARCH DESIGN 9

Overview of research process and design, Use of Secondary and exploratory data to answer the researchquestion, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES 9

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING 9

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insightsand findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Biodiversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS **9**

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filing, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

Total: 45 Hours

REFERENCES

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching:tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional programme Intellectual Property Rights, Law and practice",September 2013.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	2	2	1	2	-	2
CO2	3	2	2	2	1	2	-	2
CO3	3	2	2	2	1	2	-	2
CO4	3	2	2	2	1	2	-	2
CO5	3	2	3	3	1	2	-	2
Average	**3**	**2**	**2.2**	**2.2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

LIST OF PROFESSIONAL ELECTIVES

M.E COMPUTER SCIENCE AND ENGINEERING **2025-2026**

SEMESTER-II

25MECS2E01 DATABASE ADMINISTRATION AND TUNING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Learn the principle functions of a database administrator.
- Gain the knowledge of how the role of the database administrator might be partitioned among a group of people in a larger organization.
- Understand the issues in tuning database systems, and describe examples of typical tools used inthe process of database administration.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Identify Data Base Administration roles, tasks and tools. K3
- Apply database recovery, backup and security privileges. K3
- Identify performance monitoring and management in the context of database administration. K3
- Examine the database management tools and index tuning techniques. K4
- Analyze tune and optimize relational databases for query optimization. K4

UNIT I FUNDAMENTALS OF DATABASE ADMINISTRATION 9

The Management Discipline of Database Administration- Database, Data, and System Administration- Database Design- OODBMS-Persistence-DBA Tasks- Types of DBAs- Working as a DBA- Multiplatform DBA Issues- Test and Production- DBMS Release Migration - Creating the Database Environment - Choosing a DBMS - DBMS Architectures - DBMS Clustering - DBMS Proliferation - Hardware Issues - Installing the DBMS -Storage and Memory Requirements- Configuring the DBMS

UNIT II DATABASE SECURITY, BACKUP AND RECOVERY 9

Different Security Issues- Security Models- threats to databases- Database Users – Grant and Revoke - Types of Privileges - Privileges - Security Reporting - Authorization Roles and Groups - Using Views for Security - Using Stored Procedures for Security Auditing - SQL Injection Prevention - External Security - Job Scheduling and Security – Types of Failures- Image Copy Backups - Full vs. Incremental Backups - Database Objects and Backups-Concurrent Access Issues - Backup Consistency - Log Archiving and Backup.

UNIT III PERFORMANCE MANAGEMENT 9

Designing the DBMS Environment for Recovery - Types of Recovery - DBA Tools- Monitoring Vs Management- Service level management-Performance parameters- Performance Tuning Tools- Techniques for Optimizing Databases-Database reorganization- Files and datasets- space management- Loading and unloading data-bulk data movement- Client server computing

UNIT IV DATABASES AND INDEX TUNING **9**

Introduction to Tuning- Tuning and Relational Databases – Relational Algebra – Concurrency control goals- Locking and Concurrency Control – Correctness Consideration – Lock Tuning – Logging andthe Recovery Subsystem – Principles of Recovery – Tuning the Recovery Subsystem – Operating Systems Considerations – Hardware Tuning- Types of Queries – B tree – B+ Tree - Bit Map Indexes-
Clustering Indexes – Non Clustering Indexes – Composite Indexes – Hot Tables – Comparison of Indexing and Hashing Techniques.

UNIT V OPTIMIZATION AND TROUBLESHOOTING **9**

Optimization Techniques -- Normalization – Tuning Denormalization – Clustering Two Tables – Aggregate Maintenance – Record Layout – Query Cache – Parameter Cache - Query Tuning – Transaction chopping -Triggers - Query Plan Explainers – Performance Monitors – Event Monitors. Finding 'Suspicious' Queries – Analysing Query's Access Plan – Profiling Query Execution. Tuning DBMS Subsystems - Disk Subsystem - Buffer Manager - Logging Subsystem - Locking Subsystem. Troubleshooting CPU, Disks and Controllers, Memory, and Networks

Total: 45

REFERENCES

1. Craig S. Mullins, "Database Administration: The Complete Guide to Practices andProcedures", Addison-Wesley Professional, 2nd edition, 2013.
2. Dennis Shasha and Philippe Bonnet, "Database Tuning, Principles, Experiments and Troubleshooting Techniques", Elsevier Reprint, 2005.
3. C.J. Date, A. Kannan, S. Swamynathan, ―An Introduction to Database Systems‖, EighthEdition, Pearson Education, 2006.
4. R. Elmasri, S.B. Navathe, ―Fundamentals of Database Systems‖, Sixth Edition, Pearson Education/Addison Wesley, 2010.
5. Craig S. Mullins. “DB2 Developer's Guide A Solutions-Oriented Approach to Learning the Foundation and Capabilities of DB2 for Z/OS”, IBM Press, 6th edition, 2012.
6. Henry F Korth, Abraham Silberschatz, S. Sudharshan, ―Database System Concepts, SeventhEdition, McGraw Hill, 2019
7. Thomas Connoly and Carlolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Fourth Edition, Pearson Education, 2008.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	2	-
CO2	3	-	2	2	-	2	2	-
CO3	3	-	3	3	-	2	2	-
CO4	3	-	3	3	-	2	2	-
CO5	3	-	3	3	-	2	2	-
Average	**3**	**-**	**2.6**	**2.6**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER-II

25MECS2E02 CLOUD COMPUTING TECHNOLOGIES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Learn the technologies and strengths of cloud computing.
- Understand the concepts of Virtualization.
- Interpret the cloud computing services models.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Interpret the key technologies, strengths and limitations of cloud computing. K2
- Identify the architecture, infrastructure and delivery models in cloud computing. K3
- Apply the core issues of cloud computing in security, privacy and interoperability. K3
- Choose the appropriate technologies, algorithms and approaches for the related issues in cloudcomputing. K3
- Utilize cloud platforms for security services. K3

UNIT I DISTRIBUTED SYSTEMS AND ENABLING TECHNOLOGIES 9

Technologies for network based systems - System Models for Distributed and Cloud Computing - Clustering for Massive Parallelism - Design Principles of Computer Clusters - Cluster Job and Resource Management.

UNIT II VIRTUALIZATION 9

Implementation Levels of Virtualization - Virtualization Structures, Tools and Mechanisms - Virtualization of CPU, Memory, and I/O Devices - Virtual Clusters and Resource Management - Virtualization for Data-Center Automation.

UNIT III CLOUD COMPUTING 9

Characteristics - Service Models: IaaS, PaaS, SaaS - Deployment Models: Public, Private, Community, Hybrid Clouds - Data-Center Design and Interconnection Networks - Architectural Design.

UNIT IV EXPLORING CLOUD PLATFORMS AND SERVICES 9

Compute Services – Storage Services – Database Services – Application Services – Content Delivery Services – Analytics Services – Deployment and Management Services – Identity and Access Management Services – Open source Private Cloud Softwares.

UNIT V SECURITY AND INTER-CLOUD **9**

Trust Management - Defence Strategies - Distributed Intrusion/Anomaly Detection - Data and Software Protection Techniques - Reputation-Guided Protection of Data Centers - Inter-cloud Resource Management.

Total: 45 Hours

TEXT BOOKS

1. Kai Hwang, Geoffrey C Fox, Jack J Dongarra, "Distributed and Cloud Computing from ParallelProcessing to the Internet of Things", Morgan Kauffman imprint of Elsevier, 2012.

2. Arshdeep Bahga, Vijay Madisetti, "Cloud Computing: A Hands-On Approach", Universities Press(India) Private Limited, 2014.

3. James E Smith and Ravi Nair, "Virtual Machines", Elsevier, 2005.

4. Thomas Erl, Zaigham Mahood, Ricardo Puttini, "Cloud Computing, Concept, Technology &Architecture", Prentice Hall, 2013.

5. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, "Mastering Cloud Computing", TataMcGraw-Hill, 2013.

6. Toby Velte, Anthony Velte, Robert C. Elsenpeter, "Cloud Computing, A Practical Approach",TataMcGraw-Hill Edition, 2010.

7. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, 4th Edition, 2015.

8. John Rittinghouse and James Ransome, "Cloud Computing Implementation, Management andSecurity", CRC Press, 2010.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	3	2	-	2	-	2
CO4	3	-	3	2	-	2	-	2
CO5	3	-	3	2	-	2	-	2
Average	**3**	**-**	**2.6**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

25MECS2E03 **ETHICAL HACKING** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Gain the knowledge of the penetration test and categories of Penetration Test
- Enable students to understand the types of malwares, vulnerabilities, attacks and theirprevention mechanism.
- Protect the system from malicious software and worms.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Make use of the various security tools to assess the computing system. K3
- Apply the vulnerabilities across computing system using penetration testing. K3
- Identify prediction mechanism to prevent any kind of attacks. K3
- Analyze the system from malicious software and worms. K4
- Examine the risk and support the organization for effective security measures. K4

UNIT I INTRODUCTION TO HACKING **9**

Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement –Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary –Reports.

UNIT II INFORMATION SECURITY **9**

Types of malware – Types of Vulnerabilities- Types of attacks and their prevention mechanism - Keystroke Logging - Denial of Service (DoS /DDoS) - Waterhole attack -brute force -phishing and fake WAP- Eavesdropping- Man-in-the-middle- Session Hijacking -Clickjacking -Cookie Theft - URL Obfuscation- buffer overflow- DNS poisoning -ARP poisoning -Identity Theft - IoT Attacks - BOTs andBOTNETs

UNIT III INFORMATION GATHERING AND SCANNING **9**

Information Gathering Techniques – Active Information Gathering – Passive Information Gathering– Sources of Information Gathering – Tracing the Location – Traceroute – ICMP Traceroute – TCP Traceroute – Usage – UDP Traceroute – Enumerating and Fingerprinting the Webservers – Google Hacking – DNS Enumeration – Enumerating SNMP – SMTP Enumeration – Target Enumeration and Port Scanning Techniques – Advanced Firewall/IDS Evading Techniques.

UNIT IV EXPLOITATION **9**

Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client Side Exploitation Methods – E–Mails with Malicious Attachments – Creating a Custom Executable – Creating a Backdoor with SET – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post–Exploitation – Acquiring Situation Awareness – Hashing Algorithms – Windows Hashing Methods – Cracking the Hashes – Brute force Dictionary Attacks – Password Salts –Rainbow Tables – John the Ripper – Gathering OS Information –Harvesting Stored Credentials.

UNIT V ENTERPRISE SECURITY **9**

Gaining and Maintaining Access : Systems hacking – Windows and Linux – Metasploit and Kali Linux, Keylogging, Buffer Overflows, Privilege Escalation, Network hacking - ARP Poisoning, Password Cracking, WEP Vulnerabilities, MAC Spoofing, MAC Flooding, IP Spoofing, SYN Flooding, Smurf attack, Applications hacking : SMTP/Email-based attacks, VOIP vulnerabilities, Directory traversal, Input Manipulation, Brute force attack, Unsecured login mechanisms, SQL injection, XSS, Mobile apps security, Malware analysis : Netcat Trojan, wrapping definition, reverse engineering, Additional Security Mechanisms : IDS/IPS, Honeypots and evasion techniques, Secure Code Reviews (Fortify tool,OWASP Secure Coding Guidelines)

Total: 45

REFERENCES

1. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014.
2. Certified Ethical Hacker Study Guide v9, Sean-Philip Oriyano, Sybex; Study Guide Edition,2016
3. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2007
4. Patrick Engebretson, “The Basics of Hacking and Penetration Testing – Ethical Hacking andPenetration Testing Made Easy”, Syngress Media, Second Revised Edition, 2013
5. Michael T. Simpson, Kent Backman, James E. Corley, “Hands-On Ethical Hacking and NetworkDefense”, Cengage Learning, 2012
6. Kevin Beaver, “Ethical Hacking for Dummies”, Sixth Edition, Wiley, 2018.
7. Jon Erickson , “Hacking: The Art of Exploitation”, Second Edition, Rogunix, 2007.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	1	2	-	2
CO2	3	-	2	2	1	2	-	2
CO3	3	-	2	2	1	2	-	2
CO4	3	-	3	2	1	2	-	2
CO5	3	-	3	2	1	2	-	2
Average	**3**	**-**	**2.4**	**2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER-II

25MECS2E04 OPTIMIZATIONS FOR MACHINE LEARNING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Recognize classes of optimization problems prevalent in machine learning and related disciplines, understanding their significance and applications.
- Gain insight into the mathematical foundations of optimization methods through examples drawn from various fields such as machine learning, computer vision, engineering,and data analysis.
- Learn foundational optimization concepts, including gradient descent, stochastic gradient methods, higher-order methods, and more advanced optimization algorithms, and classify optimization problems based on their tractability, difficulty, and compatibility with existingsoftware.

COURSE OUTCOMES

Upon completion of the course, the student should be able to:

- Distinguish the fundamental knowledge of optimization methods for machine learning. K4
- Summarize optimization techniques and numerical methods of optimization. K2
- Identify the fundamentals of optimization methods and apply different techniques to solve various optimization problems arising from machine learning. K3
- Examine Optimization Methods for co variance relations. K4
- Analyze about Parallel and Distributed Optimization Algorithms and applications. K4

UNIT I INTRODUCTION 9

Introduction: Optimization and Machine Learning–Convex Optimization with Sparsity-Inducing Norms–Interior-Point Methods for Large-Scale Cone Programming–Incremental Gradient, Sub-gradient, and Proximal Methods for Convex Optimization.

UNIT II OPTIMIZATION METHODS: STOCHASTIC AND ONLINE VARIANTS 9

Stochastic and Online Variants of mentioned methods–Coordinate Descent–Frank-Wolfe–Accelerated Methods– Cutting-Plane Methods in Machine Learning–Introduction to Dual Decomposition for Inference.

UNIT III ADVANCED OPTIMIZATION TECHNIQUES 9

Augmented Lagrangian Methods for Learning, Selecting, and Combining Features–The Convex Optimization Approach to Regret Minimization–Projected Newton-type Methods in Machine Learning.

UNIT IV ROBUST OPTIMIZATION TECHNIQUES **9**

Robust Optimization in Machine Learning–Improving First and Second-Order Methods by ModelingUncertainty–Optimization Methods for Sparse Inverse Covariance Selection.

UNITV ADVANCED MODEL **9**

A Pathwise Algorithm for Covariance Selection–Advanced models: GANs, adversarial optimization,robust optimization, cycle consistency–Parallel and Distributed Optimization Algorithms.

Total: 45

REFERENCES

1. Suvrit Sra, Sebastian Nowozin, and Stephen J. Wright, "Optimization for MachineLearning", MITPress, First Edition,2013.
2. Stephen Boyd and Lieven Vandenberghe, "Convex Optimization", CambridgeUniversity Press,First Edition2009.
3. Nocedal. J and Wright. S.J," Numerical Optimization", Springer Publishers, First Edition,2006.
4. Sébastien Bubeck, "Convex Optimization: Algorithms and Complexity", Now Publishers Inc,FirstEdition,2015.
5. Cong Fang, Huan Li, and Zhouchen Lin, "Accelerated Optimization for MachineLearning",Springer Publishers, First Edition, 2020.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	1	-	2	-	2
CO2	3	-	2	1	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	3	2	-	2	-	2
CO5	3	-	3	2	-	2	-	2
Average	**3**	**-**	**2.4**	**1.6**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

25MECS2E05 MULTIMEDIA SYSTEMS AND APPLICATIONS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Equip with the knowledge and skills to design, analyze, and manage advanced multimediacommunication systems.
- Ensure efficient, secure and high-quality multimedia delivery across various platforms andnetworks.
- Understand the multimedia systems and its applications.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Outline the multimedia elements and multidimensional data structures. K2
- Make use of multimedia hardware and software for editing and authoring multimedia applications. K3
- Apply compression algorithms for various multimedia applications K3
- Analyze Multimedia Communication Standards and protocols used in multimedia communications. K4
- Examine real time multimedia applications for real time accessing. K4

UNIT I MULTIMEDIA ELEMENTS 9

Principles – Cognition, Learning, Interaction, Medium of Consumption: Elements - Text – characteristics, standards, formats; Graphics – representation, file formats, Image / Graphics – file formats, standards; Digital Audio – Characteristics, formats, standards, Speech, Video – characteristics, formats; Animation

– characteristics, formats, Multidimensional Data Structures, k- d trees, Quad Trees, R-trees.

UNIT II MULTIMEDIA TOOLS AND AUTHORING 9

Hardware – Display Devices, wearables, Graphics cards, I/O devices, software – Editing tools for Text, Image, Audio, Video and animation. Authoring tools, Authoring Multimedia presentations, Authoring Metaphors.

UNIT III MULTIMEDIA COMPRESSION 9

Symmetric and Asymmetric methods, Lossy and Lossless Compression, Text compression – RLE, Huffman, Arithmetic, Dictionary based; Document Image compression standards – CCITT and Color Image Compression – JPEG, Audio Compression – PCM, ADPCM, MPEG, AAC, AC3, speech compression; Video Compression-MPEG-4, H.265, DVI

UNIT IV MULTIMEDIA COMMUNICATION SYSTEMS **9**

Multimedia Communication Standards, Transport Protocols, streaming protocols, Internet protocols, Wireless multimedia communications, synchronization and QOS, security, Entertainment networks, Collaborative multimedia support, Real-time distributed multimedia networks, Hypertext, Hypermedia.

UNIT VMULTIMEDIA APPLICATIONS **9**

Applications for WWW - Multimedia databases – Indexing and Retrieval, Visualization, Virtual, Augmented and Mixed Reality, Interactive E-learning, HCI and UX design, Games and Animation, Real-Time video conferencing.

Total: 45

REFERENCES

1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, “Fundamentals of Multimedia”, Second Edition,Springer Nature (Texts in Computer Science), 2014.
2. Prabhat K. Andleigh, Kiran Thakrar, “Multimedia Systems Design”, Pearson Education India, IstEdition, 2015
3. Ralf Steinmetz and Klara Nahrstedt, “Multimedia computing, communications, andapplications”, Pearson India, Pearson, 2002.
4. Fred Halsall, “Multimedia Communications: Applications, Networks,Protocols and Standards”, Pearson Education, 2002.
5. Khalid Sayood, “Introduction to Data Compression”, 4th Edition, Morgan Kauffman, 2012.
6. K.R. Rao, Zoran S. Bojkovic, Bojan M. Bakmaz, “Wireless Multimedia Communication systems:Design, Analysis and Implementation”, CRC press, 2017.
7. V.S. Subrahmanian, “Principles of Multimedia Database Systems”, Elsevier- Morgan Kauffmann,2008.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	-	2	1	-	2	2	-
CO2	2	-	2	1	-	2	2	-
CO3	2	-	2	1	-	2	2	-
CO4	3	-	3	2	-	2	2	-
CO5	3	-	3	2	-	2	2	-
Average	**2.6**	**-**	**2.4**	**1.4**	**-**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

25MECS2E06 FULL STACK WEB APPLICATION DEVELOPMENT 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Develop TypeScript applications with proficiency, leveraging its features for efficient andscalable development.
- Construct Single Page Applications (SPAs) using TypeScript, ensuring smooth navigationand user experience within web applications.
- Enable communication with servers over the HTTP protocol, facilitating data exchange between client and server-side components of TypeScript applications.

COURSE OUTCOMES

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

- Apply Javascript programming skills to an application. K3
- Build a front-end web application using Angular. K3
- Develop modules to organise the Application on server. K3
- Examine RESTful APIs with Node, Express and MongoDB with confidence. K4
- Analyze complex, relational data in MongoDB using Mongoose platform. K4

UNIT I FUNDAMENTALS & TYPESCRIPT LANGUAGE **9**

Server-Side Web Applications. Client-Side Web Applications. Single Page Application. About TypeScript. Creating TypeScript Projects. TypeScript Data Types. Variables. Expression and Operators. Functions. OOP in Typescript. Interfaces. Generics. Modules. Enums. Decorators. Enums. Iterators. Generators.

UNIT II ANGULAR **9**

About Angular. Angular CLI. Creating an Angular Project. Components. Components Interaction. Dynamic Components. Angular Elements. Angular Forms. Template Driven Forms. Property, Style, Classand Event Binding. Two-way Bindings. Reactive Forms. Form Group. Form Controls. About Angular Router. Router Configuration. Router State. Navigation Pages. Router Link. Query Parameters.URL matching. Matching Strategies. Services. Dependency Injection. Http Client. Read Data from the Server. CRUD Operations. Http Header Operations. Intercepting requests and responses.

UNIT III NODE.js **9**

About Node.js. Configuring Node.js environment. Node Package Manager NPM. Modules. AsynchronousProgramming. Call Stack and Event Loop. Callback functions. Callback errors. Abstracting callbacks. Chaining callbacks. File System. Synchronous vs. asynchronous I/O. Path and directory operations. File Handle. File Synchronous API. File Asynchronous API. File Callback API. Timers. Scheduling Timers. Timers Promises API. Node.js Events. Event Emitter. Event Target and Event API. Buffers. Buffers and Typed Arrays. Buffers and iteration. Using buffers for binary data. Flowing vs. non- flowing streams. JSON.

UNIT IV EXPRESS.Js **9**

Express.js. How Express.js Works. Configuring Express.js App Settings. Defining Routes. Starting theApp. Express.js Application Structure. Configuration, Settings. Middleware. body-parser. cookie-parser. express-session. response-time. Template Engine. Jade. EJS. Parameters. Routing. router. Route (path).Router Class. Request Object. Response Object. Error Handling. RESTful.

UNIT V MONGODB **9**

Introduction to MongoDB. Documents. Collections. Subcollections. Database. Data Types. Dates. Arrays. Embedded Documents. CRUD Operations. Batch Insert. Insert Validation. Querying The Documents. Cursors. Indexing. Unique Indexes. Sparse Indexes. Special Index and Collection Types. Full-Text Indexes. Geospatial Indexing. Aggregation framework.

Total: 45

REFERENCES

1. Adam Freeman, Essential TypeScript, A press, 2019.
2. Mark Clow, Angular Projects, A press, 2018.
3. Alex R. Young, Marc Harter, Node.js in Practice, Manning Publication, 2014.
4. Pro Express.js, Azat Mardan, A press, 2015.
5. MongoDB in Action, Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins,Manning Publication, Second edition, 2016.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	-	1	1	1	1	-	2
CO2	2	-	1	1	1	1	-	2
CO3	2	-	1	1	1	1	-	2
CO4	3	-	2	2	1	2	-	2
CO5	3	-	2	2	1	2	-	2
Average	**2.4**	**-**	**1.4**	**1.4**	**1**	**1.4**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

25MECS2E07 DATA WAREHOUSING AND DATA MINING TECHNIQUES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Know the data warehousing components and models.
- Learn Business Analysis Framework for Data Warehouse Design.
- Gain the knowledge of classifications and clustering techniques in data mining.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Illustrate multidimensional intelligent model from typical system. K2
- Compare ROLAP, MOLAP and HOLAP server architecture. K2
- Apply the stages of the Data Mining Process to prepare data for mining. K3
- Make use of classification and clustering techniques for efficient data mining. K3
- Identify mining techniques on complex data objects. K3

UNIT I INTRODUCTION TO DATA WAREHOUSING 9

Data Warehouse: Basic Concepts - Differences between Operational Database Systems and Data Warehouses- Data warehousing Components – Data Warehousing: A Multi-tiered Architecture – Data Warehouse Models: Enterprise Warehouse, Data Mart, distributed and virtual data warehouses Building a Data warehouse - Data Warehouse and DBMS, - Data Extraction, Cleanup, and Transformation Tools - Data marts, Metadata, Multidimensional data model, Data Warehouse Modeling: Data Cube and OLAP, OLAP operations, Schemas for Multidimensional Database – Metadata.

UNIT II DATA WAREHOUSE PROCESS AND ARCHITECTURE 9

A Business Analysis Framework for Data Warehouse Design - Data Warehouse Design Process - Data Warehouse Usage for Information Processing - Data Warehouse Implementation: Efficient Data Cube Computation- Efficient Processing of OLAP, OLAP Server Architectures: ROLAP versus MOLAP versusHOLAP - tuning and testing of data warehouse - data warehouse visualization, Data Warehouse Deployment, Maintenance. Data Warehousing and Business Intelligence Trends.

UNIT III INTRODUCTION TO DATA MINING 9

Data Objects and Attribute Types - Basic Statistical Descriptions of Data - Measuring Data Similarity andDissimilarity - KDD versus data mining, Stages of the Data Mining Process-task primitives, Data Mining Techniques - Data preprocessing – Data cleaning, Data Integration, Data Transformation and Data Discretization, Data reduction - Association Rule Mining: Frequent Item set Mining Methods – Pattern Evaluation Methods – Association Mining to Correlation Analysis.

UNIT IV CLASSIFICATION AND CLUSTERING 9

Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods(Genetic Algorithms, Rough Set Approach, Fuzzy Set Approaches) – Semi-Supervised Classification - Clustering techniques – Partitioning methods : k-means- Hierarchical Methods : distance based agglomerative and divisible clustering, Probabilistic hierarchical Clustering Density-Based Methods : DBSCAN, DENCLUE – Expectation Maximization -Grid Based Methods – Clustering High-DimensionalData - Clustering Graph and Network Data - Outlier Analysis.

UNIT V TRENDS IN DATA MINING 9

Big Data - Mining complex data objects – Spatial databases – Temporal databases – Visual and Audio Data Mining – Time series and sequence data – Text mining – Web mining – Data mining Applications.

Total: 45

REFERENCES

1. Jiawei Han, Micheline Kamber and Jian Pei “Data Mining Concepts and Techniques”, Third Edition,Elsevier, 2011.
2. Alex Berson, Stephen J. Smith, “Data Warehousing, Data Mining & OLAP”, Tata McGraw Hill, TenthReprint, 2007.
3. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Eastern Economy Edition, Prentice Hallof India, Third Edition, 2014.
4. Ian.H.Witten, Eibe Frank and Mark.A.Hall, “Data Mining: Practical Machine Learning Tools andTechniques”, Morgan Kaufmann, Third edition, 2011.
5. Bruce Ratner, “Statistical and Machine - Learning Data Mining: Techniques for Better PredictiveModeling and Analysis of Big Data”, CRC Press, Second Edition, 2012.
6. Mehmed kantardzic, “Data mining: Concepts, Models, Methods, andAlgorithms”, WileyBlackwell, Second Edition, 2011.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	-	1	1	1	1	-	2
CO2	2	-	1	1	1	1	-	2
CO3	2	-	1	1	1	1	-	2
CO4	3	-	2	2	1	2	-	2
CO5	3	-	2	2	1	2	-	2
Average	**2.4**	**-**	**1.4**	**1.4**	**1**	**1.4**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

25MECS2E08 VIRTUALIZATION TECHNIQUES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Understand the fundamentals of virtualization and technologies.
- Learn the case study based on High-Performance Emulation.
- Gain knowledge on designing and implementing virtual cloud-based software systems.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Interpret the need of virtualization and technologies. K2
- Apply virtual machine programming languages and emulation. K3
- Utilize High Level Language Virtual Machine Architecture to real time systemsapplications. K3
- Distinguish network and storage virtualization. K4
- Analyze virtual clusters and resource management in virtualized environments. K4

UNIT I INTRODUCTION TO DATA WAREHOUSING 9

Data Warehouse: Basic Concepts - Differences between Operational Database Systems and Data Warehouses- Data warehousing Components – Data Warehousing: A Multi-tiered Architecture – Data Warehouse Models: Enterprise Warehouse, Data Mart, distributed and virtual data warehouses Building a Data warehouse - Data Warehouse and DBMS, - Data Extraction, Cleanup, and Transformation Tools- Data marts, Metadata, Multidimensional data model, Data Warehouse Modeling: Data Cube and OLAP, OLAP operations, Schemas for Multidimensional Database – Metadata.

UNIT II DATA WAREHOUSE PROCESS AND ARCHITECTURE 9

A Business Analysis Framework for Data Warehouse Design - Data Warehouse Design Process - Data Warehouse Usage for Information Processing - Data Warehouse Implementation: Efficient Data Cube Computation- Efficient Processing of OLAP, OLAP Server Architectures: ROLAP versus MOLAP versus HOLAP - tuning and testing of data warehouse - data warehouse visualization, Data Warehouse Deployment, Maintenance. Data Warehousing and Business Intelligence Trends.

UNIT III INTRODUCTION TO DATA MINING **9**

Data Objects and Attribute Types - Basic Statistical Descriptions of Data - Measuring Data Similarity and Dissimilarity - KDD versus data mining, Stages of the Data Mining Process-task primitives, Data Mining Techniques - Data preprocessing – Data cleaning, Data Integration, Data Transformation and Data Discretization, Data reduction - Association Rule Mining: Frequent Item set Mining Methods – Pattern Evaluation Methods – Association Mining to Correlation Analysis.

UNIT IV CLASSIFICATION AND CLUSTERING **9**

Decision Tree Induction - Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods(Genetic Algorithms, Rough Set Approach, Fuzzy Set Approaches) – Semi-Supervised Classification - Clustering techniques – Partitioning methods : k-means- Hierarchical Methods : distance based agglomerative and divisible clustering, Probabilistic hierarchical Clustering Density-Based Methods : DBSCAN, DENCLUE – Expectation Maximization -Grid Based Methods – Clustering High-Dimensional Data - Clustering Graph and Network Data - Outlier Analysis.

UNIT V TRENDS IN DATA MINING **9**

Big Data - Mining complex data objects – Spatial databases – Temporal databases – Visual and Audio Data Mining – Time series and sequence data – Text mining – Web mining – Data mining Applications.

Total: 45

REFERENCES

1. Jiawei Han, Micheline Kamber and Jian Pei“Data Mining Concepts and Techniques”, Third Edition,Elsevier, 2011.
2. Alex Berson, Stephen J. Smith, “Data Warehousing, Data Mining & OLAP”, Tata McGraw Hill,Tenth Reprint, 2007.
3. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Eastern Economy Edition, PrenticeHall of India, Third Edition, 2014.
4. Ian.H.Witten, Eibe Frank and Mark.A.Hall, “Data Mining: Practical Machine Learning Tools andTechniques”, Morgan Kaufmann, Third edition, 2011.
5. Bruce Ratner, “Statistical and Machine - Learning Data Mining: Techniques for Better PredictiveModeling and Analysis of Big Data”, CRC Press, Second Edition, 2012.
6. Mehmed kantardzic, “Data mining: Concepts, Models, Methods, and Algorithms”, WileyBlackwell, Second Edition, 2011.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	2	-	1	1	-	2	-	2
CO2	2	-	1	1	-	2	-	2
CO3	2	-	1	1	-	2	-	2
CO4	2	-	2	2	-	2	-	2
CO5	3	-	2	2	-	2	-	2
Average	**2.2**	**-**	**1.4**	**1.4**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

25MECS2E09 SOCIAL NETWORK SECURITY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Develop simple applications for the Semantic Web, integrating semantic technologies to enhance data organization and interoperability.
- Analyze privacy and security concerns within social networking platforms, emphasizing the need for robust safeguards to protect user data and privacy.
- Explore data extraction and mining techniques specific to social networks, examining methods to extract valuable insights from vast amounts of social data. Additionally, discuss the prediction of human behavior within social communities, leveraging data analytics to forecast trends and patterns.

COURSE OUTCOMES

Upon completion of the course, the student should be able to:

- Build semantic web related simple applications. K3
- Develop strategies for securing social media accounts and protecting personal informationfrom cyber threats. K3
- Identify data extraction and mining techniques in social networking medium. K3
- Examine the prediction of human behavior in social communities. K4
- Analyze the applications of social networks to predict user trends. K4

UNIT I FUNDAMENTALS OF SOCIAL NETWORKING 9

Introduction to Semantic Web, Limitations of current Web, Development of Semantic Web, Emergence of the Social Web, Social Network analysis, Development of Social Network Analysis, Key concepts and measures in network analysis, Historical overview of privacy and security, Major paradigms, for understanding privacy and security.

UNIT II SECURITY ISSUES IN SOCIAL NETWORKS 9

The evolution of privacy and security concerns with networked technologies, Contextual influences on privacy attitudes and behaviors, Anonymity in a networked world.

UNIT III EXTRACTION AND MINING IN SOCIAL NETWORKING DATA 9

Extracting evolution of Web Community from a Series of Web Archive, detecting communities in social networks, Definition of community, Evaluating communities, Methods for community detection and mining, Applications of community mining algorithms, Tools for detecting communities social network infrastructures and communities, Big data and Privacy.

UNIT IV PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES 9

Understanding and predicting human behavior for social communities, User data Management, Inference and Distribution, enabling new human experiences, Reality mining, Context, Awareness, Privacy in online social networks, what is Neo4j, Nodes, Relationships, Properties.

UNIT V ACCESS CONTROL, PRIVACY AND IDENTITY MANAGEMENT 9

Understand the access control requirements for Social Network, Enforcing Access Control Strategies, Authentication and Authorization, Roles-based Access Control, Host, storage and network access control options, Firewalls, Authentication, and Authorization in Social Network, Identity & Access Management, Single Sign-on, Identity Federation, Identity providers and service consumers, The role of Identity provisioning.

Total: 45

REFERENCES

1. Peter Mika, Social Networks and the Semantic Web, First Edition, Springer 2007.
2. BorkoFurht, Handbook of Social Network Technologies and Application, First Edition, Springer,2010.
3. David Easley, Jon Kleinberg, Networks, Crowds, and Markets: Reasoning about a HighlyConnected World‖, First Edition, Cambridge University Press, 2010.
4. Easley D. Kleinberg J., Networks, Crowds, and Markets – Reasoning about a Highly ConnectedWorld‖, Cambridge University Press, 2010.
5. Jackson, Matthew O., Social and Economic Networks‖, Princeton University Press, 2008.
6. Guandong Xu, Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniquesand applications‖, First Edition, Springer, 2011.
7. Dion Goh and Schubert Foo, Social information Retrieval Systems: Emerging Technologies andApplications for Searching the Web Effectively‖, IGI Global Snippet, 2008.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	1	2	-	2
CO2	3	-	2	2	1	2	-	2
CO3	3	-	2	2	1	2	-	2
CO4	3	-	2	2	1	2	-	2
CO5	3	-	2	2	1	2	-	2
Average	**3**	**-**	**2**	**2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

25MECS2E10 **DEEP LEARNING** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Develop and train deep neural networks, encompassing various architectures such as convolutional neural networks (CNNs), recurrent neural networks (RNNs), and autoencoders.
- Apply advanced CNN architectures including R-CNN, Fast R-CNN, Faster R-CNN, and Mask R-CNN for tasks such as object detection and recognition, leveraging their capabilities for accurateand efficient image analysis.
- Build and train RNNs for natural language processing (NLP) tasks, incorporating techniques such as word embeddings to represent textual data effectively and infer the internal structures of Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) architectures.

COURSE OUTCOMES

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

- Summarize concepts of deep learning in neural network. K2
- Apply back propagation, stochastic gradient descent, and regularization in deep learning. K3
- Develop deep learning models for image classification, object detection and natural languageprocessing. K3
- Build deep learning models using metrics such as accuracy, precision, and recall. K3
- Identify the ethical and social implications of deep learning, such as bias, privacy, andaccountability. K3

UNIT I DEEP LEARNING CONCEPTS 9

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT II NEURAL NETWORKS 9

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting.Hyper parameters.

UNIT III CONVOLUTIONAL NEURAL NETWORK **9**

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO.

UNIT VI NATURAL LANGUAGE PROCESSING USING RNN **9**

About NLP & its Toolkits. Language Modeling. Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co- occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN). Long Short-Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING **9**

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders.

Total: 45

REFERENCES

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam GibsonO'Reilly Media,Inc.2017.
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018.
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, A press, 2020.
4. Deep Learning with Python, François Chollet, Manning ShelterIsland,2017.
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	1	2	2	-	2	-	2
CO2	3	1	2	2	-	2	-	2
CO3	3	1	2	2	-	2	-	2
CO4	3	1	2	2	-	2	-	2
CO5	3	1	2	2	-	2	-	2
Average	**3**	**1**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25MECS2E11 DIGITAL IMAGE AND VIDEO PROCESSING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Gain a thorough understanding of image processing concepts and analysis, includingkey techniques and their applications.
- Familiarize with the image processing environment and explore various image processing techniques, learning their practical implementations.
- Understand the diverse applications of image processing across different fields, and learn specialized techniques such as image registration and visualization to enhance datainterpretation and analysis.

COURSE OUTCOMES

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

- Interpret the digital image processing and the characteristics of images. K2
- Apply image enhancement techniques in contrast stretching, histogram equalization,and spatial filtering. K3
- Identify image processing in the frequency domain using Fourier Transform . K3
- Build image segmentation algorithms for region-basedsegmentation, and clustering. K3
- Develop proficiency in using image processing software and tools like MATLAB, OpenCV, andImageJ. K3

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.

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: 45

REFERENCES

1. Alasdair McAndrew, ―Introduction to Digital Image Processing with Matlab‖, Cengage Learning, 2011.
2. Anil J Jain, ―Fundamentals of Digital Image Processing‖, PHI, 2006.
3. Kavyan Najarian and Robert Splerstor, ‖ Biomedical signals and Image processing‖, CRC –Taylorand Francis, New York, 2006.
4. Rafael C. Gonzalez and Richard E.Woods, ― Digital Image Processing‖, ThirdEdition, PearsonEducation, 2008, New Delhi.
5. S.Sridhar, ―Digital Image Processing‖, Oxford University Press, 2011.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	2	2	-	2	-	2
Average	**3**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-II

25MECS2E12 WEB CONTENT DESIGN AND MANAGEMENT 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course is for the students to:

- Gain the knowledge of principles of web design and elements of page design
- Understand the web content design and management.
- Learn the Web Analytics process for onsite and offsite analytics.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Outline the web pages design process and the standards. K2
- Develop web sites using elements of page design. K3
- Make use of content management system for designing web Content. K3
- Apply content management system tools for managing content for large web sites. K3
- Utilize the web analytics methods and analytics tools for better management. K3

UNIT I PRINCIPLES OF WEB DESIGN 9

User Centered Design, Web Medium, Information Architectures, Site types and Architectures, Page Structure, Site Maps, Navigation, Search, Web Design Process, Designing for multiple screen resolutions, creating a unified site design, Evaluating Web Sites.

UNIT II ELEMENTS OF PAGE DESIGN 9

Elements of Page Design, Adding styles with CSS, Pages and Layout, Typography, Color, Images, GUI Widgets and Forms, responsive web designs, User input forms, Working with data tables, Webstandards and styles.

UNIT III WEB CONTENT DESIGN 9

Features – Automated templates – Template processor –Front Controller pattern – content modeling-content aggregation – plug-ins – Search Engine Optimization – recommended usage of tools – word press

UNIT IV WEB CONTENT MANAGEMENT 9

Work flow management – document management – collaboration – versioning – recommended usageof tools – WORDPRESS.

UNIT V WEB ANALYTICS **9**

Web Analytics process – Data collection – qualitative analysis – log file analysis – Page Tagging – hybrid methods – click analytics – onsite and offsite analytics – web analytics methods

Total: 45

REFERENCES

1. Patrich J. Lynch, Sarah Horton, "Web Style Guide-Foundations of User ExperienceDesign",Yale University Press, 4th Edition, 2016.
2. Joel Sklar, Principles of Web Design, Cengage Learning –Web Warrior Series, 6th Edition,2015.
3. Deane Barker, "Web Content management-Systems, Features and Best Practices", O'reillyMedia, 1st Edition, 2016.
4. Brian Clifton, "Advanced web Metrics with Google Analytics", Third Edition, Sybex Publishers,2012.
5. Avinash Kaushik, Web Analytics 2.0: The Art of Online Accountability and Science of CustomerCentricity, 1st edition, Sybex publishers, 2009.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	1	2	2	-
CO2	3	-	2	2	1	2	2	-
CO3	3	-	2	2	1	2	2	-
CO4	3	-	2	2	1	2	2	-
CO5	3	-	2	2	1	2	2	-
Average	**3**	**-**	**2**	**2**	**1**	**2**	**2**	**-**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E01 DATA SCIENCE 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Understand and implement fundamental algorithms to process data, including statistical methods and machine learning algorithms essential for data science.
- Apply hypotheses and data to generate actionable predictions, effectively communicating findings through comprehensive documentation and visualization techniques.
- Develop foundational knowledge and key concepts necessary to become a proficient data science professional, mastering the tools and techniques required for the field.

COURSE OUTCOMES

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

- Apply data visualization in big-data analytics. K3
- Build EDA, inference and regression techniques in data science. K3
- Identify Matrix decomposition techniques to perform data analysis. K3
- Apply data pre-processing techniques to social media application. K3
- Analyze Machine Learning Algorithms to perform data visualization. K4

UNIT I INTRODUCTION TO DATA SCIENCE 9

Data science process – roles, stages in data science project – working with data from files –working with relational databases – exploring data – managing data – cleaning and samplingfor modeling and validation – introduction to NoSQL.

UNIT II MODELING METHODS 9

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.

UNIT III INTRODUCTION TO R 9

Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R -manipulating objects – data distribution.

UNIT IV DISTRIBUTED FILE SYSTEM **9**

Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop MapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting -Reducing phase execution.

UNIT V DATA VISUALIZATION **9**

Documentation and deployment – producing effective presentations – Introduction to graphical analysis – Plot() function – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph using graphics parameters - Case studies.

Total: 45

REFERENCES

1. Nina Zumel, John Mount, "Practical Data Science with R", Manning Publications, 2014.
2. Mark Gardener, "Beginning R - The Statistical Programming Language", John Wiley &Sons, Inc.,2012.
3. W. N. Venables, D. M. Smith and the R Core Team, "An Introduction to R", 2013.
4. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical DataScienceCookbook", Packet Publishing Ltd., 2014.
5. Nathan Yau, "Visualize This: The Flowing Data Guide to Design, Visualization,and Statistics",Wiley, 2011.
6. Boris Lublinsky, Kevin T. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", JohnWiley & Sons Inc., 2013.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	1	2	-	2
CO2	3	-	2	2	1	2	-	2
CO3	3	-	2	2	1	2	-	2
CO4	3	-	2	2	1	2	-	2
CO5	3	-	3	3	1	2	-	2
Average	**3**	**-**	**2.2**	**2.2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E02 PARALLEL ALGORITHMS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Learn the concepts of sequential and parallel algorithms.
- Gain the knowledge of sorting, searching and graph problems.
- Implement parallel algorithms using parallel programming paradigms and languages and understand the trade-offs between different approaches.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Compare and contrast sequential and parallel algorithms. K2
- Apply parallel algorithms in parallel model computation. K3
- Solve searching and sorting problems. K3
- Apply the permutations and combinations for algebraic problems. K3
- Identify the graphs for solving non-linear structures. K3

UNIT I INTRODUCTION 9

Introduction to Parallel Algorithms – Principles of Parallel Algorithm Design- Parallel Algorithm Models - Analyzing Parallel Algorithms- PRAM Algorithms: PRAM Model of Computation – ParallelReduction – Prefix Sum-List ranking- Merging Sorted lists

UNIT II PROCESSOR ORGANISATION 9

Mesh -Binary Tree Network-Hyper Tree Network- Pyramid – Butterfly- Hypercube –Shuffle-ExchangeNetworks – Multiprocessor- Multicomputer- Data Mapping

UNIT III SORTING & SEARCHING 9

Sorting Networks – Sorting on a Linear Array – Sorting on CRCW, CREW, EREW – Searching a sortedsequence – Searching a random sequence – Bitonic Sort

UNIT IV ALGEBRAIC PROBLEMS 9

Permutations and Combinations – Matrix Transpositions – Matrix by Matrix Multiplications – Matrix by Vector Multiplication.

UNIT V GRAPH ALGORITHMS 9

Connectivity Matrix – Connected Components – All Pair Shortest Paths – Single Source ShortestPath - Minimum Spanning Trees – Sollin’s Algorithm - Kruskal’s Algorithm-Algorithms for Sparse Graphs

Total: 45

REFERENCES

1. Michael J. Quinn, “Parallel Computing: Theory & Practice”, Tata McGraw Hill Edition, 2003.
2. Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar,” Introduction to Parallel Computing”, Pearson, 2012
3. Selim G. Akl, “The Design and Analysis of Parallel Algorithms”, Prentice Hall, New Jercy, 1989
4. Joseph JaJa, “Introduction to Parallel Algorithms”, Addison-Wesley, 1992.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	2	-
CO2	3	-	2	2	-	2	2	-
CO3	3	-	2	2	-	2	2	-
CO4	3	-	2	2	-	2	2	-
CO5	3	-	2	2	-	2	2	-
Average	**3**	-	**2**	**2**	-	**2**	**2**	-

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER-III

25MECS3E03 CYBER PHYSICAL SYSTEM 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Equip with the knowledge and skills Cyber-Physical Systems (CPS) design, CPS HW platformsand CPS - feedback systems.
- Gain the knowledge of HiTL Technologies and its applications.
- Learn Human Centric Computing in a Data-Driven Society.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Explain the Characteristics and foundation of Cyber-Physical Systems. K3
- Identify the key technologies, strengths and limitations of Human Centered Cyber Physical Systems. K3
- Utilize computational knowledge base to create their own methods for answering novel questionsof either a theoretical or applied nature. K3
- Develop the challenges in HiTL and the future of HiTL CPS. K3
- Analyze the theoretical perspectives, empirical findings, and historical trends in Cyber-PhysicalSystems. K4

UNIT I CYBER-PHYSICAL SYSTEMS 9

Cyber-Physical Systems (CPS) in the real world - Characteristics of CPS - Architecture of CPS - Distinctivefeatures of CPS systems - CPS for Industry 4.0 - IIOT implications - Logical Foundations of Cyber-Physical Systems - CPS HW platforms: Processors, Sensors, Actuators - CPS Network-Scheduling Real Time CPStasks.

UNIT II CPS - FEEDBACK SYSTEMS 9

Modeling of system : Continuous Dynamics, Discrete Dynamic, Hybrid Systems, Composition of State Machine, Concurrent Models of Computation - CPU Dynamics - Relation between physical and software models - Principles of Dynamical Systems : Dynamical Systems and Stability - Controller DesignTechniques - Meta Model of CPS - Control systems: Human-in or on the loop - Economics in the loop - Environment in the loop.

UNIT III CPS - HiTL **9**

Taxonomies for HiTL CPS - Data Acquisition: Humans as Sets of Sensors, Humans as Communication Nodes - State Inference: Humans as Processing Nodes - Actuation - HiTL Technologies and Applications - Requirements and Challenges for HiTL Applications - Future of Human-In-the-Loop Cyber-Physical Systems - Human-in-the-Loop Constraints.

UNIT IV HUMAN CENTRIC COMPUTING **9**

Aim of Human Centric Computing - Context-aware service technology - Multi-device Collaboration technology - Human Interaction technology - Human Centric Computing in a Data-Driven Society.

UNIT V CPS IMPLEMENTATION ISSUES **9**

From features to automotive software components - Mapping software components to ECUs -CPS Performance Analysis - effect of scheduling, bus latency, sense and actuation faults on control performance,network congestion - Building real-time networks for CPS.

Total: 45

REFERENCES

1. E. A. Lee and S. A. Seshia, “Introduction to Embedded Systems: A Cyber-Physical Systems Approach”,2011.
2. R. Alur, “Principles of Cyber-Physical Systems,” MIT Press, 2015.
3. R. Alur, “Principles of Cyber-Physical Systems,” MIT Press, 2015.
4. T. D. Lewis “Network Science: Theory and Applications”, Wiley, 2009.
5. P. Tabuada, “Verification and control of hybrid systems: a symbolic approach”, Springer- Verlag 2009.
6. C. Cassandras, S. Lafortune, “Introduction to Discrete Event Systems”, Springer 2007.
7. Constance Heitmeyer and Dino Mandrioli, “Formal methods for real-time computing”, Wiley publisher,1996.
8. Platzer, Andre, " Logical Foundation of Cyber-Physical Systems", Theorectical Computer Science,Springer-2018.
9. Rajkamal, " Enbedded Systems, Architecture, Programming and Design", Second Edition, Tata McGraw-Hill Publisher, 2008.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	1	2	-	2
CO2	3	-	2	2	1	2	-	2
CO3	3	-	2	2	1	2	-	2
CO4	3	-	2	2	1	2	-	2
CO5	3	-	3	2	1	2	-	2
Average	**3**	**-**	**2.2**	**2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, ‘-' - No Correlation

SEMESTER-III

25MECS3E04 SOFT COMPUTING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Equip with the knowledge and skills in Soft Computing and Fuzzy logic.
- Gain the knowledge of Genetic Algorithm and Multi-Objective Evolutionary Algorithm (MOEA).
- Develop real time applications with neural network and fuzzy logic.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Infer how intelligent system works with human intelligence and AI. K2
- Identify the feasibility of a soft computing methodology to solve problem. K3
- Apply fuzzy logic and reasoning to handle uncertainty engineering problems. K3
- Build genetic algorithms to optimization problems. K3
- Analyze neural networks for pattern classification and regression problems K4

UNIT I SOFT COMPUTING AND FUZZY COMPUTING

Introduction to Soft Computing and Fuzzy logic, Fuzzy membership functions, Operations on Fuzzy sets Fuzzy relations, Fuzzy propositions, Fuzzy implications, Fuzzy inferences, Defuzzyfication Techniques, Fuzzy logic controller, Industrial Applications.

UNIT II FUNDAMENTALS OF NEURAL NETWORKS

Neuron, Nerve Structure and Synapse – Artificial Neuron and its Model – Activation Functions – Neural Network Architecture: Single Layer and Multilayer Feed Forward Networks, Recurrent Networks – Various Learning Techniques: Perception and Convergence Rule, Auto-Associative and Hetero-Associative Memory.

UNIT III BACK PROPAGATION NETWORKS AND COMPETITIVE NEURAL NETWORKS

Back Propagation Networks Architecture: Perceptron Model- Single Layer Artificial Neural Network, Multilayer Perception Model – Back Propagation Learning Methods – Effect of Learning Rule CoEfficient – Factors Affecting Back Propagation Training – Kohenen's Self Organizing Map – SOM Architecture, learning procedure – Application; Learning Vector Quantization, learning by LVQ – Adaptive Resonance Theory – Learning procedure – Applications.

UNIT IV GENETIC ALGORITHM

Basic Concepts – Working Principle – Procedures of GA – Flow Chart of GA – Genetic Representation: (Encoding) Initialization and Selection – Genetic Operators: Mutation, Generational Cycle – Applications. Multi-objective Optimization Problem Solving: Concept of multi-objective

optimization problems (MOOPs) and issues of solving them -Multi-Objective Evolutionary Algorithm (MOEA) -Non-Pareto approaches to solve MOOPs - Pareto-based approaches to solve MOOPs - Some applications with MOEAs.

UNIT V APPLICATIONS

Control systems; Speech systems; Image processing; Natural language processing and decision making, Handwritten Script Recognition; Automotive Systems and Manufacturing; Decision Support System; Bioinformatics; Investment and trading.

Total: 45

REFERENCES

1. S. Rajasekaran, G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications", Prentice Hall of India, 2010.
2. J.S.R. Jang, C.T. Sun, E. Mizutani, "Neuro-Fuzzy and Soft Computing", Pearson Education, 2004.
3. An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)
4. Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2ndEdition), Collelo, Lament, Veldhnizer (Springer)
5. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Second Edition, Wiley-India,2007

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	3	3	-	2	-	2
Average	**3**	**-**	**2.2**	**2.2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E05 GAME THEORY 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Introduce the student to the notion of a game, its solutions concepts, and other basic notions and tools of game theory, and the main applications for which they are appropriate, including electronic trading markets.
- Formalize the notion of strategic thinking and rational choice by using the tools of game theory,and to provide insights into using game theory in modeling applications.
- Draw the connections between game theory, computer science, and economics, especially emphasizing the computational issues.

COURSE OUTCOMES

Upon Completion of the course, the students will be able to:

- Interpret the notion of a strategic game and equilibria of an application. K2
- Utilize Nash equilibria, mixed strategy equilibrium, zero-sum games. K3
- Identify key strategic aspects to connect them to appropriate game and theoretic concepts to givena real-world situation. K3
- Build game applications that need aspects of Bayesian Games. K3
- Analyze the optimal strategies of players to exploit strategic situations for the benefit of their own. K4

UNIT I INTRODUCTION 9

Introduction - Making rational choices: basics of Games - strategy - preferences - payoffs - Mathematical basics - Game theory - Rational Choice - Basic solution concepts-noncooperative versus cooperative games - Basic computational issues - finding equilibria and learning in games- Typical application areasfor game theory (e.g. Google's sponsored search, eBay auctions, electricity trading markets).

UNIT II GAMES WITH PERFECT INFORMATION 9

Games with Perfect Information - Strategic games - prisoner's dilemma, matching pennies – Nash equilibria -mixed strategy equilibrium - zero-sum games

UNIT III GAMES WITH IMPERFECT INFORMATION 9

Games with Imperfect Information -Bayesian Games - Motivational Examples – General Definitions - Information aspects - Illustrations - Extensive Games with Imperfect - Information - Strategies - Nash Equilibrium -Repeated Games - The Prisoner's Dilemma - Bargaining

UNIT IV NON-COOPERATIVE GAME THEORY

Non-cooperative Game Theory - Self-interested agents - Games in normal form – Analyzing games:

from optimality to equilibrium - Computing Solution Concepts of Normal - Form Games - Computing Nash equilibria of two-player, zero-sum games -Computing Nash equilibria of two player, general- sum games - Identifying dominated strategies

UNIT V MECHANISM DESIGN

Aggregating Preferences - Social Choice - Formal Model - Voting - Existence of social functions - Ranking systems - Protocols for Strategic Agents: Mechanism Design - Mechanism design with unrestricted preferences

Total :45

TEXT BOOKS

1. M. J. Osborne, An Introduction to Game Theory. Oxford University Press, 2012.
2. M. Machler, E. Solan, S. Zamir, Game Theory, Cambridge University Press, 2013.
3. N. Nisan, T. Roughgarden, E. Tardos, and V. V. Vazirani, Algorithmic Game Theory.Cambridge University Press, 2007.
4. A.Dixit and S. Skeath, Games of Strategy, Second Edition. W W Norton & Co Inc, 2004.
5. YoavShoham, Kevin Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic,and Logical Foundations, Cambridge University Press 2008.
6. Zhu Han, DusitNiyato, WalidSaad, TamerBasar and Are Hjorungnes, "Game Theory inWireless and Communication Networks", Cambridge University Press, 2012.
7. Y.Narahari, "Game Theory and Mechanism Design", IISC Press, World Scientific.
8. William Spaniel, "Game Theory 101: The Complete Textbook", CreateSpace IndependentPublishing, 2011.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	3	3	-	2	-	2
Average	**3**	**-**	**2.2**	**2.2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E06 **WEB ANALYTICS** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Understand the evolution of Web analytics platforms and various Web analytics versions.
- Learn various data collection techniques and the benefits of surveys and data capture.
- Analyze common web metrics and KPI-related concepts.

COURSE OUTCOMES

Upon completion of this course, the students should be able to:

- Identify the fundamentals of web analytics, including key concepts, terminology and metrics. K3
- Choose web analytics tools to process Google Analytics or Adobe Analytics. K3
- Apply web analytics data to make data-driven decisions. K3
- Select the role of web analytics in digital marketing and e-commerce. K3
- Analyze analytics to track and measure the success of online campaigns and initiatives. K4

UNIT I INTRODUCTION 9

Definition, Process, Key terms: Site references, Keywords and Key phrases; building block terms:Visit characterization terms, Content characterization terms, Conversion metrics; Categories:Offsite web, on site web; Web analytics platform, Web analytics evolution, Need for web analytics, Advantages, Limitations.

UNIT II DATA COLLECTION 9

Click stream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E-commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.

UNIT III QUALITATIVE ANALYSIS 9

Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, Post-visit surveys, creating and running a survey, Benefits of surveys. Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, Selecting optimal web analytic tool, Understanding click stream data quality, Identifying unique page definition, Using cookies, Link coding issues.

UNIT IV WEB METRICS **9**

Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, non e-commerce sites): Improving bounce rates, Optimizing ad words campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI. Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files & Cookies,Web Bugs.

UNIT V WEB ANALYTICS 2.0 **9**

Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis: CI data sources, Toolbar data, Panel data, ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities. Google Analytics: Brief introduction and working, Ad words, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues**.**

Total: 45

REFERENCES

1. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nded, 2012.
2. Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of Customer Centricity, Wiley Publishing, Inc. 1st ed, 2010.
3. Sterne J., Web Metrics: Proven methods for measuring web site success, JohnWiley and Sons, 2002.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	3	3	-	2	-	2
Average	**3**	**-**	**2.2**	**2.2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E07 BIG DATA MINING AND ANALYTICS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Understand computational approaches to modeling and feature extraction.
- Analyze the need, application of MapReduce, and interpret streaming data.
- Understand search algorithms, identify large data sets, and learn clustering techniquesapplicable to Big Data.

COURSE OUTCOMES

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

- Illustrate the fundamentals of big data and its characteristics. K2
- Summarize techniques for data preprocessing and feature selection for big data analysis. K2
- Classify supervised, unsupervised, and reinforcement learning approaches. K4
- Choose big data mining and analytics tools for Apache Spark and Hadoop. K3
- Identify the ways to use machine learning algorithms for big data classification, clustering,and association rule mining. K3

UNIT I DATA MINING AND LARGESCALE FILES **9**

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

UNIT II SIMILAR ITEMS **9**

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Localitysensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSH Families – Methods for High Degree of Similarities.

UNIT III MINING DATA STREAMS **9**

Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.

UNIT IV LINK ANALYSIS AND FREQUENT ITEMSETS **9**

Page Rank –Efficient Computation - Topic Sensitive Page Rank – Link Spam – Market BasketModel – A-priori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.

UNIT V CLUSTERING **9**

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means –CURE – Clustering in Non -– Euclidean Spaces – Streams and Parallelism – Case Study:Advertising on the Web – Recommendation Systems.

Total: 45

REFERENCES

1. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets",Cambridge University Press, 3rd Edition, 2020.
2. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining Concepts and Techniques",MorganKaufman Publications, Third Edition, 2012.
3. Ian H. Witten, Eibe Frank "Data Mining – Practical Machine Learning Tools andTechniques",Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, Heikki Mannila and Padhraic Smyth, "Principles of Data Mining", MITPRESS,2001.

WEBSITES

1. https://swayam.gov.in/nd2_arp19_ap60/preview.
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106104189/lec1.pdf.
3. https://examupdates.in/big-data-analytics/.
4. https://www.tutorialspoint.com/big_data_analytics/index.html.
5. https://www.tutorialspoint.com/data_mining/index.html.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	2	2	-	2	-	2
Average	**3**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E08 SOFTWARE DEFINED NETWORKS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Understand the need for SDN and its data plane operations
- Explore various techniques of network function virtualization
- Comprehend the concepts behind network virtualization

COURSE OUTCOMES:

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

- Explain the SDN architecture and motivation behind SDN. K2
- Identify the functions of the data plane and control plane. K3
- Build network applications using SDN. K3
- Apply SDN open source for Network Virtualization K3
- Analyze the use cases of SDN and NFV for a real world problem. K4

UNIT I SDN INTRODUCTION 9

Evolving Network Requirements – SDN Origins and Evolution- The SDN Approach – SDN architecture - SDN Data Plane, Control plane and Application Plane- The Genesis of SDN

UNIT II SDN DATA PLANE AND CONTROL PLANE 9

Data Plane functions and protocols - OpenFlow Protocol - Flow Table - Control Plane Functions-Southbound Interface, Northbound Interface – SDN Controllers - Ryu, Open Daylight, ONOS - Distributed Controllers

UNIT III SDN APPLICATIONS 9

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking - SDN in Other Environments - SDN Use Cases - The Open Network Operating System

UNIT IV NETWORK FUNCTION VIRTUALIZATION 9

SDN Open Source - SDN Futures -Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and Requirements – Reference Architecture

UNIT V NFV FUNCTIONALITY **9**

NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV - Network Function Virtualization - NetApp Development

Total: 45

REFERENCES

1. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud",Pearson Education, 1st Edition, 2015.
2. Ken Gray, Thomas D. Nadeau, "Network Function Virtualization", Morgan Kauffman, 2016.
3. Thomas D Nadeau, Ken Gray, "SDN: Software Defined Networks", O'Reilly Media, 2013.
4. Fei Hu, "Network Innovation through OpenFlow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
5. Paul Goransson, Chuck Black Timothy Culver, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann Press, 2016.
6. Oswald Coker, Siamak Azodolmolky, "Software-Defined Networking with OpenFlow", 2nd Edition, O'Reilly Media, 2017.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	3	3	-	2	-	2
Average	**3**	**-**	**2.2**	**2.2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E09 SOCIAL NETWORK ANALYSIS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Gain comprehensive understanding of the components comprising a social network, encompassing user profiles, connections, and interactions within the platform.
- Model and visualize the structure of the social network, utilizing techniques to represent user relationships and network dynamics visually.
- Employ data mining methodologies to extract valuable insights from user data within the social network, facilitating analysis of user behavior, preferences, and trends over time and tracking changes in user connections, activity levels, and content engagementpatterns.

COURSE OUTCOMES

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

- Choose the key concepts for social network analysis. K3
- Identify Visualization techniques to a social network application. K3
- Develop community detection and mining process to a problem. K3
- Apply Algorithms for Expert Location system in Social Networks. K3
- Analyze the text mining process in social networks. K4

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 aggregatingsocial 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 and Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

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 TEXT AND OPINION MINING **9**

Text Mining in Social Networks -Opinion extraction – Sentiment classification and clustering - Temporal sentiment analysis - Irony detection in opinion mining - Wish analysis - Product review mining – Review Classification – Tracking sentiments towards topics over time.

Total: 45

REFERENCES

1. Charu C. Aggarwal, “Social Network Data Analytics”, Springer; 2011
2. Peter Mika, “Social Networks and the Semantic Web”, Springer, 1st edition, 2007.
3. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 1st, edition,2010.
4. Guandong Xu, Yanchun Zhang and Lin Li, “Web Mining and Social Networking – Techniques and applications”, Springer, 1st edition, 2011.
5. Giles, Mark Smith, John Yen, “Advances in Social Network Mining and Analysis”, Springer,2010.
6. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, “Computational SocialNetwork Analysis: Trends, Tools and Research Advances”, Springer, 2009.
7. Toby Segaran, “Programming Collective Intelligence”, O’Reilly, 2012

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	1	2	-	2
CO2	3	-	2	2	1	2	-	2
CO3	3	-	2	2	1	2	-	2
CO4	3	-	2	2	1	2	-	2
CO5	3	-	3	3	1	2	-	2
Average	**3**	**-**	**2.2**	**2.2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E10 STATISTICAL NATURAL LANGUAGE PROCESSING 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Develop foundational knowledge in linguistics, probability, and statistics, providing the necessary groundwork for understanding natural language processing (NLP) concepts and methodologies.
- Study statistical approaches to NLP, focusing on sequence labeling tasks and exploring techniques for accurately labeling sequences of words or tokens within textdata.
- Investigate various parsing techniques employed in NLP, including syntactic parsing and semantic parsing, to analyze the structure and meaning of sentence and explore semantic aspects of language such as word semantics and semantic role labeling.

COURSE OUTCOMES

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

- Explain the basics of linguistics, probability and statistics associated with NLP. K2
- Outline the challenges of natural language understanding and processing. K2
- Apply a sequence labeling problem for a given domain. K3
- Build semantic processing tasks and simple document indexing and searching systemusing the concepts of NLP. K3
- Develop a chatbot application using dialogue system concepts. K3

UNIT I INTRODUCTION **9**

Natural Language Processing – Components - Basics of Linguistics and Probability and Statistics-Words-Tokenization-Morphology-Finite State Automata.

UNIT II STATISTICAL NLP AND SEQUENCE LABELING **9**

N-grams and Language models –Smoothing -Text classification- Naïve Bayes classifier – Evaluation - Vector Semantics – TF-IDF - Word2Vec- Evaluating Vector Models - Sequence Labeling – Part of Speech – Part of Speech Tagging -Named Entities –Named Entity Tagging.

UNIT III CONTEXTUAL EMBEDDING **9**

Constituency –Context Free Grammar –Lexicalized Grammars- CKY Parsing – Earley's algorithm- Evaluating Parsers -Partial Parsing – Dependency Relations- Dependency Parsing - Transition Based- Graph Based.

UNIT IV COMPUTATIONAL SEMANTICS 9

Word Senses and WordNet – Word Sense Disambiguation – Semantic Role Labeling – Proposition Bank- FrameNet - Selectional Restrictions - Information Extraction - Template Filling.

UNIT V DISCOURSE ANALYSIS AND SPEECH PROCESSING **9**

Discourse Coherence – Discourse Structure Parsing – Centering and Entity Based Coherence – Question Answering –Factoid Question Answering – Classical QA Models – Chatbots and Dialogue systems – Frame-based Dialogue Systems – Dialogue–State Architecture.

Total: 45

REFERENCES

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition" (PrenticeHall Series in Artificial Intelligence), 2020.
2. Jacob Eisenstein. "Natural Language Processing ", MIT Press, 2019.
3. Samuel Burns "Natural Language Processing: A Quick Introduction to NLP with Python andNLTK, 2019.
4. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press,2009.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	2	2	-	2	-	2
Average	**3**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25MECS3E11 VISUALIZATION TECHNIQUES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Develop foundational knowledge in linguistics, probability, and statistics, providing the necessary groundwork for understanding natural language processing (NLP) concepts and methodologies.
- Study statistical approaches to NLP, focusing on sequence labeling tasks and exploring techniques for accurately labeling sequences of words or tokens within text data.
- Investigate various parsing techniques employed in NLP, including syntactic parsing and semantic parsing, to analyze the structure and meaning of sentences.

COURSE OUTCOMES

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

- Apply data visualization to a defined data set. K3
- Choose the Visualization stages to visual variables. K3
- Identify the visualization techniques in computing applications. K3
- Build visualization techniques to built-in framework. K3
- Develop data visualization techniques to a given requirements imposed by the data. K3

UNIT I INTRODUCTION AND DATA FOUNDATION 9

Basics - Relationship between Visualization and Other Fields -The Visualization Process - Pseudo code Conventions - The Scatter plot. Data Foundation - Types of Data - Structure within and between Records - Data Preprocessing - Data Sets.

UNIT II FOUNDATIONS FOR VISUALIZATION 9

Visualization stages - Semiology of Graphical Symbols - The Eight Visual Variables – HistoricalPerspective - Taxonomies - Experimental Semiotics based on Perception Gibson‘s Affordance theory – A Model of Perceptual Processing.

UNIT III VISUALIZATION TECHNIQUES 9

Spatial Data: One-Dimensional Data - Two-Dimensional Data – Three-dimensional Data - DynamicData - Combining Techniques. Geospatial Data: Visualizing Spatial Data - Visualization of Point Data -Visualization of Line Data - Visualization of Area Data – Other Issues in Geospatial Data Visualization Multivariate Data: Point-Based Techniques – Line Based Techniques - Region-Based Techniques - Combinations of Techniques – Trees Displaying Hierarchical Structures – Graphics and Networks- Displaying Arbitrary Graphs/Networks.

UNIT IV INTERACTION CONCEPTS AND TECHNIQUES **9**

Text and Document Visualization: Introduction - Levels of Text Representations - The Vector Space Model - Single Document Visualizations -Document Collection Visualizations-ExtendedText Visualizations Interaction Concepts: Interaction Operators - Interaction Operands and Spaces - A Unified Framework. Interaction Techniques: Screen Space - Object-Space – Data Space - Attribute Space- Data Structure Space - Visualization Structure – Animating Transformations - Interaction Control.

UNIT V RESEARCH DIRECTIONS IN VISUALIZATIONS **9**

Steps in designing Visualizations – Problems in designing effective Visualizations- Issues of Data. Issues of Cognition, Perception, and Reasoning. Issues of System Design Evaluation, Hardware and Applications

Total: 45

REFERENCES

1. Matthew Ward, Georges Grinstein and Daniel Keim, "Interactive Data VisualizationFoundations,Techniques, Applications", 2020.
2. Colin Ware, "Information Visualization Perception for Design", 4th edition, Morgan KaufmannPublishers, 2021.
3. Robert Spence "Information visualization – Design for interaction", Pearson Education, 2ndEdition,2007.
4. Alexandru C. Telea, "Data Visualization: Principles and Practice," A. K. Peters Ltd, 2014.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	2	2	-	2	-	2
Average	**3**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E12 MOBILE APPLICATION DEVELOPMENT 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Acquire the knowledge on Android OS and its features.
- Gain the knowledge on GUI design required for Android App development.
- Apply the knowledge to publish android applications into market.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Choose application framework for matric application development. K3
- Make use of GUI design for Android application development. K3
- Build web based mobile application that accesses internet and location data. K3
- Apply the knowledge of persistence data storage mechanism in Android Applications. K3
- Develop an application using telephony and Google Map. K3

UNIT I INTRODUCTION 9

Mobile applications – Characteristics and Benefits – Application Model – Frameworks and Tools – Mobile OS: Android, iOS – versions with its features – Android architecture –ART (Android Runtime) –ADB (Android Debug Bridge) – Application framework basics

UNIT II USER INTERFACE DESIGN 9

Designing the right UI – GUI for Android – activity and its lifecycle – Material Design: new themes, newwidgets, Card layouts – Backward compatibility – v7 app compat library – Intent object, intent filters, adding categories – Menus – fragment and its lifecycle

UNIT III DATA PERSISTENCE 9

Different Data persistence schemes – content provider and resolver – shared preferences – saved instance-file read/write operations – SQLite database – Android in build content providers – user content provider

UNIT IV ANDROID SERVICE COMPONENT 9

Intent Service – Remote service – Service handlers – communication between service and Activity Broadcast Receivers: Local Broadcast Manager, Dynamic Broadcast Receiver – System Broadcast Pending Intent, Notifications – Packaging and deployment

UNIT V ANDROID APPLICATION DEVELOPMENT **9**

Communication via the web – Telephony Manager: Sending SMS and making calls – Google maps service using API – Publishing Android Apps: Guidelines, policies and process of uploading Apps to Google Play.

Total: 45

REFERENCES

1. Reto Meier, "Professional Android 4 Application Development", Wiley, 2012
2. Wei-Meng Lee, "Beginning Android Application Development", Wiley Publishing, 2011
3. Zigurd Mednieks, Laird Dornin, G. Blake Meike, Masumi Nakamura, "Programming Android",O'Reilly, 2011
4. Rick Rogers, John Lombardo, Zigurd Mednieks, Blake Meike, "Android ApplicationDevelopment", O'Reilly, 2010

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	1	2	-	2
CO3	3	-	2	2	1	2	-	2
CO4	3	-	2	2	1	2	-	2
CO5	3	-	2	2	1	2	-	2
Average	**3**	**-**	**2**	**2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E13 HIGH PERFORMANCE COMPUTING FOR BIG DATA 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Gain proficiency in fundamental concepts of high-performance computing (HPC), coveringkey principles and techniques for optimizing computational performance.
- Understand the network and software infrastructure essential for supporting HPC systems, including parallel processing architectures and distributed computing frameworks.
- Analyze real-time analytics applications leveraging HPC capabilities, exploring techniques for processing and analyzing large volumes of data with high efficiency and low latency andcreate awareness on emerging big data applications.

COURSE OUTCOMES

Upon completion of the course, the student should be able to:

- Explain the basics concepts of high performance computing systems. K2
- Apply the concepts of network and software infrastructure for high performance computing. K3
- Identify real time analytics using high performance computing. K3
- Apply the security models and big data applications in high performance computing. K3
- Analyze the emerging big data applications for solving real world problems. K4

UNIT I INTRODUCTION **9**

The Emerging IT Trends- IOT/IOE-Apache Hadoop for big data analytics - Big data into big insights and actions – Emergence of BDA discipline – strategic implications of big data-BDA Challenges –HPC paradigms – Cluster computing – Grid Computing – Cloud computing – Heterogeneous computing – Mainframes for HPC - Supercomputing for BDA-Appliances forBDA.

UNIT II NETWORK & SOFTWARE INFRASTRUCTURE FOR HIGH PERFORMANCE BDA **9**

Design of Network Infrastructure for high performance BDA – Network Virtualization – Software Defined Networking – Network Functions Virtualization – WAN optimization for transfer of big data started with SANs- storage infrastructure requirements for storing big data –FC SAN – IP SAN – NAS – GFS – Panasas – Luster file system – Introduction to cloud storage.

UNIT III REAL TIME ANALYTICS USING HIGH PERFORMANCE COMPUTING **9**

Technologies that support Real time analytics – MOA: Massive online analysis – GPFS: General parallel file system – Client case studies – Key distinctions – Machine data analytics –operational analytics – HPC Architecture models – In Database analytics – In memory analytics.

UNIT IV SECURITY AND TECHNOLOGIES **9**

Security, Privacy and Trust for user – generated content: The challenges and solutions – Role of real time big data processing in the IoT – End to End Security Framework for big sensing data streams – Clustering in big data.

UNIT V EMERGING BIG DATA APPLICATIONS **9**

Deep learning Accelerators – Accelerators for clustering applications in machine learning - Accelerators for classification algorithms in machine learning – Accelerators for Big data Genome Sequencing.

Total: 45

REFERENCES

1. Pethuru Raj, Anupama Raman, Dhivya Nagaraj and Siddhartha Duggirala, "High- PerformanceBig-Data Analytics: Computing Systems and Approaches", Springer, 1st Edition, 2015.
2. "Big Data Management and Processing", Kuan-Ching Li, Hai Jiang, Albert Y. Zomaya, CRC Press,1st Edition,2017.
3. "High Performance Computing for Big Data: Methodologies and Applications", Chao wang, CRC Press,1st Edition,2018.
4. "High-Performance Data Mining and Big Data Analytics", Khosrow Hassibi, Create Space Independent Publishing Platform, 1st Edition,2014.
5. "High performance computing: Modern systems and practices", Thomas Sterling, Matthew Anderson, Morgan Kaufmann publishers,1st Edition,2017.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	3	3	-	2	-	2
Average	**3**	**-**	**2.2**	**2.2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E14 SECURITY AND PRIVACY IN CLOUD 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Understand fundamentals of cloud computing security.
- Learn security design and architectural considerations for cloud.
- Know the identity management, access control, monitor, audit and management of cloudsecurity.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Interpret the basics of security service and cryptography. K2
- Apply security architectural design in the cloud computing. K3
- Identify access control requirements for Cloud infrastructure. K3
- Apply risks, audit and monitoring mechanisms in the cloud. K3
- Analyze the privacy issues and security challenges in the cloud. K4

UNIT I FUNDAMENTALS OF CLOUD SECURITY CONCEPTS 9

Overview of cloud security- Security Services - Confidentiality, Integrity, Authentication, Nonrepudiation, Access Control - Basic of cryptography - Conventional and public-key cryptography,hash functions, authentication, and digital signatures.

UNIT II SECURITY DESIGN AND ARCHITECTURE FOR CLOUD 9

Security design principles for Cloud Computing - Comprehensive data protection - End-to-end access control - Common attack vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies – Data Protection strategies: Data retention, deletion and archiving procedures for tenant data, Encryption, Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT III ACCESS CONTROL AND IDENTITY MANAGEMENT 9

Access control requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization - Verified and measured boot - Intruder Detection and prevention

UNIT IV CLOUD SECURITY DESIGN PATTERNS **9**

Intent Service – Remote service – Service handlers – communication between service and Activity Broadcast Receivers: Local Broadcast Manager, Dynamic Broadcast Receiver – System Broadcast Pending Intent, Notifications – Packaging and deployment

UNIT V MONITORING, AUDITING AND MANAGEMENT **9**

Proactive activity monitoring - Incident Response, monitoring for unauthorized access, malicious traffic, abuse of system privileges - Events and alerts - Auditing – Record generation, Reporting and Management, Tamper-proofing audit logs, Quality of Services, Secure Management, User management, Identity management, Security Information and Event Management

Total: 45

TEXT BOOKS

1. Raj Kumar Buyya , James Broberg, Andrzej Goscinski, "Cloud Computing:", Wiley 2013
2. Dave shackleford, "Virtualization Security", SYBEX a wiley Brand 2013.
3. Mather, Kumaraswamy and Latif, "Cloud Security and Privacy", OREILLY 2011

REFERENCES

1. Mark C. Chu-Carroll ―Code in the Cloud‖,CRC Press, 2011
2.Rajkumar Buyya,Christian Vechiola, S. ThamaraiSelvi," Mastering Cloud Computing: Foundationsand Applications Programming" ,2013

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	1	2	-	2
CO2	3	-	2	2	1	2	-	2
CO3	3	-	2	2	1	2	-	2
CO4	3	-	2	2	1	2	-	2
CO5	3	-	3	3	1	2	-	2
Average	**3**	**-**	**2.2**	**2.2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E15 BLOCKCHAIN TECHNOLOGIES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Acquire the knowledge on technical concepts of blockchain technology and uses of bitcoins.
- Learn the relation between Web3 and Hyperledger.
- Use the smart contracts & Ethereum to real time applications.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Explain cryptocurrencies and their relationship with the blockchain technology. K2
- Illustrate the different steps in the use of Bitcoins. K2
- Develop Web 3 and Hyperledger to concepts in blockchain technologies. K3
- Apply blockchains to different real-life problems K3
- Build simple application using Ethereum. K3

UNIT I INTRODUCTION 9

Blockchain Overview-History and Origin of Blockchain - Technical Concepts of Blockchain Systems: Physical Ledger Technology and Security - Digital Ledger Technology, Digital Security Technology: Cryptographic Hash Functions - Digital Signatures

UNIT II FOUNDATIONS 9

Centralization vs. Decentralization of Blockchain - Distributed Ledger Technology (DLT) Technical Concepts: Mining - Distributed Consensus- Incentives - Proof of Work - Cryptosystems in practice- Distributed Networks – Attacks - Consensus Protocols

UNIT III WEB3 AND HYPERLEDGER 9

Web 3 Contract deployment – POST requests – Frontend – Development framework – Hyperledger Projects – Protocol – Reference architecture – Hyperledger Fabric – Corda.

UNIT IV SMART CONTRACTS & ETHEREUM 9

Smart Contracts – Definition – Recardian contracts - Ethereum blockchain –Ethereum network – Components of Ethereum ecosystem –Programming languages - Ethereum development environment -Non-Fungible Token (NFT)

UNIT V ALTERNATIVE BLOCKCHAINS AND APPLICATIONS **9**

Alternative blockchains – Applications, Internet of Things, Government, Health, Finance – Scalability –Privacy.

Total: 45

REFERENCES

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and SmartContracts Explained", Second Edition, Packt Publishing, 2018.
2. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction" Princeton University Press, 2016.
3. Alex Leverington, "Ethereum Programming" Packt Publishing Limited, 2017.
4. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", O'Reilly Publishing, 2014.
5. Roger Wattenhofer, "The Science of the Blockchain" Create Space Independent Publishing Platform,2016.
6. Arshdeep Bahga and Vijay Madisetti, "Blockchain Applications: A Hands-On Approach", 2017.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	1	2	-	2
CO4	3	-	2	2	1	2	-	2
CO5	3	-	2	2	1	2	-	2
Average	**3**	**-**	**2**	**2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E16 SPEECH PROCESSING AND SYNTHESIS 3H-3C

Instruction Hours/week: L:3 T:0 P:0 Marks: Internal:40 External:60 Total:100

End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Learn the fundamental concepts and algorithms of speech processing and synthesis, encompassing techniques for analyzing, generating, and manipulating speech signals.
- Familiarize students with various speech signal representation, coding, and recognition methods, enabling them to understand the underlying principles and practical applications of speech processing technologies.
- Understand the significance of speech processing in contemporary technologies and expose students to real-world applications, providing insights into how speech processing enhances communication systems, virtual assistants, speech-to-text applications, and other domains.

COURSE OUTCOMES

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

- Identify the various temporal, spectral and cepstral features required for identifying speech units- phoneme, syllable and word. K3
- Apply Mel-frequency cepstral coefficients for processing all types of signals. K3
- Choose speech processing and synthesis, techniques for human-computer interaction. K3
- Apply speech processing and synthesis tools and software, such as Praat, Festival and HTS. K3
- Analyze the ethical and social implications of speech processing and synthesis. K4

UNIT I FUNDAMENTALS OF SPEECH PROCESSING **9**

Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory-
Significance Testing – Information Theory.

UNIT II SPEECH SIGNAL REPRESENTATIONS AND CODING **9**

Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis – Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder.

UNIT III SPEECH RECOGNITION **9**

Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.

UNIT IV TEXT ANALYSIS **9**

Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation.

UNIT V SPEECH SYNTHESIS **9**

Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modificationof Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.

Total: 45

REFERENCES

1. Joseph Mariani, ―Language and Speech Processing‖, Wiley, 2009.
2. Lawrence Rabiner and Biing-Hwang Juang, ―Fundamentals of Speech Recognition‖, Prentice Hall Signal Processing Series, 1993.
3. Sadaoki Furui, ―Digital Speech Processing: Synthesis, and Recognition, SecondEdition, (Signal Processing and Communications) ‖, Marcel Dekker, 2000.
4. Thomas F. Quatieri, ―Discrete-Time Speech Signal Processing‖, Pearson Education,2002.
5. Xuedong Huang, Alex Acero, Hsiao-Wuen Hon, ―Spoken Language Processing – Aguideto Theory, Algorithm and System Development‖, Prentice Hall PTR, 2001.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	3	2	1	2	-	2
Average	**3**	**-**	**2**	**2**	**1**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-III

25MECS3E17 **MIXED REALITY** **3H-3C**

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**

End Semester Exam:3 Hours

COURSE OBJECTIVES:

The goal of this course for the students is to:

- Learn the mixed reality and differentiate between virtual reality and augmented reality.
- Gain the knowledge of MR Computing architecture and MR modeling
- Understand what mixed reality offers in real-world applications.

COURSE OUTCOMES:

Upon Completion of the course, the students will be able to:

- Explain the basic concepts of Mixed Reality. K2
- Illustrate the working principles of input output devices used in mixed reality applications K2
- Apply 3D reality models for MR modelling techniques. K3
- Build Mixed Reality Programming with Toolkit. K3
- Develop the Mixed Reality applications in different domains. K3

UNIT I INTRODUCTION **9**

Introduction to Virtual Reality – Definition – Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR – System Structure of Augmented Reality – Key Technology in AR – 3D Vision – Approaches to Augmented Reality – Alternative Interface Paradigms – Spatial AR – Input Devices – 3D Position Trackers – Performance Parameters – Types Of Trackers – Interaction-Modelling and annotation-Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System.

UNIT II MR COMPUTING ARCHITECTURE **9**

Computing Architectures of VR – Rendering Principle – Graphics and Haptics Rendering – PC Graphics Architecture – Graphics Accelerators – Graphics Benchmarks – Workstation Based Architectures – SGI Infinite Reality Architecture – Distributed VR Architectures – Multi-pipeline Synchronization – Collocated Rendering Pipelines – Distributed Virtual Environments – AR Architecture

UNIT III MR MODELING **9**

Modeling – Geometric Modeling – Virtual Object Shape – Object Visual Appearance – Kinematics Modeling – Transformation Matrices – Object Position – Transformation Invariants – Object Hierarchies – Viewing The 3D World – Physical Modeling – Collision Detection – Surface Deformation – Force Computation – Force Smoothing and Mapping – Behavior Modeling – Model Management

UNIT IV MR PROGRAMMING **9**

VR Programming – Toolkits and Scene Graphs – World Toolkit – Java 3D – Comparison of World Toolkit and Java 3D – GHOST – People Shop – Human Factors in VR – Methodology and Terminology-VR Health and Safety Issues – VR and Society –Mixed Reality Coding – Trajectories through Mixed Reality Performance – Mobile Interface Design – Quantitative Evaluation – Qualitative Evaluation

UNIT V APPLICATIONS **9**

Emerging MR Applications in Medical, Military & Manufacturing– Education, Arts and Entertainment– Applications of MR in Robotics-Application of AI in AR & VR: virtual assistant, Digital avatars and characters, user engagement, Interactive training, digital art creation – Information Visualization – Wearable Computing – Games

Total: 45

REFERENCES

1. Grigore C. Burdea, Philip Coiffet, "Virtual Reality Technology", Second Edition, Wiley India, 2006.
2. Benford, S., Giannachi G., "Performing Mixed Reality", MIT Press, 2011
3. Dieter Schmalstieg, Tobias Hollerer, "Augmented Reality: Principles & Practice", Addison Wesley, 2016.
4. Charles Palmer, John Williamson, "Virtual Reality Blueprints: Create Compelling VR Experiences for Mobile", Packt Publisher, 2018.
5. John Vince, "Introduction to Virtual Reality", Springer-Verlag, 2004.
6. William R. Sherman, Alan B.Craig: Understanding Virtual Reality – Interface, Application, Design", Morgan Kaufmann, 2003.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	2	2	-	2	-	2
Average	**3**	**-**	**2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

25MECS3E18 DEVOPS AND MICROSERVICES 3H-3C

Instruction Hours/week: L:3 T:0 P:0 **Marks: Internal:40 External:60 Total:100**
End Semester Exam:3 Hours

COURSE OBJECTIVES

The goal of this course for the students is to:

- Acquire a comprehensive understanding of DevOps principles, terminology, and basic concepts, providing a solid foundation for implementing DevOps practices.
- Explore DevOps platforms and gain practical knowledge of their functionalities, enabling effective collaboration and integration across development and operations teams.
- Develop proficiency in building microservices for applications, leveraging DevOps automation tools to streamline deployment, testing, and monitoring processes to ensure seamless integration, deployment, and management of machine learning models in production environments.

COURSE OUTCOMES

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

- Compare Agile process models and Devops process model. K2
- Outline the processes of migrating applications to the cloud, managing change, andensuring smooth operation and support of cloud-based services. K2
- Apply effective communication and coordination mechanisms between Microservices toensure the quality and reliability of Micro services. K3
- Identify benefits and challenges for automating infrastructure provisioning,configuration, and management. K3
- Analyze devops practices using machine learning algorithms. K4

UNIT I INTRODUCTION **9**

Software Engineering - traditional and Agile process models - DevOps -Definition - Practices - DevOps life cycle process - need for DevOps –Barriers

UNIT II DEVOPS PLATFORM AND SERVICES **9**

Cloud as a platform - IaaS, PaaS, SaaS - Virtualization - Containers –Supporting Multiple Data Centers - Operation Services - Hardware provisioning- software Provisioning - IT services - SLA - capacity planning - security - Service Transition - Service Operation Concepts.

UNIT III BUILDING, TESTING AND DEPLOYMENT 9

Microservices architecture - coordination model - building and testing - Deployment pipeline - Development and Pre-commit Testing -Build and Integration Testing - continuous integration - monitoring - security - Resources to Be Protected - Identity Management.

UNIT IV DEVOPS AUTOMATION TOOLS **9**

Infrastructure Automation- Configuration Management - Deployment Automation - PerformanceManagement - Log Management –Monitoring.

UNIT V MLOPS **9**

MLOps - Definition - Challenges -Developing Models - Deploying to production - Model Governance - Real world examples.

Total: 45

REFERENCES

1. Len Bass, Ingo Weber and Liming Zhu, —" DevOps: A Software architect's Perspective",Pearson Education, 2016
2. Joakim Verona - "Practical DevOps" - Packet Publishing, 2016
3. Viktor Farcic -" The DevOps 2.1 Toolkit: Docker Swarm" - Packet Publishing, 2017
4. Mark Treveil, and the Dataiku Team-" Introducing MLOps" - O'Reilly Media- 2020.

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	-	2	2	-	2	-	2
CO2	3	-	2	2	-	2	-	2
CO3	3	-	2	2	-	2	-	2
CO4	3	-	2	2	-	2	-	2
CO5	3	-	3	2	-	2	-	2
Average	**3**	**-**	**2.2**	**2**	**-**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

PROJECT WORK

SEMESTER-III

25MECS391 **PROJECT WORK PHASE I** **12H-6C**

Instruction Hours/week: L:0 T:0 P:12 **Marks: Internal:40 External:60 Total: 100**

COURSE OBJECTIVES

The goal of this course for the students is to:

- Identify real-life problems within specified focus areas and propose diverse solutions based on comprehensive literature surveys.
- Develop mathematical models to address identified problems effectively, ensuring finalization of system requirements and specifications.
- Analyze future trends in providing alternative solutions and consolidate findings into comprehensive reports.

COURSE OUTCOMES

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

- Apply the engineering concepts to solve the identified research work through literature survey and function effectively as an individual to engage in independent learning. K3
- Identify available engineering tools, and select the tool for implementing the identified research work. K3
- Build systems using hardware components/software tools considering health, safety and societal need and validate the results of the identified work leading to publications. K3
- Develop professional ethics to meet societal and environmental needs. K3
- Examine the principles of project management and finance during the implementation of the project. K4

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	2	2	2	2	-	2
CO2	3	2	2	2	2	2	-	2
CO3	3	2	2	2	2	2	-	2
CO4	3	2	3	2	2	2	-	2
CO5	3	2	3	2	2	2	-	2
Average	**3**	**2**	**2.4**	**2**	**2**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation

SEMESTER-IV

25MECS491 PROJECT WORK AND VIVA VOCE PHASE II 24H-12C

Instruction Hours/week: L:0 T:0 P:24 **Internal-120 External 180 Total: 300**

COURSE OBJECTIVES

The goal of this course for the students is to

- Enable the students in convenient groups of not more than members on a project involving theoretical and experimental studies related to the branch of study. Every project work shall have a guide who is the member of the faculty of the institution. Twenty four periods per week shall be allotted in the time table and this time shall be utilized by the students to receive the directions from the guide, on library reading, laboratory work, computer analysis or field workas assigned by the guide and also to present in periodical seminar son the progress made in the project.
- Produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion. This final report shall be typewritten form as specified in the guidelines.

COURSE OUTCOMES

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

- Apply and analyze the engineering concepts to solve the identified research work throughliterature survey and function effectively as an individual to engage in independent learning. K3
- Identify the list of available engineering tools, and select the tool for implementing the identified research work K3
- Design systems using hardware components/software tools considering health, safety andsocietal need and validate the results of the identified work leading to publications K3
- Explain about professional ethics and meet societal and environmental needs
- Perform in the team, contribute to the team, Communicate effectively through presentationand demonstration of the project and preparation of the report and video K3
- Apply the principles of project management and finance during the implementation K3

CO, PO, PSO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2
CO1	3	2	2	2	2	2	-	2
CO2	3	2	2	2	2	2	-	2
CO3	3	2	2	2	2	2	-	2
CO4	3	2	3	2	2	2	-	2
CO5	3	2	3	2	2	2	-	2
Average	**3**	**2**	**2.4**	**2**	**2**	**2**	**-**	**2**

1 - Low, 2 - Medium, 3 - High, '-' - No Correlation