SRI SANKARA ARTS AND SCIENCE COLLEGE

(AUTONOMOUS)

ENATHUR, KANCHIPURAM – 631 561.

Learning Outcome-based Curriculum Framework (LOCF)

for

M.SC. COMPUTER SCIENCE AND TECHNOLOGY

Choice Based Credit System (CBCS)

(Effective from the academic year2022 - 2023)

Table of Contents

CHAPTER NO.	CHAPTER NAME	PAGE NO.
	Preamble	1
1	Introduction	2
2	Learning Outcomes-based Curriculum Framework	3
2.1	Nature and Extent of the M.Sc. CST Programme	3
3	Graduate Attributes	3
3.1	List Of Graduate Attributes For M.Sc CST	4
4	Qualification Descriptors	5
4.1	Qualification Descriptors for M.Sc. with CST	5
5	Programme Outcomes (PO)	6
5.1	Programme Specific Outcome (PSO)	6
6	Syllabus and Regulation	7
7	Course Outcomes (CO)	29
8	PSO – CO Mapping	135
9	Teaching – Learning Process	189
10	Assessment Methods	190
11	Keywords	191

Preamble

The curriculum of the 5-years integrated **M.Sc., Computer Science and Technology** programme offered by Department of Computer Science is prepared in accordance with UGC and Tamil Nadu State Council of Higher Education (TANSCHE). The Programme complies with the Outcome Based Education (OBE) and is designed with relevance to Choice Based Credit System (CBCS) affiliated to the University of Madras.

The curriculum and syllabi conform to the Learning Outcomes-based Curriculum Framework (LOCF) to make it student-centric, interactive and outcome-oriented education for the student's community. The Programme Outcome (PO), Programme Specific Outcome (PSO) and Course Outcome (CO) were discussed and finalized keeping the broad requirements of the programme.

A uniquely designed curriculum for the higher secondary passed-out students to pursue 5-year integrated PG course which provides a blended curriculum comprising of fundamental concepts and advanced research-oriented concepts. The five years of course provides lot of leeway in designing a comprehensive curriculum to cater to the diverse needs of novice-learner in the first year to a pro-learner in the fifth year of graduation. The long span of the course helps to leverage the broader yet deeper aspects of Computer Science to churn out a well-rounded graduate after completion of the course.

A comprehensive and detailed curriculum and syllabi along with Text books and Reference books were framed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Research Organizations and Parents to capture the voice of the respective stakeholders.

The students are offered a well-rounded curriculum that are research-oriented and advanced subjects such as such as Microservices Architecture, communication Network and Wireless Technology, Artificial Neural Network, Internet of Things, parallel computing, among many other courses.

1. Introduction

The field of Computer Science has been on an evolution spree for the past three decades and the state-of-the-art technologies have often been breached day-in and day-out by the emergence of new technologies. The mutual growth of hardware and software has supplemented and complimented each other to propel the field of computer science and expanded the horizons of the field. Computers have invaded into every form of human lives giving them instant solutions for the problems that they encounter in their daily life. So, its safe to say that computers have become an integral part of humankind and inevitable to stay away from its magic.

The field of Computer science has been stretching its contours at a rapid pace so much so that even highly complex problems are being breached with consummate ease with the ever-evolving cutting-edge technologies. The latest topics that are hogging the limelight of late are Machine Learning, Artificial Intelligence, Internet of things, Image Processing, Cloud Computing, Natural Language Processing, etc.,

The 5 years integrated M.Sc. Computer Science and Technology programme aims to blend the fundamentals learnings of Computer Science with cutting-edge technologies and research-endearing subjects in a single capsuled degree. The curriculum is designed so as to enhance the research and problem-solving capabilities, entrepreneurship skill, and skill necessary for cracking the competitive exams such as SET and NET. In particular, the course prepares the students to be employable as Web Developer, Network Administrator, Database Administrator, Data Analyst and a Research Scholar.

The Learning Outcomes-based Curriculum Framework for M.Sc. CST is structured and developed to facilitate the students to achieve the following:

- To acquire basic core competencies in research-oriented papers and higher-end technologies such as Digital Image Processing, Microservices Architecture, Algorithms Design, Communication and Networking.
- To develop an ability to synthesize the learned knowledge to analyze the real-world problems and to propose new self-thought solutions from the acquired knowledge.
- To learn advanced and latest technologies to meet the industry standards and challenges. The course outcomes and objectives are designed to cater to the enlisted purposes.

2. Learning Outcomes-based Curriculum Framework

2.1 Nature and Extent of the M.Sc. CST Programme

The 5-years integrated postgraduate programme in Computer Science & Technology provides a stream of courses targeting fundamental knowledge which infuses core-competencies in Computer Science and basic programming languages as well as creates a temperament for research among technology-savvy graduates.

Curriculum and syllabi framework is intended to introduce students to the advanced computing concepts and higher-end technologies and its applications. It is highly critical in inculcating a strong research-temper in computer science so as to venture into a advanced research and equip them to solve highly complex problems in of computer science. The curriculum in computer science and Technology is reinforced with internship and main-project work to expose the graduates to the corporate standards and procedures and introduce them to hands-on problems.

3. Graduate Attributes:

Graduate Attributes (GA) are the qualities, skills and understandings that students should develop during their graduation. These qualities prove to be the characteristics and defining roles of the graduates. Graduate attribute is a key outcome that underpin curriculum planning and development. The graduate attributes are fostered through meaningful learning experiences made available through the curriculum, college experience and a process of critical and reflective thinking.

The graduate attributes can be viewed as qualities as listed subcategories:

- **Critical Thinking:**

Capability to apply analytic thought to a body of knowledge; anlayse and evaluate evidence, arguments, claim, beliefs on the basis of empirical evidence; formulate arguments, critically evaluate practices, policies and theories.

- **Scientific Reasoning:**

Ability to analyse, interpret and draw conclusions from quantitative/qualitative data and critically evaluate ideas, evidence and experiences from an open-mined and reasoned perspective.

- **Problem Solving and Design:**

Problem solving skills empower students to find methodical solutions to any real-world problems or real-time problems using computational algorithms and solutions. Problem solvers are most sought-after attributes of the graduates form the field of Computer Science. They should possess the ability to clearly understand the problem, think creatively or out-of-the-box thinking and to convert the problem into a computational model to find a scientific solution backed by the theories.

- **Multicultural Competence:**

Process knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

- **Leadership readiness / qualities:**

Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring the team members to engage in the vision and used management skills to guide people to the right destination.

3.1. LIST OF GRADUATE ATTRIBUTES FOR B.SC CS:

GA-1: Ability to apply imaginative and reflective thinking to their studies.

GA-2: Ability to communicate and collaborate with individual and within teams in professional and community settings.

GA-3: Ability to apply mathematics, logic and statistics to the design, development and analysis of software systems.

GA-4: Ability to design components, systems and/or process to meet required specifications.

GA-5: Ability to apply decision making methodologies to evaluate solutions for efficiency, effectiveness and sustainability.

GA- 6: Ability to negotiate difficult social situations, defuse conflict and engage positively in purposeful debate.

4. Qualification Descriptors:

Qualification Descriptors are generic statements that define the outcomes of the graduates. The Qualification descriptors are used as metric by two parties:

The first party is the designer of academic programmes who can use the qualification metrics to measure the achievement of students for the award of the qualification.

The second party is the employers of the graduates who can use the qualification descriptors to assess the quality and capabilities of the graduates holding the qualification.

4.1. Qualification Descriptors for M.Sc. CST

On completion of M.Sc. with Computer Science and Technology, the expected learning outcomes that a student should be able to demonstrate are the following.

QD-1: A systematic, extensive and coherent knowledge and understanding of the field of computer science as whole and its applications, critical understanding of the established theories and number of advanced and emerging issues in the field of Computer Science.

QD-2: Demonstrate comprehensive knowledge, including current research, scholarly and/or profession literature, related to essential and advanced learning areas pertaining to the chosen areas and techniques.

QD-3: Apply one's disciplinary knowledge and transferable skills to new/unfamiliar contexts and to identify and analyse problems and issues and seek solutions to real-life problems.

QD-4: Communicate the results of studies undertaken in Computer Science accurately in a range of different contexts using main concepts, constructs and techniques.

QD-5: Demonstrate subject-related and transferable skills that are relevant to industry and employment opportunities.

5. PROGRAM OUTCOMES (PO)

PO-1. Enriching the knowledge in theoretical and practical aspects.

PO-2. Developing research aptitude among the students and encouraging them to take up research projects and publish research papers.

PO-3. Enabling the students to come out successfully in competitive examinations.

PO-4. Developing students' skills, based on current trends by offering Job oriented, Entrepreneurial, certificate courses and Value-added courses.

5.1. PROGRAMME SPECIFIC OUTCOME (PSO)

PSO-1. Ability to apply knowledge of basic sciences, mathematics, statistics and physics into computer science for solving real world problems.

PSO-2. Ability to learn various software tools, programming languages and apply algorithmic models thus making them more employable.

PSO-3. Students equipped with state-of-the-art technologies and cutting-edge solutions so as to enable them to foray into Entrepreneurship.

PSO-4. Students enriched with requisite and holistic skills to embrace themselves for competitive exams like NET, SET and other exams for career prospects.

PSO-5. Students with a drive and passion for Research aptitude and motivated enough for venturing into Advanced Research.

PO – PSO MATRIX

	PSO-1	PSO-2	PSO-3	PSO-4	PSO-5
PO-1	✓				
PO-2					✓
PO-3				✓	
PO-4		✓	✓		

6. Regulation and Syllabus

Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

Sl.No	Level	Parameter	Description
1	K1	Knowledge / Remembering	It is the ability to remember the previously learned
2	K2	Comprehension / Understanding	The learner explains ideas or concepts
3	K3	Application / Applying	The learner uses the information in a new way
4	K4	Analysis / Analysing	The learner distinguishes among different concepts
5	K5	Evaluation / Evaluating	The learner justifies a stand or decision
6	K6	Synthesis / Creating	The learner creates a new product of point of view

CHOICE BASED CREDIT SYSTEMREGULATIONS

6.1 ELIGIBILITY FOR ADMISSION:

Candidates seeking admission to the first year of the integrated M.Sc. Computer Science and Technology course shall be required to have passed Higher Secondary Examination conducted by Government of Tamil Nadu or an examination accepted as equivalent thereto by the syndicate, with Mathematics & Physics.

6.1ELIGIBILITY FOR THE AWARD OF DEGREE

6.2 B.Sc CST

A Candidate shall be eligible for the award of the Degree only if he/she has undergone the prescribed course of study in a Autonomous College for a period of not less than three academic years, passed the examinations of all the Six Semesters prescribed earning **140** credits in Parts-I, II, III, IV, V & VI and fulfilled such conditions as have been prescribed therefore. The parent university will award degrees to the students evaluated and recommended by autonomous colleges. The degree certificates will be in a common format devised by the university. The name of the college will be mentioned in the degree certificate, if so desired. The declaration of results was decided by the examination committee.

6.3 M.Sc CST

A Candidate shall be eligible for the award of the Degree only if he / she has undergone the prescribed course of study in a Autonomous College for a period of not less than five academic years, passed the examinations of all the ten Semesters prescribed earning 231 (140+91) credits in Parts-I, II, III, IV & V and fulfilled such conditions as have been prescribed therefore. The parent university will award degrees to the students evaluated and recommended by autonomous colleges. The degree certificates will be in a common format devised by the university. The name of the college will be mentioned in the degree certificate, if so desired. The declaration of results was decided by the examination committee.

6.4 DURATION

Each academic year shall be divided into two semesters. The first academic year shall comprise the first and second semesters, the second academic year shall comprise the third and fourth semesters, the third academic year shall comprise the fifth and sixth semesters, the fourth academic year shall comprise the seventh and eighth semester, the fifth academic year shall comprise the nineth and tenth semesters respectively.

The odd semesters shall consist of the period from June to November of each year and the even semesters from December to April of each year. There shall be not less than 90 working days for each semester exclusive of the days for the conduct of semester examinations.

In each semester, Courses are administered in 15 teaching weeks and another 5 weeks are utilized for evaluation and grading purposes. Each week has 30 working hours spread over in a 5 day week. Depending upon the content and specialization, a paper may have 1 to 6 credits. Total number of teaching hours in a semester will be 450 hrs.

6.5MEDIUM OF INSTRUCTION

The medium of instruction shall be English.

6.6 COURSE OF STUDY

A Master‟s programme consists of a number of papers. The term Course is used to indicate logical part of a subject matter of the programme. In each of Master‟s programmes, there will be a prescription of (i) language –I (Tamil, Sanskrit or other languages), (ii) language – II (English), (iii) a set of compulsory courses (called core subjects), some optional courses (called elective / allied subjects) and projects, (iv) a set of papers recommended by UGC and TANSCHE (Advanced Tamil / Soft skill / Environmental Studies / Value education), (v) Extension activities.

The detail of the Study for Master Degree Courses shall consist of the following:

PART – I Language Courses (LC) [Tamil / Other Languages]

PART – II English Language Courses (ELC)

PART – III Core Subjects

Allied Subjects Projects / Field work

PART – IV

1. (a) Those who have not studied Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Tamil comprising of two papers (level will be at 6th Standard).
   (b) Those who have studies Tamil up to XII Std. and taken a Non-Tamil Language under Part-I shall take Advanced Tamil comprising of two papers.
   (c) Others who do not come under a + b can choose non-major elective comprising of two papers.

2. Skill Based Subjects - Soft Skills

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed papers on Soft Skills. For three years PG degree Programme, a candidate must undergo a minimum of 2 papers (2 x 2 = 4 credits). Papers will be finalized in due course.

3. Environmental Studies

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed paper on Environmental studies. For three years UG degree Programme, a candidate must undergo environmental studies during third semester of second year (2 credits). Syllabus is common to all UG courses.

4. Value Education

A candidate shall be eligible for the award of the degree only if he/she has undergone the prescribed paper on value education. For three years UG degree Programme, a candidate must undergo value education during fourth semester of second year (1 credit). Paper will be finalized in due course.

PART – V Extension Activities

A candidate shall be awarded a maximum of 1 Credits for Compulsory Extension Service. All the Students shall have to enroll for NSS /NCC/ NSO (Sports & Games) Rotract / Youth Red cross or any other service organizations in the college and shall have to put in Compulsoryminimum attendance of 40 hours which shall be duly certified by the Principal of the collegebefore 31st March in a year. If a student LACKS 40 HOURS ATTENDANCE in the First year, he/she shall have to compensate the same during the subsequent years. Students those whocomplete minimum attendance of 40 hours in One year will get HALF A CREDIT and those who complete the attendance of 80 or more hours in Two Years will ONE CREDIT. Literacy and population Education Field Work shall be compulsory components in the above extensionservice activities. The working hours should not overlaps the normal teaching hours.

PART – VII Internship

Each PG student shall appear for intenship training during the vacation of II Semester for a minimum period of 15 days and shall submit the report to the controller of examinations. Each student is allotted 4 credits on submission of the report.

The following procedure be be followed for Internal Marks:

Theory Papers: Internal Marks

Best Two tests out of 3	10 marks
Attendance	5 marks
Seminar	5 marks
Assignment	5 marks
	25 marks

Break-up Details for Attendance

Below 60%	- No marks
60% to 75%	- 3 marks
76% to 90%	- 4 marks
91% to 100%	- 5 marks

Practical: Internal Marks 40

Attendance	5 marks
Practical Best Test 2 out of 3	30 marks
Record	5 marks

Project:

Internal Marks	Best 2 out of 3 presentations	20 marks
Viva		20 marks
Project Report		60 marks

6. REQUIREMENTS FOR PROCEEDING TO SUBSEQUENT SEMESTERS:

(i) Candidates shall register their names for the First semester examination after the admission in the PG courses.

(ii) Candidates shall be permitted to proceed from the First Semester upto the Final Semester irrespective of their failure in any of the Semester Examination subject to the condition that the candidates should register for all the arrear subjects of earlier semesters along with current

(subject) Semester subjects.

(iii) Candidates shall be eligible to proceed to the subsequent semester, only if they earn, sufficient attendance as prescribed therefore by the Syndicate from time to time.

Provided in case of candidate earning less than 50% of attendance in any one of the semester due to any extraordinary circumstance such as medical grounds, such candidates who shall produce Medical Certificate issued by the Authorised Medical Attendant (AMA), duly certified by the Principal of the College, shall be permitted to proceed to the next semester and to complete the course of study. Such candidate shall have to repeat the missed semester by rejoining after completion of final semester of the course, after paying the fee for the break of study as prescribed by the University from time to time.

7. PASSING MINIMUM:

a) There shall be no Passing Minimum for Internal.

b) For External Examination, Passing Minimum shall be of 50%(Fifty Percentage) of the maximum marks prescribed for the paper.

c) In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-voce.

d) Grading shall be based on overall marks obtained (internal + external).

For M.Sc. Degree Course in Computer Science & Technology (5 year Integrated course)
B.Sc. Degree Course in Computer Science and Technology

A candidate shall be declared to have passed:

a) There shall be no Passing Minimum for Internal.

b) For External Examination, Passing Minimum shall be of 40%(Forty Percentage) of the maximum marks prescribed for the paper for each Paper/Practical/Project and Viva-voce.

c) In the aggregate (External + Internal) the passing minimum shall be of 40% .

d) He/She shall be declared to have passed the whole examination, if he/she passes in all the papers and practicals wherever prescribed / as per the scheme of examinations by earning 140 CREDITS in Parts-I, II, III, IV & V. He/she shall also fulfill the extension activities prescribed earning a minimum of 1 Credit to qualify for the Degree.

8. CLASSIFICATION OF SUCCESSFUL CANDIDATES:

Candidates who secured not less than 60% of aggregate marks (Internal + External) in thewhole examination shall be declared to have passed the examination in the First Class.

All other successful candidates shall be declared to have passed in Second Class.

Candidates who obtain 75% of the marks in the aggregate (Internal + External) shall be deemed to have passed the examination in First Class with Distinction, provided they pass all the examinations (theory papers, practicals, project and viva-voce) prescribed for the course in the First appearance.

9. GRADING SYSTEM:

The term grading system indicates a Seven (7) Point Scale of evaluation of the performances of students in terms of marks obtained in the Internal and External Examination, grade points and letter grade.
SEVEN POINT SCALE (As per UGC notification 1998)

GRADE	GRADE POINT	PERCENTAGE EQUIVALENT
`O" = Outstanding	5.50 – 6.00	75 – 100
`A" = Very Good	4.50 – 5.49	65 – 74
`B" = Good	3.50 – 4.49	55 – 64
`C" = Average	3.00 – 3.49	50 – 54
`D" = Below Average	1.50 – 2.99	35 – 49
`E" = Poor	0.50 – 1.49	25 – 34
`F" = Fail	0.00 – 0.49	0 – 24

10. RANKING:

Candidates who pass all the examinations prescribed for the course in the first appearanceitself alone are eligible for Ranking / Distinction.

Provided in the case of candidates who pass all the examinations prescribed for the course with a break in the First Appearance due to the reasons as furnished in the Regulations under "Requirements for Proceeding to subsequent Semester" are only eligible for Classification.

11. PATTERN OF QUESTION PAPER:

PART –A (50 words):Answer 10 out of 12 Questions 10 x 1 = 10 marks

PART –B (200 words):Answer 5 out of 7 Questions 5 x 5 = 25 marks

PART –C (500 words):Answer 4 out of 6 Questions 4 x 10 = 40 marks

12. INSTANT EXAMINATION

Candidates who have passed all the theory papers upto 3rd semester and failed in only one paper pertaining to the 4th semester can apply for Instant Examination. Application form with a demand draft for Rs.400/-, drawn in favour of "The Principal, Sri Sankara Arts and Science College, Enathur" should be submitted on or before 10 days after the publication of results. The results are published within 15 days after the date of examinations.

13. PASSING MINIMUM

A candidate shall be declared to have passed:

a) There shall be no Passing Minimum for Internal.

b) For External Examination, Passing Minimum shall be of 50 % (Fifty Percentage) of themaximum marks prescribed for the paper for each Paper/Practical/Project and Viva-voce.

c) In the aggregate (External + Internal) the passing minimum shall be of 50%.

d) He/She shall be declared to have passed the whole examination, if he/she passes in all the papers and practicals wherever prescribed / as per the scheme of examinations by earning 91 CREDITS in Parts-I, II, III, IV & V. He / She shall also complete one certificate course to qualify for the Degree.

A candidate who fails in any of the unit / project work / Project Report / dissertation / vivavoice shall reappear in that unit / project work / Project Report / Dissertation / viva-voice and pass the examination subsequently.

14. CLASSIFICATION OF SUCCESSFUL CANDIDATES

PART- I CORE SUBJECTS (COURSE): Successful candidates passing the Examinations for the Language and securing the marks 60 percent and above in the aggregate shall be declared to have passed the examination in the FIRST Class. All other successful candidates shall be declared to have passed the examination in the SECOND Class.

PART – II ELECTIVE SUBJECTS (COURSE): Successful candidates passing the examinations for English and securing the marks 60 percent and above in the aggregate shall be declared to have passed the examination in the FIRST Class. All other successful candidates shall be declared to have passed the examination in the SECOND class.

PART – III Soft skill

Successful Candidate earning of 2 credits for soft skill paper SHALL NOT BE taken into consideration for Classification / Ranking / Distinction.

PART – IV INTERNSHIP

Successful Candidate earning of 2 credits for internship SHALL NOT BE taken into consideration for Classification / Ranking / Distinction.

15. RANKING

Candidates who pass all the examinations prescribed for the Course in the FIRST APPEARANCE ITSELF ALONE are eligible for Ranking / Distinction. Provided in the case of Candidates who pass all the examinations prescribed for the Course with a break in the First Appearance due to the reasons as furnished in the Regulations 11(iii) category are only eligible for Classification.

16. APPEARANCE FOR IMPROVEMENT

Candidates who have passed in a theory paper / papers are allowed to appear again for theory paper / papers only once in order to improve his/her marks, by paying the fee prescribed from time to time. Such candidates are allowed to improve within a maximum period of 10 semesters counting from his/her first semester of his/her admission. If candidate improve his marks, then his improved marks will be taken into consideration for the award of Classification only. Such improved marks will not be counted for the award of Prizes / Medals, Rank and Distinction. If the candidate does not show improvement in the marks, his previous marks will be taken into consideration. No candidate will be allowed toimprove marks in the Practical, Project, Viva-voce, and Field work.

17. CONDONATION

Students must have 75% of attendance in each course for appearing the examination. Students who have 74% to 70% of attendance shall apply for condonation in the prescribed formwith the prescribed fee Rs.200/-.Students who have 69% to 60% of attendance shall apply for condonation in prescribed form with the prescribed fee along with the Medical Certificate. Students who have below 60% of attendance are not eligible to appear for the examination. They shall re-do the semester(s) after completion of the programme.

18. RETOTALING

Candidates are permitted to apply for retotaling within 10 days from the date of publication of results. The student should submit request for retotaling in the prescribed format.and pay the feeprescribed per paper.

19. PHOTOCOPY OF ANSWER SCRIPT

Candidates are permitted to apply for obtaining a photocopy of answer paper within 20 days from the date of publication of results. The student should submit request for photocopy of answer script in the prescribed format.

20. REVALUATION

Candidates are permitted to apply for revaluation after obtaining a photocopy of answer paper within 30 days from the date of publication of results. The student should submit request for revaluation in the prescribed format and pay the fee prescribed per paper.

21. MALPRACTICE

Any malpractice by the students debars them from subsequent appearance based on the decisionof the examination committee. In all cases of malpractice their conduct certificates will indicate malpractice.

22. EVALUATION AND GRADING SYSTEM

The performance of a student in each paper is evaluated in terms of percentage of marks with a provision for conversion to grade points (GP). Evaluation for each paper shall be done by a continuous internal assessment by the concerned paper teacher as well as by an end semester examination and will be consolidated at the end of the course.

The term grading system indicates a Ten Point Scale of evaluation of the performances of students in terms of marks obtained in the Internal and External Examination, grade points and letter grade.
Once the marks of the Internal and end-semester examinations for each of the papers are available, they will be added. The marks thus obtained will then be graded as per details provided in Table.

The sum of total performance in each semester will be rated by Grade Point Average (GPA) while the continuous performance from the second semester onwards will be marked by Cumulative Grade Point Average (CGPA). These two are calculated by the following formulae.

$$GPA = \frac{\text{Sum of [Credits acquired x Grade points]}}{\text{Sum of Credits acquired}}$$

For the calculation of Grade Point Average (GPA), Gi is the grade point awarded; Ci is the credit units earned for the ith paper.

$$CGPA = \frac{\sum_{i=1}^{n} C_i GP_i}{\sum_{i=1}^{n} C_i}$$

where „Ci" is the Credit earned for the paper i in any semester ; „Gi" is the Grade Point obtained by the student for the paper i and „n" is the number of papers passed in that or CGPA = GPA of all the papers starting from the first semester to the current semester.

Note: The GPA and CGPA shall be calculated separately for the following five parts:

Part I: Core Subject; Part II: Elective Subject, Part III: Skill based subjects, Part IV:Internship and Part V: Certificate
course

Marks	Grade Point	CGPA	Letter Point	Classification of Final Result
96 and above	10	9.51 and above	S^+	First Class with Exemplary
91 – 95	9.5	9.01 – 9.50	S	
86 – 90	9.0	8.51 – 9.00	D^{++}	First Class with Distinction
81 – 85	8.5	8.01 – 8.50	D^+	
76 – 80	8.0	7.51 – 8.00	D	
71 – 75	7.5	7.01 – 7.50	A^{++}	First Class
66 – 70	7.0	6.51 – 7.00	A^+	
61 – 65	6.5	6.01 – 6.50	A	
56 – 60	6.0	5.51 – 6.00	B^+	Second Class
51 – 55	5.5	5.01 – 5.50	B	
46 – 50	5.0	4.51 – 5.00	C^+	Third Class
40 – 45	4.5	4.00 – 4.50	C	
Below 40	0	Below 4.00	F	Fail

The grade card / mark sheet issued at the end of the semester to each student will contain the following:

a. the marks obtained for each paper registered in the semester

b. the credits earned for each paper registered for that semester

c. the performance in each paper by the letter grade point obtained

d. the Grade Point Average (GPA) of all the papers registered for that semester and

e. from the second semester onwards, the Cumulative Grade Point Average (CGPA) of all the papers and

f. the class and grade of the student in the final CGPA

23. TRANSITORY PROVISION

Candidates who have undergone the course of study prior to the academic year 2008-2009 will be permitted to appear for the examinations under those Regulations for a period of three years i.e., up to and inclusive of April/May 2012 Examinations. Thereafter, they will be permitted to appear for the examination only under the Regulations then in force.

*M.Sc. COMPUTER SCIENCE AND TECHNOLOGY (5 YEAR INTEGRATED)

Structure of the Course and Evaluation Pattern:

If a candidate is unable to continue this course after the sixth semester, he/she will be awarded B.Sc.(Computer Science & Technology) provided he/she has passed in all subjects up to VI Semester.

I SEMESTER

Course/Component	Name of theSubject	Credits	Exam Duration	Marks		
				Int.	Ext.	Total
Part –I, Paper I	**Language – I***	3	3	25	75	100
Part – II, Paper I	**Communicative English – I**	3	3	25	75	100
Part - III Allied–I: Paper I	**Mathematics – I**	5	3	25	75	100
Part - III Allied–II:Paper I	**Applied Physics – I**	5	3	25	75	100
Part – III	**C and C++ Programming**	4	3	25	75	100
Non Major Elective / VI Tamil for non Tamil Students	**Non Major Elective / VI Tamil for non Tamil Students**	2	3	25	75	100
Part – IV SoftSkill	**Soft Skill –I (English for Physical Sciences-1)**	3	3	40	60	100

II Semester

Course/Component	Name of the Subject	Credits	Exam Duration	Marks		
				Int.	Ext.	Total
Part –I, PaperII	**Language –II***	3	3	25	75	100
Part– II, PaperII	**Communicative English -II***	3	3	25	75	100
Part - III Allied–I:Paper II	**Mathematic s – II**	5	3	25	75	100
Part - III Allied–II:Paper II	**Applied Physics – II**	5	3	25	75	100
Part – III	**Practical –I: C and C++ Programming Lab**	3	3	40	60	100
Non Major Elective / VI Tamil for non Tamil Students	**Non Major Elective / VI Tamil for non Tamil Students**	2	3	40	60	100
Part – IV SoftSkill	**Soft Skill – II (English for Physical Sciences-II)**	3	3	50	50	100

III Semester Theory

Course/Component	Name of theSubject	Credits	Exam Duration	Marks		
				Int.	Ext.	Total
Part – III	**Computer Oriented Mathematics**	4	3	25	75	100
Part – III	**Digital & Microprocessor**	4	3	25	75	100
Part – III	**Object Oriented Analysis and Design**	4	3	25	75	100
Part – III	**Python Programming**	4	3	25	75	100
Part – IV SoftSkill	**Soft Skill –III (Personality Enrichment)**	3	3	50	50	100
EnvironmentalStudies	**Environmental Studies / Exam. In IV Semester**	2	3	25	75	100
Part – III	**Practical –III : Python Programming Lab**	3	3	40	60	100

IV SEMESTER THEORY

Course/Component	Name of the Subject	Credits	Exam Duration	Marks		
				Int.	Ext.	Total
Part – III	**Data Analytics Using R**	4	3	25	75	100
Part – III	**Computer Architecture and Organization**	4	3	25	75	100
Part – III	**Computer Graphics**	4	3	25	75	100
Part – III	**Multimedia Systems**	4	3	25	75	100
Part – IV SoftSkill	**Soft Skill – IV (Quantitative Aptitude)**	3	3	50	50	100
Part – III	**Practical IV : Data Analytics using R LAB**	3	3	40	60	100

V SEMESTER THEORY

Course/Component	Name of the Subject	Credits	Exam Duration	Marks		
				Int.	Ext.	Total
Part – III	**JAVA Programming and Data Structures**	4	3	25	75	100
Part – III	**Elective- I**	5	3	25	75	100
Part – III	**Operating System**	4	3	25	75	100
Part – III	**Software Engineering**	4	3	25	75	100
Part – III	**Practical V : Data Structures using Java LAB**	3	3	40	60	100
Part – IV	**Value Education**	2	3	25	75	100

ELECTIVE – I

1. Internet of Things
2. System Software
3. Web Frameworks

VI SEMESTER THEORY#

Course/Component	Name of the Subject	Credits	Exam Duration	Marks		
				Int.	Ext.	Total
Part – III	**Elective – II**	5	3	25	75	100
Part – III	**Elective –III**	5	3	25	75	100
Part – III	**Computer Networks**	4	3	25	75	100
Part – III	**Web Development Using Open Source Technology**	5	3	25	75	100
Part – III	**Practical – VI : Web Development Using Open-Source Technology Lab**	3	3	40	60	100
Part – V	**Extension Activities**	1				

ELECTIVE – II

1. Software Quality Assurance
2. Data Mining
3. Microservices Architecture

ELECTIVE – III

1. Cloud Computing
2. Ethical Hacking
3. Web Mining

VII SEMESTER THEORY

Course/Component	Name of theSubject	Credits	Exam Duration	Marks		
				Int.	Ext.	Total
Part – III	**Relational Database Management Systems**	4	3	25	75	100
Part – III	**Mobile Application Development**	4	3	25	75	100
Part – III	**Fundamentals of Machine Learning**	4	3	25	75	100
Part – III	**Elective IV**	4	3	25	75	100
Part – IV Soft Skill	**Soft Skill – V**	2	3	50	50	100
Part – III	**Practical VII: RDBMS Lab.**	3	3	40	60	100
Part – III	**Practical VIII : Mobile Application Development Lab**	3	3	40	60	100

ELECTIVE – IV

1. Principles of Algorithm Design
2. Parallel Computing
3. Text Mining

VIII SEMESTER THEORY

Course/Component	Name of theSubject	Credit	Exam Duration	Marks		
				Int.	Ext.	Total
Part – III	**Software Testing**	4	3	25	75	100
Part – III	**Unix and Perl Programming**	4	3	25	75	100
Part – III	**Mobile Computing**	4	3	25	75	100
Extra Disciplinary Elective -1	**Theory of Computation**	4	3	25	75	100
Part – III	**Elective V**	3	3	25	75	100
Part – IV SoftSkill	**Soft Skill – VI**	2	3	50	50	100
Part – IV SoftSkill	**Soft Skill – VII**	2	3	50	50	100
Part – V Internship**	**During SummerVacation**	-	3	-	-	100
Part – III	**Practical IX : Unix and Perl Programming Lab**	3	3	40	60	100

**** Internship will be carried out during the summer vacation of the fourth year and marksshould be sent to the University by the College and the same will be included in the Ninth Semester Marks Statement.**

ELECTIVE – V:

1. Software Project Management
2. Distributed Database Management Systems
3. Java Web Services

IX SEMESTER

Course/Component	Name of the Subject	Credits	Exam Duration	Marks		
				Int.	Ext.	Total
Part – III	**Communication Network and Wireless Technology**	4	3	25	75	100
Part – III	**Digital Image Processing**	4	3	25	75	100
Extra Disciplinary Elective -II	**E-commerce**	4	3	25	75	100
Part – III	**ElectiveVI**	3	3	25	75	100
Part – III	**ElectiveVII**	3	3	25	75	100
Part – IV SoftSkill	**Soft Skill – VIII**	2	3	50	50	100
Part – V	**Internship**	2		-	100	100
Part – III	**Practical X : Digital Image Processing Lab**	3	3	40	60	100

ELECTIVE – VI:

1. Artificial Intelligence
2. Cryptography and Network security
3. Artificial Neural Network

ELECTIVE – VII:

1. Distributed Computing
2. Big Data Analytics
3. Introduction to Natural Language Processing

X SEMESTER

Course/Component	Name of the Subject	Credits	Exam Durati on	Marks		
				Int.	Ext.	Total
Part – III	Project	16	3	20	80	100

 # Soft Skill courses for IV and V year shall be opted by the students as per soft skills regulations for postgraduate courses.

Core Paper Theory – 1			
Title of the paper withsubject code	**C and C++ Programming**		
Category of the course	Year	Semester	Credits
Core	**I**	**I**	**4**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To learn the fundamental programming concepts and methodologies which are essential to building good C/C++ programs.
- To practice the fundamental programming methodologies in the C/C++ programming language via laboratory experiences. Microsoft Visual Studio is the programming environment that will used.
- To code, document, test, and implement a well-structured, robust computer program using the C/C++ programming language.
- To write reusable modules (collections of functions).

COURSE OUTCOMES:

CO1: Understand the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions, Pointers, Structures and File programming

CO2: Acquire knowledge about the object-oriented paradigm.

CO3: Role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language.

CO4: Use of inheritance, polymorphism and encapsulation concepts in object-oriented programming.

CO 5: Role of Functions involving the idea of modularity.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	C fundamentals – character set – identifier and key works – data types – constants – variables – declarations – expressions – statements – arithmetic, unary, relational and logical, assignment and conditional operators – library functions – flow of control – control structures – switch, break and continue, go to statements – comma operator.	12	CO-1	K1 , K2
II	Functions – defining, accessing functions – functions prototypes – passing arguments – recursions – storage classes – multi file programs - Arrays –passing arrays to functions – multidimensional arrays – arrays and string – structures – passing structures to functions - Pointers – declarations – passing pointers to functions – operation in pointers – pointer and arrays – arrays of pointers – structures and pointers.	12	CO-2	K2, K3
III	Principles of Object Oriented Programming (OOP) – Software Evaluation -- OOP Paradigm – Basic Concepts of OOP – Benefits of OOP – Applications of OOP. Classes and Objects – Constructors and Destructors -- Operator overloading - Type Conversions – Type Conversions – Type of Constructors – Function Overloading.	12	CO-3	K4
IV	Inheritance – Types of Inheritance – Virtual Functions and Polymorphism Constructors in inheritance – Mapping Console I/O operations.	12	CO-4	K5
V	Files – File Streams – File operations – File pointer – Error Handling during file operations – Command line arguments.	12	CO-5	K6

TEXT BOOKS:

1. Gottfried B S – Programming with C – II Edition TMH Pub Co Ltd.
2. E.Balaguruswamy, 1995,Programming in ANSI C, TMH Publishing Company Ltd.
3. Stanley Lippmann, Josee Lajoie – C++ Primer – Third Edition – Addison Wesley.
4. Robert Lafore – Object Oriented Programming in Microsoft C++ - Galgotia
5. HillPublishing Company Ltd.

REFERENCE BOOKS:

1. Kanetkar Y – Let us C - BPB Publication.

E. Balagurusamy,1995,Object Oriented Programming with C++, Tata McGraw-

Core Paper Practical – 1			
Title of the paper withsubject code	**C and C++ Programming Lab**		
Category of the course	Year	Semester	Credits
Core	**I**	**II**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To learn the fundamental programming concepts and methodologies which are essential to building good C/C++ programs.
- To practice the fundamental programming methodologies in the C/C++ programming language via laboratory experiences. Microsoft Visual Studio is the programming environment that will used.
- To code, document, test, and implement a well-structured, robust computer program using the C/C++ programming language.

COURSE OUTCOMES:

CO1: Understand the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions, Pointers, Structures and File programming

CO2: Acquire knowledge about the object-oriented paradigm.

CO3: Role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language.

CO4: Use of inheritance, polymorphism and encapsulation concepts in object-oriented programming.

CO 5: Role of Functions involving the idea of modularity.

UNIT NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Summation of series a. sin(x) b. cos(x) c. exp(x)	CO-1 CO-2 CO-3 CO-4 CO-5	K1,K2,K3, K4,K5.K6
2	String manipulations a. Counting the number of vowels, consonants, words white spaces in a line of text and array of lines. b. Reverse a string & check for palindrome c. Sub string detection and count d. Sub string removal e. Find and replacing substrings		
3	Recursion a. GCD of two numbers b. Fibonacci sequence c. Tower of Honoi		
4	Matrix manipulation a. Addition & subtraction b. Multiplication		
5	Sorting and searching a. Insertion sort b. Bubble sort		
6	Create a class Box containing length, breath and height. Include following methods in it: a) Calculate surface Area b) Calculate Volume c) Overload ++ operator d) Overload -- operator		
7	Create a structure Student containing fields for Roll No., Name, Class, Year and Total Marks. Create 10 students and store them in a file.		
8	Write a program to retrieve the student information from file created in previous question and print it in following format: Roll No. Name Marks		
9	Create the Person class. Create some objects of this class (by taking information from the user). Inherit the class Person to create two classes Teacher and Student class. Maintain the respective information in the classes and create, display and delete objects of these two classes (Use Runtime Polymorphism).		
10	Create a class Triangle. Include overloaded functions for calculating area. Overload assignment operator and equality operator.		

Core Paper Theory – 2			
Title of the paper withsubject code	**DIGITAL AND MICROPROCESSOR**		
Category of the course	Year	Semester	Credits
Core	**II**	**III**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To inculcate the basic building blocks of the computers in the form of digital circuits.
- To enable students, learn the heart of the computers in the form of microprocessors.
- To generalize on how computer memory and microprocessor are constructed.
- To focus on assembly level programming.

COURSE OUTCOMES:

CO-1: Demonstrate the principles of number systems, conversion between number systems and understanding the logic gates.

CO-2: Apply Boolean algebra and theorem for simplification of Boolean functions and also apply Karnaugh map, tabulation method for reducing Boolean expressions.

CO-3: Deduce the working principles of sequential circuits and combinational circuits.

CO-4: Understanding the architecture of 8085 micro-processor and instruction set.

CO-5: Design aspects of various addressing modes and Write programs using various instructions of 8085 microprocessor.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Fundamentals of computers – Characteristics of computers - Computer Language - Number Systems - conversion from one number system to another – Compliments - Boolean Algebra & Logic Gates – Truth Tables – Universal Gates.	12	CO-1	K1,K2
II	Simplification of Boolean functions: SOP, POS methods – Karnugh Map [upto 4 variables]. – Combinational Logic: Adders &Subtractors – Multiplexer – Demultiplexer - Encoder – Decoder Sequential Logic: RS, Clocked RS, D, JK, Master Slave JK, T Flip-Flops	12	CO-2	K3
III	Introduction to Microprocessors - Microprocessor Architecture and Its Operations – Memory – 8085 pin diagram – Introduction to 8085 Instructions – Data Transfer, Arithmetic, Logic and Branch Operations – Addressing Modes	12	CO-3	K3, K4
IV	Writing Assembly Language Programs –8 bit Addition and subtraction – 8 bit multiplication and division- BCD to Binary and Binary to BCD conversions –BCD to HEX and HEX to BCD - ASCII to BCD and BCD to ASCII conversions - Binary to ASCII and ASCII to Binary conversions. BCD Arithmetic -	12	CO-4	K5

	BCD Addition and Subtraction.			
V	Stack and Subroutines –8085 Interrupt – Vectored Interrupts – Interfacing I/O Devices: Basic Interfacing Concepts – Interfacing Input Devices- Memory-Mapped I/O- Direct Memory Access (DMA).	12	CO-5	K5, K6

TEXT BOOKS:

1. V.Rajaraman - Fundamentals of Computers, Third Edition, PHI, New Delhi.
2. M.M Mano, Digital Logic Fundamentals and Computer Design, Pearson Education.
3. Ramesh S. Gaonkar- Microprocessor Architecture, Programming, and Applications with the 8085, 5th Edition, Penram International Publishing (India) Pvt. Ltd.

REFERENCE BOOKS:

1. T.C.Bartee, Computer Architecture and Logical Design, Tata McGraw-HILL.
2. V. Vijayendran, Digital Electronic and Microprocessor 8085, S.Viswanathan (Printers & Publishers) Pvt. Ltd.
3. Mathur- "Introduction to Microprocessor"- 3 rd Edition- Tata McGraw-Hill.

Core Paper Theory – 3			
Title of the paper withsubject code	**OBJECT ORIENTED ANALYSIS AND DESIGN**		
Category of the course	Year	Semester	Credits
Core	**II**	**III**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To understand the role of objects in software process models
- To analyze the importance of use cases
- To model the system using standard design diagrams
- To design and manage object-based systems
- To study standard OO patterns and their impact on testing

COURSE OUTCOMES:

CO-1: Recall the object-oriented concepts for analysis and design of systems and gather functional requirements.

CO-2: Analyze the real-world problems using the use case diagrams.

CO-3: Apply knowledge of OOPs concepts in Object Oriented Design and analyze the case study for the UML notations.

CO-4: Draw activity and state chart diagram for real word applications for evaluating a class diagram and object diagram for user requirements

CO-5: Design case studies and model it in different views with respect user requirement such as use case, logical, component and deployment and etc, and preparation of document of the project for the unified Attendance application.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	System Development - Object Basics - Development Life Cycle - Methodologies - Patterns - Frameworks - Unified Approach – UML	12	CO-1	K1, K2,
II	Use-Case Models - Object Analysis - Object relations - Attributes - Methods - Class and Object responsibilities - Case Studies	12	CO-2	K2, K3
III	Design Processes - Design Axioms - Class Design - Object Storage - Object Interoperability - Case Studies	12	CO-3	K3, K4
IV	User Interface Design - View layer Classes - Micro-Level Processes - View Layer Interface - Case Studies	12	CO-4	K5
V	Quality Assurance Tests - Testing Strategies - Object orientation on testing - Test Cases - test Plans - Continuous testing - Debugging Principles - System Usability - Measuring	12	CO-4 CO-5	K6

	User Satisfaction - Case Studies			

TEXT BOOKS:

1. Ali Bahrami - Object Oriented Systems Development - McGraw Hill International Edition – 1999
2. Grady Booch- Object Oriented Analysis and design with applications–Addison Wesley, 2007
3. UML Distilled: A Brief Guide to the Standard Object Modeling Language, Martin Fowler, 3rd Edition, 2003

REFERENCE BOOKS:

1. Ramnath, Sarnath, and Brahma Dathan. *Object-oriented analysis and design*. Springer Science & Business Media, 2010.
2. Kahate, Atul. *Object Oriented Analysis & Design*. Tata McGraw-Hill Education, 2004

Core Paper Theory – 4			
Title of the paper withsubject code	**PYTHON PROGRAMMING**		
Category of the course	Year	Semester	Credits
Core	**II**	**III**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To implement the python programming features in practical applications.
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.
- Use functions for structuring Python programs.
- Represent compound data using Python lists, tuples, dictionaries, turtles, Files and modules.

COURSE OUTCOMES:

CO-1: Understand the fundamentals of Tokens, Data types, operators, library functions and Input / Output statements of Python-language.

CO-2: Comprehend the branching constructs and looping constructs of python-language and write simple programs implementing each of the constructs.

CO-3: Analyze Complex data types, List, Tuple, Sets and Dictionary. Review User-defined functions, recursive functions with an example program illustrating its use.

CO-4: Demonstrate the object-oriented programming concepts, modules and exception handling in python.

CO-5: Review the concepts of file operations. Create programs to illustrate the usage of file pointer and file handling for input and output of data.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**INTRODUCTION TO PYTHON:** Python Tokens, Python Data types, Python Operators, Python Blocks.	12	CO-1	K1
II	**PYTHON FLOW CONTROL, BRANCHING STATEMENTS**: if, else and else if, Python Flow Control: Looping statements- Definite and Indefinite Loops, For loops, ranges, While loops, Use of pass, continue, break and else in Loops.	12	CO-2	K2,K3

III	**PYTHON COMPLEX DATA TYPES**: String data type and string operations, List, Tuple, Set and Dictionary, String manipulation, List. Set and Dictionary manipulation, User Defined functions, Call by Value, Call by Reference, Recursive functions, Default arguments in functions, variable scope.	12	CO-3	K3
IV	**OBJECT ORIENTED PROGRAMMING USING PYTHON**: Objects, Abstraction, Encapsulation, Inheritance, Polymorphism, Python Modules, Exception Handling	12	CO-4	K4,K5
V	**PYTHON FILE OPERATIONS**: Reading files, Writing files in python, Understanding read functions, read(), readline(), readlines(). Understanding write functions, write() and writelines() Manipulating file pointer using seek Programming, using file operations.	12	CO-5	K6

TEXT BOOKS:

1. Charles Dierbach, "Introduction to Computer Science using Python - A computational Problem solving Focus", Wiley India Edition, 2015.
2. Wesley J. Chun, "Core Python Applications Programming", 3rd Edition, Pearson Education, 2016
3. Taming Python by Programming, Jeeva Jose, Khanna Publishing House

REFERENCE BOOKS:

1. Mark Lutz, "*Learning Python Powerful Object Oriented Programming*", O'reilly Media 2018, 5th Edition.
2. Timothy A. Budd, "*Exploring Python*", Tata MCGraw Hill Education Private Limited 2011, 1st Edition.
3. Allen Downey, Jeffrey Elkner, Chris Meyers, "*How to think like a computer scientist: learning with Python*", 2012.
4. Sheetal Taneja & Naveen kumar, "*Python Programming a Modular approach – A Modular approach with Graphics, Database, Mobile and Web applications*", Pearson, 2017.
5. Ch Satyanarayana M Radhika Mani, B N Jagadesh, "*Python programming*", Universities Press 2018.

WEB REFERENCES

- http://www.ibiblio.org/g2swap/byteofpython/read/
- NPTEL & MOOC courses titled Python programming

http://spoken-tutorial.org/tutorial-search/?search_foss=Python&search_language=English

Core Practical – 2			
Title of the paper withsubject code	**PYTHON PROGRAMMING LAB**		
Category of the course	Year	Semester	Credits
Core	**II**	**III**	**3**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To implement the python programming features in practical applications.
- To write, test, and debug simple Python programs.
- To implement Python programs with conditionals and loops.

COURSE OUTCOMES:

CO-1: Understand the basic concept of Python Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions and File programming

CO-2: Acquire knowledge about the basic concept of writing a program.

CO-3: Role of constants, variables, identifiers, operators, type conversion and other building blocks of Python Language.

CO-4: Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.

CO-5: Role of Functions involving the idea of modularity.

SL NO	**SYLLABUS**	**COS**	**cognitive**
1	Program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.	CO-1 CO-2 CO-3 CO-4 CO-5	K1,K2,K3, K4,K5,K6
2	Program to calculate total marks, percentage and grade of a student. Marks obtained in each of the five subjects are to be input by user. Assign grades according to the following criteria: Grade A: Percentage >=80 Grade B: Percentage >=70 and <80 Grade C: Percentage >=60 and <70 Grade D: Percentage >=40 and <60 Grade E: Percentage <40		
3	Program, to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.		
4	Program to display the first n terms of Fibonacci series		
5	Program to find factorial of the given number using recursive function		

6	Write a Python program to count the number of even and odd numbers from array of N numbers		
7	Python function that accepts a string and calculate the number of upper case letters and lower case letters.		
8	Python program to reverse a given string and check whether the give string is palindrome or not.		
9	Write a program to find sum of all items in a dictionary.		

Core Paper Theory – 5			
Title of the paper withsubject code	**DATA ANALYTICS WITH R**		
Category of the course	Year	Semester	Credits
Core	**II**	**IV**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To enable the students to learn the basic concepts of Data Analytics.
- To have a basic understanding of R-Programming.
- To have an overview of Data analytical packages used in R-language.
- To familiarize students with basic regression and data mining concepts implemented using R-language.

COURSE OUTCOMES:

CO-1: Understand how to download R-package and handling of R packages. Exploring the data types in R.

CO-2: Analyze the data and data frames in R and operators available in R

CO-3: Demonstrate the concepts of linear regression, logistic regression and its types.

CO-4: Understand the decision tree representation in R and clustering concepts.

CO-5: Synthesis association rules and clustering algorithms in Data mining concepts.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Introduction to R-Downloading and Installing R, IDEs and Text Editors, Handling Packages in R, Getting Started with R - Working with Directory, Data Types in R, Few Commands for Data Exploration,	12	CO-1	K1
II	Loading and Handling Data in R-Challenges of Analytical Data Processing, Expression, Variables and Functions, Missing Values Treatment in R, Using the 'as' Operator, Vectors, Matrices, Factors, List, Few Common Analytical Tasks, Aggregating and Group Processing, Simple Analysis, Methods for Reading Data, Comparison of R GUIs for Data Input - Exploring Data in R - Data Frames, Understanding Data in Data Frames, Load Data Frames, Exploring Data, Missing Values, Outliers, Descriptive Statistics, data Visualizations	12	CO-2	K1, K2

III	Linear Regression using R-Model Fitting, Linear Regression, Assumptions, Validating Linear Assumption, - Logistic Regression-What is Regression?, Generalized Linear Models, Logistic Regression, Binary Logistic Regression, Diagnosing Logistic Regression , Multinomial Logistic Regression Models	12	CO-3	K3, K4
IV	Decision Tree - What is a Decision Tree?, Representation in R, Appropriate Problems, Learning Algorithms, Measuring Features, Hypothesis Space Search, Inductive Bias, Why Prefer Short Hypotheses, Issues-Clustering - What is Clustering?, Basic Concepts, Hierarchical Clustering, k-means Algorithm, CURE Algorithm, Clustering in Non-Euclidean Space	12	CO-4	K4, K5
V	Association Rules-Frequent Itemset, Data Structure Overview, Mining Algorithm Interfaces, Auxiliary Functions, Sampling from Transaction, Generating Synthetic Transaction Data, Additional Measures of Interestingness, Distance-based Clustering Transaction and Associations - Mining Frequent Patterns, Associations, and Correlations, Frequent Itemsets, Closed Itemsets and Association Rules, Frequent Itemsets: Mining Methods, Pattern Evaluation Methods	12	CO-5	K5, K6

TEXT BOOKS:

1. Data Analytics using R, Seema Acharya, McGraw Hill Education
2. Data Science & Analytics, V.K. Jain, Khanna Publishing House
3. Beginner's Guide for Data Analysis using R Programming, Jeeva Jose, ISBN: 978-93-86173454

REFERENCE BOOKS:

1. THE BIG R-BOOK *FROM DATA SCIENCE TO LEARNING MACHINES AND BIG DATA , Philippe J.S. De Brouwer , 2021,* John Wiley & Sons
2. A First Course in Statistical Programming with R, 2nd Edition, W. John Braun and Duncan J. Murdoch

Core Paper Theory – 6			
Title of the paper withsubject code	**COMPUTER ARCHITECTURE AND ORGANIZATION**		
Category of the course	Year	Semester	Credits
Core	**II**	**IV**	**4**
Paper mainly focusses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To identify the functional units in a digital computer system
- To distinguish between the various ISA styles
- To compare different approaches used for implementing a functional unit
- To understand the fundamentals of memory and I/O systems and their interaction with the processor
- To evaluate different computer systems based on performance metrics

COURSE OUTCOMES:

CO-1: Demonstrate basic components of computer system and its accessories.
CO-2: Comprehend various types of memory organization and its advantages and disadvantages.
CO-3: Deduce the principles of computer architecture concepts such as instruction formats, addressing modes, registers and RISC vs CISC pipelining concepts
CO-4: Apply computer arithmetic algorithms and memory organization structures.
CO-5: Deduce microprogrammed control concepts.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**Computer Evolution**: Pentium and Power PC Evolution. Computer System: Components – Function – Interconnection Structures – Bus Interconnection – Basics of PCI Bus. Memory: Characteristics – Hierarchy – Cache Memory – Principles – Cache Design – Locality of Reference.	12	CO-1	K1,K2
II	**Main Memory:** Static RAM – Dynamic RAM – Types of ROM – Memory Chip Organization – Types of DRAM. **External Memory**: Magnetic Disk – Basics of RAID – Optical Memory – Magnetic Tapes.	12	CO-,2	K2, K3
III	**Input/Output**: External Devices – I/O Module – Programmed I/O – Interrupt Driven I/O – DMA – I/O Channels & Processors. **Computer Arithmetic:** ALU – Integer Representation and Arithmetic – Floating Point Representation	12	CO-3	K3

	and Arithmetic. **Instruction Set**: Characteristics – Operand Types – Operation Types – Addressing Modes – Instruction Formats – Pentium and Power PC Operands, Operations, Addressing Modes (Simple Examples).			
IV	**CPU:** Organization of Processors and Registers – Instruction Cycle – Instruction Pipelining – Pentium Processor. RISC: Characteristics – Large Register File – Register Optimization – Architecture – RISC Vs CISC Characteristics – Pipelining.	12	CO-4	K4, K5
V	**Control Unit:** Micro-Operations – Control of Processors – Hardwired Implementation - Micro Programmed Control Concepts – Microinstruction Sequencing – General Microinstruction Execution	12	CO-4, CO-5	K5,K6

TEXT BOOKS:

1. M.M.Mano – Computer System Architecture – 3 rd Edition – PHI – 1994.
2. J.P.Hayes – Computer System Architecture – McGrawHill – 1988.
3. D.A Patterson and J.L. Hennessy, Computer Architecture – A

REFERENCE BOOKS:

1. Vincent P. Heuring, Harry F. Jordan Computer Systems Design and Architecture, AddisonWesley, 1999.
2. Computer Architecture: A Quantitative Approach, David Patterson and John L. Hennessy
3. Andrew S. Tanenbaum, Structured Computer Organization, Prentice Hall of India, IV Edition

Core Paper Theory – 7			
Title of the paper withsubject code	**COMPUTER GRAPHICS**		
Category of the course	Year	Semester	Credits
Core	**II**	**IV**	**4**
Paper mainly focusses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To comprehend basic 2D and 3D Graphics viewing pipeline that includes, Modeling, manipulation and rendering
- To acquaint students with advanced Graphics for visual realism, with add on exposure to OpenGL programming and applications

COURSE OUTCOME:

CO-1: Understand the principles of graphical components generated on computer displays.

CO-2: Infer output primitives and algorithms for line drawing, Circle generation and Ellipse drawing.

CO-3: Apply two dimensional transformations on objects and two-dimensional viewing of line, curve, and polygon.

CO-4: Evaluate various color models and animations such as graphics programming packages such as OPENGL

CO-5: Build a camera using a program to create shaded objects and to render textures and drawing shadows on an image.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**INTRODUCTION TO COMPUTER GRAPHICS**: Brief Survey of Computer Graphics – Graphics Systems: Video Display Devices – Types – Raster-Scan Systems and Random-Scan Systems – Input Devices – Hard-Copy Devices – Graphics Software.	12	CO-1	K1,K2
II	**OUTPUT PRIMITIVES AND THEIR ATTRIBUTES**: Line Drawing (DDA and Bresenham's) Algorithms – Circle-Generating (Midpoint) Algorithm – Ellipse-Generating (Midpoint) Algorithms Area-Filling (Boundary-Fill and Flood-Fill) Algorithms - Line Attributes - Color and Grayscale Levels – Character Attributes – Inquiry Functions.	12	CO-1 CO-2	K2, K3

III	**TWO-DIMENSIONAL TRANSFORMATIONS AND VIEWING:** Basic Transformations - Matrix Representations and Homogeneous Coordinates – Composite Transformations - Other Transformations – Window-to- Viewport Coordinate Transformation – Clipping Algorithms: Cohen-Sutherland Line Clipping and Sutherland Hodgeman Polygon Clipping – Basic Modeling Concepts - Interactive Input Methods: Logical Classification of Input Devices – Interactive Picture-Construction Techniques.	12	CO-3	K3
IV	**THREE-DIMENSIONAL CONCEPTS:** Three-Dimensional Display Methods: Parallel and Perspective Projections – Depth Cueing - Visible Line and Surface Identification – Polygon Surfaces: Polygon Tables, Plane Equations and Polygon Meshes - Three-Dimensional Transformations: Basic, Other and Composite Transformations.	12	CO-4 CO-,5	K4, K5
V	**THREE-DIMENSIONAL VIEWING**: Viewing Pipeline and Coordinates – Transformation from World to Viewing Coordinates – Projection Transformations. **GRAPHICS PROGRAMMING WITH OPENGL**: Drawing 3D Scenes. Removal of Hidden Faces, Using Shading Models, Colors and Light, Adding Texture and Shadows, Applying a Ray Tracer. Understanding 3D Modeling and Animation Tools like 3D Studio Max, Maya, Blender.	12	CO-5	K5, K6

TEXT BOOKS:

1. D. Hearn and M.P. Baker,2005, Computer Graphics, 2nd Edition, Pearson Education, Prentice Hall, 19th Reprint.
2. S. Harrington,1987, Computer Graphics, 2nd Edition, McGraw-Hill Book Co. ii. W.M. Newman and R.F. Sproull ,1997
3. Principles of Interactive Computer Graphics, 2nd Edition, Tata McGraw-Hill Publishing Co. Ltd.

REFERENCE BOOKS:

1. D.P. Mukherjee ,1999, Fundamentals of Computer Graphics and Multimedia, 1st Edition, Prentice-Hall of India Pvt. Ltd.
2. N. Krishnamurthy ,2002, Introduction to Computer Graphics, 1st Edition, Tata McGraw-Hill Publishing Co. Ltd.
3. D.F.Rogers,2001,Procedural Elements for Computer Graphics, 2nd Edition, Tata McGraw-Hill Publishing Co. Ltd.

Core Paper Theory – 8			
Title of the paper withsubject code	**MULTIMEDIA SYSTEMS**		
Category of the course	Year	Semester	Credits
Core	**II**	**IV**	**4**
Paper mainly focusses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- Students will understand multimedia in respect to many applications including business, schools, home, education, and virtual reality.
- Students will understand the hardware and software needed to create projects using creativity and organization to create them.
- Student will develop multimedia skills understanding the principal players of individual players in multimedia teams in developing projects.

COURSE OUTCOMES:

CO – 1: Describe the types of media and define multimedia system.
CO – 2: Describe the process of digitizing (quantization) of different analog signals (text, graphics, sound and video).
CO – 3: Use and apply tools for image processing, video, sound and animation.
CO - 4: Apply methodology to develop a multimedia system.
CO – 5: Apply acquired knowledge in the field of multimedia in practice and independently continue to expand knowledge in this field.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**INTRODUCTION:** Objectives – History of Multimedia – Its market – Content copyright – Resources for multimedia developers – Types of produces – Evaluation – Hardware Architecture – OS and Software – Multimedia Architecture – Software library – Drivers.	12	CO-1	K1,K2
II	**MULTI MEDIA AUDIO:** Digital medium - Digital audio technology - sound cards - recording -editing - MP3 - MIDI fundamentals - Working with MIDI - audio file formats - adding sound to MM project.	12	CO-2	K2
III	**MULTIMEDIA TEXT:** Text in MM - Text and Graphics : Elements of Text – Text Data files – Using text in Multimedia Application – Hypertext – Elements of Graphics – Images and color – Graphics files and Application formats – Creating images for multimedia use –Using graphics in Application.	12	CO-3	K3,K4

IV	**MULTIMEDIA ANIMATION:** Computer animation fundamentals - Kinematics - morphing - animation s/w tools and techniques. **MULTIMEDIA VIDEO:** How video works - broadcast video standards - digital video fundamentals - digital video production and editing techniques - file formats.	12	CO-4, CO-5	K4, K5
V	**MULTIMEDIA PROJECT:** stages of project - MM skills - design concept - authoring - planning and costing – MM team. **MULTIMEDIA AND INTERNET:** Internet – HTML and web authoring – Multimedia considerations for Internet – Design considerations for web pages.	12	CO-5	K5, K6

TEXT BOOKS:

1. Multimedia Magic - S.Gokul revised and updated second edition - BPB
2. Multimedia Making it Work - TayVaughen 6th edition - TMH
3. Multimedia Technology and Applications – David Hillman-Galgotia Publications pvt.Ltd, 1998.

REFERENCE BOOKS:

1. Introduction to Multimedia Systems by Sugata Mitra, Gaurav Bhatnagar, Shikha Mehta

2 Multimedia Systems by Klara Nahrstedt and Ralf Steinmetz

Core Practical – 3			
Title of the paper withsubject code	**DATA ANALYTICS USING R LAB**		
Category of the course	Year	Semester	Credits
Core	**II**	**IV**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To enable the students to learn the basic concepts of Data Analytics.
- To have a basic understanding of R-Programming.
- To have an overview of Data analytical packages used in R-language.

COURSE OUTCOMES:

CO1: Understand R programming language concepts such as branching and looping constructs.
CO2: Understand various Data analytical procedures using R applications.
CO3: Implement correlation analysis and covariance analysis using R applications.
CO4: Understand the Min-Max normalization and Z-score normalizations.
CO5: Apply decision and iteration control structures to implement algorithms

SL. NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Finding mean, mode, median, and IQR	CO-1 CO-2 CO-3 CO-4 CO-5	K1,K2,K3, K4,K5
2	Finding vriance, standard deviation and drawing quantile plot & histogram		
3	Finding dissimilarity between binary attributes		
4	Finding Euclidean distance, manhattan distance and Supremum distance		
5	Finding dissimilarity between ordinal attributes		
6	Finding cosine similarity between two term frequency vectors		
7	Finding Correlation analysis of nominal attributes using chi2 & Covariance analysis of numeric attribute		
8	Finding Min-Max normalization & Z score normalization		
9	R script for implementing of “a data cube is a lattice of cuboids”		
10	Finding rare patterns and negative patterns & Negatively related patterns		
11	Finding closed and maximal item sets & pattern distance		
12	Finding Semantic annotations of a frequent patterns		
13	Generating ROC Curve		
14	Implementing Backpropagation algorithm		

15	Implementing k-means algorithm		
16	Fuzzy clustering using the EM algorithm		
17	Detecting outliers using different techniques		
18	Implementing linear & logistic regression		
19	Implementing Decision tree algorithms		
20	Implementing frequent pattern mining algorithms		

Core Paper Theory – 9			
Title of the paper withsubject code	**JAVA PROGRAMMING AND DATA STRUCTURES**		
Category of the course	Year	Semester	Credits
Core	**III**	**IV**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To enable the students to learn the basic concepts of Java programming
- To use class and objects to create applications
- To have an overview of interfaces, packages, multithreading and exceptions.
- To familiarize students with basic data structures and their use in algorithms.

COURSE OUTCOMES:

CO-1: Conceive the Programming constructs such as branching statements and looping statements of JAVA language, Class, object, and file stream classes.

CO-2: Recall the principles of Object-Oriented Programming paradigm, its advantages, disadvantages and applications. Understand how JAVA programming language can be used to implement the OOP's concepts through Class, Object, inheritance, polymorphism.

CO-3: Understanding the concepts of Packages, Exception handling and Multithreading in JAVA.

CO-4: Comprehend the basic data structures such as stack, queue, Linked-list, applications of stacks.

CO-5: Understanding of Trees, Graphs and their traversals. Calculate the single source shortest path using Dijkstra's Algorithm by representing the problem as graph.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Features of Java – Java Virtual Machine - Object Oriented Paradigm in Java – Data Types – Naming Conventions- Variables- Type Conversion and Casting- Operators – Branching and Looping Statements – Arrays.	12	CO-1	K1
II	Classes - Objects - Constructors – Inheritance – Interface - String and Vector Class- Overloading and Overriding methods - Using super-Abstract class - this keyword – finalize() method.	12	CO-2	K1,K2

III	Packages - Importing Packages - Exception Handling – Multithreaded Programming – Java thread life cycle and Synchronization in Threads - Thread Priorities - I/O Streams - File Streams - Applets .	12	CO-3	K2, K3
IV	Abstract Data Types(ADTs)-List ADT-Array based implementation-linked list implementation-singly linked list-doubly linked list-circular linked list-Stack ADT operations-Applications-Evaluating arithmetic expressions-Conversion of infix to postfix expression-Queue ADT-operations-Applications of Queues.	12	CO-4	K3, K4
V	Trees-Binary Trees- representation - Operations on Binary Trees- Traversal of a Binary Tree -Binary Search Trees, Graphs-Representation of Graphs - Traversal in Graph - Dijkstra's Algorithm, Depth-First vs Breadth-First Search	12	CO-5	K5, K6

TEXT BOOKS:

1. E. Balagurusamy," *Programming with Jav: A Primer*", Tata McGraw Hill 2014, 5th Edition.
2. Mark Allen Weiss, "*Data Structures and Algorithms Analysis in C++*", Person Education 2014, 4th Edition.
3. Fundamentals of Data Structures, Sartaj Sahni, University Press

REFERENCES BOOKS:

1. Herbert Schildt, "*JAVA 2: The Complete Reference*", McGraw Hill 2018, 11th Edition.
2. Aho, Hopcroft and Ullman, "*Data Structures and Algorithms* ", Pearson Education 2003.
3. Data Structures, RS Salaria, Khanna Publishing House

WEB REFERENCES:

- NPTEL & MOOC courses titled Java and Data Structures
- https://nptel.ac.in/courses/106106127/
- https://nptel.ac.in/courses/106105191/

Core Paper Theory – 10			
Title of the paper withsubject code	**OPERATING SYSTEM**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To understand the fundamental concepts and role of Operating System.
- To learn the Process Management and Scheduling Algorithms
- To understand the Memory Management policies
- To gain insight on I/O and File management techniques

COURSE OUTCOMES:

CO-1: Understand the fundamentals of Operating System structures, focusing on process scheduling, memory management, file systems and I/O systems. Summarize various process-scheduling algorithms for a processor

CO-2: Identify the problem of race condition in time sharing operating system and the need for process synchronization. Relate the effects of synchronization on creation of deadlock. Discuss the methods of deadlock avoidance, prevention and ignoring.

CO-3: Compare and contrast different memory management methods and discuss how virtual memory is implemented by memory management unit using page replacement algorithm.

CO-4: Summarize the file structures and directory structure concepts along with its protection, implementation and recovery of file system. Deduce how file systems is implemented in Unix OS and Window OS.

CO-5: Demonstrate how I/O subsystems work and discuss how Mass storage structure work such as disk scheduling and management.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**Operating System Basics:** Basic Concepts of Operating System - Services of Operating System-Classification of Operating System- Architecture and Design of an Operating System-Process Management - Introduction to Process-Process State -PCB - Process Scheduling - Interprocess Communication. **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of Multithreads.	12	CO-1	K1
II	**OPERATING SYSTEM SCHEDULING:** CPU Scheduling**:** Introduction - Types of CPU Scheduler - Scheduling Criteria - Scheduling Algorithms - FCFS Scheduling – SJF Scheduling - Priority Scheduling - Round-Robin Scheduling- Multilevel Queue Scheduling. **PROCESS SYNCHRONIZATION**: critical section problem -Hardware synchronization- Semaphores – classical problems of synchronization. **DEADLOCK**: Basic Concept of Deadlock- Deadlock Prevention - Deadlock Avoidance- Deadlock - Detection and Recovery.	12	CO-2	K1,K2
III	**MEMORY MANAGEMENT:** Memory Management - Basic Concept of Memory - Address Binding; Logical and Physical Address Space- Memory Partitioning - Memory Allocation- Protection-Fragmentation and Compaction	12	CO-3	K3,K4
IV	**SWAPPING:** Swapping- Paging-Mapping of Pages to Frames - Hierarchical Page Tables- Segmentation - Virtual Memory - Basic Concept of Virtual Memory- Demand Paging - Transaction Look aside Buffer (TLB) - Page Replacement Algorithms.	12	CO-4 CO-,5	K5, K6
V	**FILE MANAGEMENT:** Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed) **I/O HARDWARE:** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software – Components of the I/O Subsystem.	12	CO-5	K6

TEXT BOOKS:

1. Abraham Silberschatz Peter B. Galvin, G. Gagne, "Operating System Concepts",Sixth Edition, Addison Wesley Publishing Co., 2003.
2. Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall of India.
3. Operating Systems A Concept-Based Approach, Dhananjay M. Dhamdhere, McGraw Hill

REFERENCE BOOKS:

1. Operating Systems, Ekta Walia, Khanna Publishing House, DelhiOperating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition
2. Operating Systems – Flynn, McHoes, Cengage Learning
3. Operating Systems – Pabitra Pal Choudhury, PHI

Core Paper Theory – 11			
Title of the paper withsubject code	**SOFTWARE ENGINEERING**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**
Paper mainly focuses on	**ENTREPRENEURSHIP**		

COURSE OBJECTIVES:

- To introduce the software development life cycles
- To introduce concepts related to structured and objected oriented analysis & design co
- To provide an insight into UML and software testing techniques

COURSE OUTCOMES:

CO-1: Understand the Software Engineering concepts for creation of software project and product.

CO-2: Plan a Software Project involving project scheduling and tracking along with risk analysis of the project undertaken.

CO-3: Discuss the Software Configuration Management system for a software project. Analyze the sequence of steps in software project and do a analysis modeling.

CO-4: Review various Design concepts in Software engineering such as Architectural design and User Interface design.

CO-5: Demonstrate the Component level design and testing techniques and strategies for the software along with the metrics for the software design.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Introduction to Software Engineering: Some Definitions – Some Size factors – Quality and Productivity Factors – Managerial Issues. Planning a Software Project: Defining the Problem – Developing a Solution Strategy – Planning the Development Process – Planning an Organizational Structure – Other Planning Activities.	12	CO-1	K1,K2
II	Software Cost Estimation: Software Cost Factors – Software Cost Estimation Techniques – Staffing-Level Estimation – Estimating Software Maintenance Costs.	12	CO1, CO-2	K2,K3
III	Software Requirements Definitions: The Software Requirements Specification – Formal Specification Techniques – Languages and Processors for Requirements Specification.	12	CO-3	K4
IV	Software Design: Fundamental Design Concepts – Modules	12	CO-4	K4, K5

	and Modularization Criteria – Design Notations – Design Techniques – Detailed Design Considerations – Real-Time and Distributed System Design – Test Plans – Milestones, Walkthroughs, and Inspections - Design Guidelines.			
V	Verification and Validation Techniques: Quality Assurance – Static Analysis – Symbolic Execution – Unit Testing and Debugging – System Testing – Formal Verification. Software Maintenance: Enhancing Maintainability During Development – Managerial Aspects of Software Maintenance – Configuration Management – Source-Code Metrics – Other Maintenance Tools and Techniques.	12	CO-5	K5, K6

TEXT BOOKS:

1. A concise introduction to software Engineering, Pankaj Jalote, Springer
2. Richard Fairley, Sommerville "Software Engineering – Design Reliability and Management" ,Pearson Education, 7 th Edition
3. Software Engineering, Nasib Singh Gill, Khanna Publishing House

REFERENCE BOOKS:

1. Software Engineering, K.K. Aggarwal & Yogesh Singh, New Age International
2. Software Engineering – K.L.James, Prentice Hall of India Pvt. Ltd., New Delhi, 2009.
3. Fundamentals of Software Engineering – Rajib Mall, Prentice Hall of India Pvt. Ltd., New Delhi, 2003.

Elective Paper Theory – I			
Title of the paper withsubject code	**INTERNET OF THINGS**		
Category of the course	Year	Semester	Credits
Elective	**III**	**V**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To understand the concepts of Internet of Things and the application of IoT.
- To Determine the Market perspective of IoT.
- To Understand the vision of IoT from a global context

COURSE OUTCOMES:

CO-1: Understanding the diverse fields where IoT is being used and wider range of IoT-applications

CO-2: Comprehend how M2M value chains are converted to IoT value chains

CO-3: Analyze IoT architecture, reference model and different types of views in IoT model.

CO-4: Deduce how IoT can be applied to factories, Retail Industry, Business models and other smart applications.

CO-5: Review various Governance policies in privacy and security issues.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	IoT & Web Technology, The Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.	12	CO-1	K1, K2
II	M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	12	CO-1, CO-2	K2, K3

III	IoT Architecture -State of the Art – Introduction, State of the art, Architecture. Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.	12	CO-3	K3
IV	IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.	12	CO-4 CO-,5	K4, K5
V	Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.	12	CO-5	K5, K6

Text Books

1. Cirani, Simone, Gianluigi Ferrari, Marco Picone, and Luca Veltri. Internet of Things: Architectures, Protocols and Standards. John Wiley & Sons, 2018.

2.Holler, Jan, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, and David Boyle. Internet of Things. Academic Press, 2014.

REFERENCE BOOKS:

1. Michael Miller, "*The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World*", Pearson Education 2015.

2. Francis da Costa, "*Rethinking the Internet of Things: A Scalable Approach to Connecting Everything*", Apress Publications 2013, 1st Edition.

3. Waltenegus Dargie, Christian Poellabauer, "*Fundamentals of Wireless Sensor Networks: Theory and Practice*", **Wiley 2014.**

4. CunoPfister, "*Getting Started with the Internet of Things*", O"Reilly Media 2011.

WEB REFERENCES:

- https://github.com/connectIOT/iottoolkit
- https://www.arduino.cc/
- http://www.zettajs.org/

Elective Paper Theory – I			
Title of the paper withsubject code	**SYSTEM SOFTWARE**		
Category of the course	Year	Semester	Credits
Elective	**III**	**V**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To understand the relationship between system software and machine
- To know the design and implementation of assemblers, macro processor, linker
- To understand the process of scanning and parsing.
- To have an understanding of loader, system software tools and compiler.

COURSE OUTCOMES:

CO-1: Recall the basic functioning of compilers, assemblers, interpreters and steps involved in executing a High-level program.

CO-2: Design, Analyze and Implement one pass, two pass or multi pass assembler

CO-3: Design, Analyze and Implement loader, linker and macros.

CO-4: Assess various system software tools for editing, debugging and creating an user interface.

CO-5: Critique the features of modern editing /debugging tools.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**INTRODUCTION TO SYSTEM SOFTWARE AND SOFTWARE TOOLS: LANGUAGE PROCESSORS:** Introduction - Language Processing Activities - Fundamentals of Language Processing & Language Specification - Language Processor Development Tools. Data Structures for Language Processing: Search Data structures - Allocation Data Structures. Software Tools: Software Tools for Program Development - Editors - Debug Monitors - Programming Environments - User Interfaces.	12	CO-1	K1, K2
II	**ASSEMBLERS:** Elements of Assembly Language Programming - A Simple Assembly Scheme - Pass Structure of Assemblers - Design of a Two Pass Assembler - A single pass Assembler for IBM PC.	12	CO-1 CO-,2	K1, K2
III	**MACROS AND MACRO PROCESSORS:** Macro Definition and Call - Macro Expansion - Nested Macro Calls - Advanced Macro Facilities - Design of a Macro Preprocessor.	12	CO-3	K3, K4
IV	**INTERPRETERS AND INTRODUCTION OF COMPILERS:** Interpreters: Use and overview of interpreters Introduction of scanning and parsing - Phases of the Compiler	12	CO-4	K4, K5

	- Pure and impure interpreters. - Aspects of compilation.			
V	**LINKERS AND LOADERS:** Introduction to linkers - Relocation and Linking Concepts - Design of a Linker - Self-Relocating Programs - A Linker for MS-DOS - Linking for Overlays and Loaders.	12	CO-5	K5, K6

TEXT BOOK:

1. D. M. Dhamdhere, "Systems Programming and Operating Systems", Second Revised Edition, Tata McGraw-Hill, 1999.
2. 1. Leland L. Beck, "System Software – An Introduction to Systems Programming", 3rd Edition, Pearson Education Asia, 2000.
3. Santanu Chattopadhyay, "System Software", Prentice-Hall India, 2007

REFERENCE BOOKS:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools",2nd Edition, Pearson Education Asia.

Elective Paper Theory – I			
Title of the paper withsubject code	**WEB FRAMEWORKS**		
Category of the course	Year	Semester	Credits
Elective	**III**	**V**	**4**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVE:

- To understand the purpose of responsive web application
- To understand the fundamental concepts of ReactJS

COURSE OUTCOME:

CO – 1: Designing a simple responsive web application.

CO – 2: Analyzing CRUD operations using ReactJS

CO – 3: Understanding Life cycle model for the ReactJS

CO – 4: Demonstrating Event-driven programming model for ReactJS.

CO – 5: Designing Server-side Scripting of ReactJS.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Introduction to React- Understanding React - React's Future - Keeping up the changes - Setting up the Environment - Working with Files - Emerging JavaScript Declaring Variables - Arrow Functions - Transpiling ES6 - ES6 Objects and Arrays - Promises - Classes - ES6 Modules.	12	CO-1	K1, K2
II	Functional Programming with JS Understanding Functional Programming - Functional Concepts: Immutability, Pure Functions, Data Transformations, Higher-Order Functions, Recursion, Composition - Pure React Page Setup - The Virtual DOM- React Elements - ReactDOM - Children - Constructing Elements with Data - React Components - DOM Rendering - Factories 2.3 React with JSX React Elements as JSX - Babel - Recipes as JSX - Intro to Webpack.	12	CO-2	K2, K3
III	Props, State and Component Tree Property Validation - Validating Props with createClass - Default Props - Custom Property Validation - ES6 Classes and Stateless Functional	12	CO-3	K3, K4

	Components - Refs - React State Management - State within the Component Tree Enhancing Components Component Life Cycles: Mounting, Updating, React Children - JavaScript Library Integration - Higher Order Components - Managing State Outside of React - Flux: Views, Actions and Action Creators, Dispatcher, stores, Flux Implementations.			
IV	Forms Basic Button - Events and Event Handlers - Text Input - Remote Data - Async Persistence - Redux - Form Modules React Router Incorporating the Router - Nesting Routes - Router Parameters.	12	CO-4	K4, K5
V	React and Server Isomorphism vs Universalism - Universal Color Organizer - Communicating with the Server 5.2 Database Operations CRUD operations in ReactJS.	12	CO-4, CO-5	K5, K6

TEXT BOOKS:

1. Anthony, Accomazzo, Murray Nathaniel, and Lerner Ari, "Fullstack React: The Complete Guide to ReactJS and Friends", 2017.
2. Banks, Alex, and Eve Porcello, "Learning React: Functional Web Development with React and Redux", O'Reilly Media, Inc., 2017.

REFERENCE BOOKS:

1. Lopez, Lionel, "React: Quick start Step-by-step Guide to Learning React Javascript Library"
2. Robin Wieruch, "The Road to learn React", LeanPub, 2017.
3. Sidelnikov, Greg, "React.js Book: Learning React JavaScript Library From Scratch", River Tigris LLC, 1st Edition, 2017.
4. "ReactJS notes for Professionals", Goal Kicker.com

Core Practical – 4			
Title of the paper withsubject code	**DATA STRUCTURES USING JAVA LAB**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To enable the students to learn the basic concepts of Java programming
- To use class and objects to create applications
- To have an overview of interfaces, packages, multithreading and exceptions.

COURSE OUTCOMES:

CO1: Apply object-oriented programming features to program design and implementation
CO2: Understand object-oriented concepts and how they are supported by JAVA
CO3: Understand implementation issues related to object-oriented techniques.
CO4: Demonstrate the ability to analyze, use, and create functions, classes, to overload operators.
CO5: Demonstrate the ability to understand and use inheritance and interface when creating or using classes.
CO6: Determine which algorithm or data structure to use in different scenarios and be familiar with writing recursive methods.
CO7: Demonstrate understanding of the abstract properties of various data structures such as stacks, queues, lists, trees and graphs and use various data structures effectively in application programs.

SL NO	**SYLLABUS**	**COS**	**COGNITIVE LEVEL**
1	Write a Java program to implement the Stack ADT using a singly linked list.	CO-1 CO-2 CO-3 CO-4 CO-5	K1,K2,K3, K4,K5,K6
2	Write a Java program to implement the Queue ADT using a singly linked list.		
3	Write a Java program for the implementation of circular Queue.		
4	Write a Java program that reads an infix expression, converts into postfix form		
5	Write a Java program to evaluate the postfix expression (use stack ADT).		
6	Write a Java program to an Insert an element into a binary		

	search tree.		
7	Write a Java program to delete an element from a binary search tree.		
8	Write a Java program to search for a key element in a binary search tree.		
9	Write a Java program for the implementation of BFS for a given graph.		
10	Write a Java program for the implementation of DFS for a given graph.		

Core Paper Theory – 12			
Title of the paper withsubject code	**COMPUTER NETWORKS**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**4**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To understand the concept of Computer network
- To impart knowledge about networking and inter networking devices

COURSE OUTCOMES:

CO-1: Recall the concepts of communication, types of networks, transmission mode, types of medium, protocols and addresses.

CO-2: Apply layered protocol approach to communication representing OSI Reference model explaining the functional characteristics of each layer.

CO-3: Analyzing the protocols respective to the physical, data link, network, transport, session, presentation and application layers.

CO-4: Evaluate error control using error detection and correction, flow control using sliding window mechanism, IP addressing and subnet masking.

CO-5: Create an appropriate networking architecture for an organizational structure along with relevant protocols to support the network.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Introduction – Network Hardware - Software - Reference Models - OSI and TCP/IP Models - Example Networks: Internet, ATM, Ethernet and Wireless LANs - Physical Layer - Theoretical Basis for Data Communication - Guided Transmission Media.	12	CO-1	K1, K2
II	Wireless Transmission - Communication Satellites - Telephone System: Structure, Local Loop, Trunks and Multiplexing and Switching – Circuit-switched Networks – Packet Switching. Data Link Layer: Design Issues - Error Detection and Correction	12	CO-2	K2, K3
III	Elementary Data Link Protocols - Sliding Window Protocols - Data Link Layer in the Internet - Medium Access Layer -	12	CO-3	K3, K4

	Ethernet – Wireless LANs – Introduction – IEEE 802.11, Bluetooth – Connecting Devices			
IV	Network Layer - Design Issues - Routing Algorithms - Congestion Control Algorithms - IP Protocol - IP Addresses - Internet Control Protocols – Multicasting Basics.	12	CO-4 CO-5	K5, K6
V	Transport Layer - Services - Connection Management - Addressing, Establishing and Releasing a Connection - Simple Transport Protocol - Internet Transport Protocols (ITP) - Network Security: Cryptography. Application Layer: WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP.	12	CO-5	K5, K6

TEXT BOOKS:

1. A. S. Tanenbaum, "Computer Networks", Prentice-Hall of India 2008, 4th Edition.
2. Computer Networks, M. Dave, Cengage
3. An Integrated Approach to Computer Networks, Bhavneet Sidhu, Khanna Publications

REFERENCE BOOKS:

1. Stallings, "Data and Computer Communications", Pearson Education 2012, 7th Edition.
2. B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill 2007, 4th Edition.
3. F. Halsall, "Data Communications, Computer Networks and Open Systems", Pearson Education2008.
4. D. Bertsekas and R. Gallagher, "Data Networks", PHI 2008, 2nd Edition.
5. Lamarca, "Communication Networks", Tata McGraw Hill 2002.

WEB REFERENCES:

- NPTEL & MOOC courses titled Computer Networks
- https://nptel.ac.in/courses/106106091/

Core Paper Theory – 13			
Title of the paper withsubject code	**WEB DEVELOPMENT USING OPEN-SOURCE TECHNOLOGY**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**5**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To understand Web based programming and scripting languages.
- To learn the basic web concepts using open-source technologies such as PHP, JAVA SCRIPT, MYSQL.
- To learn how to interconnect PHP and MYSQL.

COURSE OUTCOMES:

CO-1: Understand the basics of PHP statements, operators, branching and looping statements.

CO-2: Analyze the usage of Arrays and functions in PHP. Comprehend the concepts of files.

CO-3: Analyze the features of client-side scripting languages such as Java Script such as keywords, operators, functions and DOM extensions.

CO-4: Deduce MySQL database data types, creating and manipulating table operations and data manipulation table aggregation functions.

CO-5: Design application programs with PHP as front-end and MySQL as back-end tool.

SL NO	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**HTML & CSS:** Creating a simple page, marking up text, adding links, adding images, table markup, forms, introducing cascading style sheets - formatting text, colors and backgrounds.	12	CO-1	K1, K2
II	**JAVASCRIPT – I:** Introduction- Introduction to Web Development , Client-Side and Server-Side JavaScript, Origin, History and Evolution of JavaScript, Features of JavaScript , Structure of Browsers, Saying *Hello World* to JS , Placement of Code, - Building the Basics - Character Set , Variables , Data Types , Operators , Control Flow Statements - Objects-Properties, Creating Objects , Objects as Record and Dictionary , Operations on Objects, Prototypal Inheritance , Classes , Garbage Collection - Functions - Variable Scope , Declaration , Parameters-Arrays – Properties , Declaration, Accessing an Array , Built-In Methods, Nesting and	12	CO-2	K2, K3

	Multidimensional Arrays .			
III	Browser Object Model- Window, History, Navigator, Location, Screen, Document Object -Document Object Model-Relationship, DOM Tree and Nodes , Document Object , Elements, Accessing Elements, Event Handling- Standard Built-In Objects- Fundamental Objects, Error Objects, Number and Dates , Text or String Processing , Keyed Collections , Indexed Collections , Structured Data ,Value Properties, Function Properties - Validation- Error Handling-Error Handling and Cookies.	12	CO-3	K3, K4
IV	**PHP:** Understanding PHP - How to Use PHP, PHP Variables, Operators, Including Files, - Flow Control- Logic Control, Looping, Own Functions, Event-Driven PHP, – Libraries-Text Functions, Math Functions, Date and Time Functions, Image-Handling Functions, - Security- Vulnerabilities, Solutions, - Object-Oriented Programming- the Basics, Class Methods, Loading Classes, Extending, - Sessions and Carts - Persistent Data, Cookies, Sessions, Shopping Carts.	12	CO-4	K4,K5
V	**MySQL:** Introducing MySQL- data types - Administering MySQL- Administration Tools, User Accounts, Designing and Building a Database- Creating Databases, Building Tables, - Using the Database- Working with Data, Searching for Data, Playing It Safe with Data - Communicating with the Database-Database Support in PHP, mysqli Library, Putting It All Together.	12	CO-5	K5,K6

TEXT BOOKS:

1. Vikram Vaswani, "PHP and MySQL", Tata McGraw-Hill, 2005
2. Ben Forta, "MySQL Crash course " SAMS, 2006.
3. Jaworski, Mastering Javascript, BPB Publications.

REFERENCE BOOKS:

1. Tim Converse, Joyce Park and Clark Morgan, "PHP 5 and MySQL", Wiley India reprint, 2008.
2. Robert Sheldon, Geoff Moes, "Beginning MySQL", Wrox, 2005.
3. Alexis Leon and Mathews Leon, "Database Management Systems", Vikas, 2008.

WEB REFERENCES:

- https://www.w3schools.com/php/
- https://www.phptpoint.com/php-tutorial-pdf/
- http://www.xmlsoftware.com/

Elective Paper Theory – II			
Title of the paper withsubject code	**SOFTWARE QUALITY ASSURANCE**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**
Paper mainly focuses on	**ENTREPRENEURSHIP**		

COURSE OBJECTIVES:

- Understand the basic tenets of software quality and quality factors.
- Be exposed to the Software Quality Assurance (SQA) architecture and the details of SQA Components.
- Understand of how the SQA components can be integrated into the project life cycle.
- Be familiar with the software quality infrastructure.
- Be exposed to the management components of software quality.

COURSE OUTCOMES:

CO-1: Analyze software documentations using inspections and walkthrough

CO-2: Associate various software metrics to context

CO-3: List the components of test plan

CO-4: Device a Testing Group

CO-5: Explain standards, assessments and certificates.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE** Need for Software quality – Quality challenges – Software quality assurance (SQA) – Definition and objectives – Software quality factors- McCall's quality model – SQA system and architecture – Software Project life cycle Components – Pre project quality components – Development and quality plans.	12	CO-1	K1, K2
II	**SQA COMPONENTS AND PROJECT LIFE CYCLE** Software Development methodologies – Quality assurance activities in the development process- Verification & Validation – Reviews – Software Testing – Software Testing implementations – Quality of software maintenance – Pre-Maintenance of software quality components – Quality assurance tools – CASE tools for software quality – Software maintenance quality – Project Management.	12	CO-1, CO-2	K2, K3
III	**SOFTWARE QUALITY INFRASTRUCTURE** Procedures and work instructions - Templates - Checklists – 3S	12	CO-3	K3, K4

	developmenting - Staff training and certification Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control – Storage and retrieval.			
IV	**SOFTWARE QUALITY MANAGEMENT & METRICS** Project process control – Computerized tools - Software quality metrics – Objectives of quality measurement – Process metrics – Product metrics – Implementation – Limitations of software metrics – Cost of software quality – Classical quality cost model – Extended model – Application of Cost model.	12	CO-4	K4, K5
V	**STANDARDS, CERTIFICATIONS & ASSESSMENTS** Quality management standards – ISO 9001 and ISO 9000-3 – capability Maturity Models – CMM and CMMI assessment methodologies - Bootstrap methodology – SPICE Project – SQA project process standards – IEEE st 1012 & 1028 – Organization of Quality Assurance – Department management responsibilities – Project management responsibilities – SQA units and other actors in SQA systems.	12	CO-5	K5, K6

TEXT BOOKS:

1. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003.
2. Stephen Kan, "Metrics and Models in Software Quality", Addison-Wesley, Second Edition, 2004.
3. Milind Limaye, ―Software Quality Assurance‖, McGraw Hill, 2011.

REFERENCE BOOKS:

1. M G Limaye, "Software Testing – Principles, Techniques and Tools", McGraw Hill, 2011.
2. Edward Kit, "Software Testing in the Real World – Improving the Process", Pearson Education, 1995.
3. Elfriede Dustin, "Effective Software Testing", Pearson Education, 2003

Elective Paper Theory – II			
Title of the paper withsubject code	**DATA MINING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To learn about data mining Concepts
- To study the different data mining techniques

COURSE OUTCOMES:

CO-1: Understanding the data mining concepts and different types of data warehouse such as Relational, Transactional, Object oriented, spatio-temporal, multimedia databases.

CO-2: Comprehend the data preprocessing techniques such as data reduction, data integration, data transformation, data reduction and discretization.

CO-3: Analyze various data mining techniques such as association rule mining, Multilevel, Multidimensional, and Constraint Based Association Mining and implement Apriori algorithm.

CO-4: Compare and contrast the classification and prediction techniques such as Tree induction, Bayesian Classification and Back Propagation.

CO-5: Review various Clustering Methods such as Hierarchical Methods, Density Based Methods, Web Mining, Spatial Mining and Temporal Mining.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Introduction to Data mining: Motivation - On what kind of data - Data Mining Functionalities - Classification of Data Mining systems - Major Issues in Data Mining systems. Data Preprocessing – Data cleaning - Data Integration and Transformation - Data Reduction - Discretization and concept Hierarchy Generation.	12	CO-1	K1, K2
II	Mining Association Rules in Large Databases: Association Rule Mining - Mining Single Dimensional Boolean Association rules from Transactional Databases - Mining Multilevel Association Rules – Mining Multidimensional Association Rules - From Association Mining to Correlation	12	CO-1 ,CO-2	K2

	Analysis - Constraint- Based Association Mining.			
III	Classification and Prediction: What is Classification and Prediction - Issues regarding Classification and Prediction - Classification by Decision Tree Induction - Bayesian Classification - Classification by Back propagation - Other Classification Methods - Prediction - Classifier Accuracy.	12	CO-3	K3, K4
IV	Cluster Analysis: What is Cluster Analysis? Types of Data in Cluster Analysis - A Categorization of Major Clustering Methods - Partitioning Methods - Hierarchical Methods - Density-Based Methods - Grid-Based Methods - Outlier Analysis.	12	CO-4, CO-5	K4, K5
V	Applications and Trends in Data Mining: Data Mining Applications - Data Mining System Products and Research Prototypes - Additional Themes on Data Mining - Social Impacts of Data Mining - Trends in Data Mining.	12	CO-5	K5, K6

TEXT BOOKS:

1.HanJiawei Han and Kamber Micheline, "Data Mining Concepts and Techniques", Morgan Kaufmann Publishers,Second Edition,2006.

2. Data Mining: Introductory and Advanced Topics, 1e, Margaret H. Dunham.

3. Data Mining Techniques, Arun Kumar Pujari.

REFERENCE BOOKS:

1. M Barry and G.Linoff ", Mastering Data Mining", John Wiiley, Second Edition

2.Introduction to Data Mining 2e Paperback – 30 May 2021by Pang-Ning Tan Michael Steinbach Anuj Karpatne Vipin Kumar.

Elective Paper Theory – II			
Title of the paper withsubject code	**MICROSERVICES ARCHITECTURE**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- Comprehend the need for Microservices and its evolution.
- Explore various patterns of service design and techniques.
- Formulate experiments with various levels and factors of microservices.
- Demonstrate applicability of Microservices architecture in various domains.

COURSE OUTCOMES:

CO - 1: Comprehend the need for Microservices architecture and its systematic evolution.
CO - 2: Apply Microservices architecture technologies to enterprise domain.
CO - 3: Design and analyze various Microservices architecture patterns and techniques.
CO - 4: Analyze the node.JS webservice connection with Express.
CO – 5: Compare and evaluate best strategies and practices of Microservices architecture.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**JavaScript – I:** Introduction- Introduction to Web Development , Client-Side and Server-Side JavaScript, Origin, History and Evolution of JavaScript, Features of JavaScript , Structure of Browsers, Saying *Hello World* to JS , Placement of Code, - Building the Basics - Character Set , Variables , Data Types , Operators , Control Flow Statements - Objects- Properties, Creating Objects , Objects as Record and Dictionary , Operations on Objects, Prototypal Inheritance , Classes , Garbage Collection - Functions - Variable Scope , Declaration , Parameters-Arrays – Properties , Declaration, Accessing an Array , Built-In Methods, Nesting and Multidimensional Arrays	12	CO-1	K1, K2
II	**JavaScript – II:** Browser Object Model- Window, History, Navigator, Location, Screen, Document Object -Document Object Model- Relationship, DOM Tree and Nodes, Document Object, Elements, Accessing Elements, Event Handling-	12	CO-1 ,CO-2	K2, K3

	Standard Built-In Objects- Fundamental Objects, Error Objects, Number and Dates, Text or String Processing, Keyed Collections, Indexed Collections, Structured Data, Value Properties, Function Properties - Validation- Error Handling- Error Handling and Cookies.			
III	**node.js – I**; Introduction- Why Node.js?, What Exactly Is Node.js? - Getting Started- Installing, Running, First Web Server, Debugging - Asynchronous Programming- The Old Way of Doing Things, The Node.js Way of Doing Things, Error Handling and Asynchronous Functions,Maintaining a Sense of Identity, Being Polite—Learning to Give Up Control, Synchronous Function Calls - Writing Simple Applications- First JSON Server, Node Pattern: Asynchronous Loops, Learning to Juggle, More on the Request and Response Objects, Increased Flexibility, Modifying Things – Modules- Writing Simple Modules, Consuming Modules, Writing Modules	12	CO-3	K3
IV	**node.js – II:** Expanding Web Server- Serving Static Content, Assembling Content - Building Web Applications with Express- Installing Express, Routing and Layers, REST API, Additional Middleware Functionality- Databases I: NoSQL- Structuring Your Data for MongoDB, Understanding the Basic Operations - Databases II: SQL (MySQL) - Getting Ready, Basic Database Operations	12	CO-4	K4, K5
V	**UNIT – V** **Microservices using node.js:** Developing Microservices- Designing Microservice Endpoints, Implementing the Data for a Microservice, Implementing Code for a Microservice - Releasing Microservices- Setting Up the Staging Environment, Deploying.	12	CO-5	K5, K6

TEXT BOOKS:

1. JavaScript Syntax and Practices, Dr Ravi Tomar & Ms Sarishma Dangi, CRC Press, 2022
2. Learning Node.js, A Hands-On Guide to Building Web Applications in JavaScript, Marc Wandschneider, Pearson Education, 2013
3. Microservices: Up and Running *A Step-by-Step Guide to Building Microservices Architecture, O'Reilly Media,* Ronnie Mitra and Irakli Nadareishvili, 2020

REFERENCE BOOKS:

1. Microservice Architecture: Aligning Principles, Practices, and Culture by Irakli Nadareishvili, Matt McLarty, Ronnie Mitra, Michael Amundsen
2. Building Microservices: Designing fine grained systems, by Sam Newman.

Elective Paper Theory – III			
Title of the paper withsubject code	**CLOUD COMPUTING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To understand the concepts in Cloud Computing and its Security
- To understand the evolving computer model caned cloud computing.
- To introduce the various levels of services that can be achieved by cloud.

COURSE OUTCOMES:

CO-1: Understand the concepts of cloud computing, need for cloud computing, advantages and disadvantages.

CO-2: Discuss various forms of cloud services, platform as service, software as service, infrastructure as service and cloud service deployment.

CO-3: Discuss how cloud computing can be used for collaborating contact list, community, corporations, group projects and events.

CO-4: Review various cloud services available can be used for collaborating for online planning, schedule management, task management, project management, database and sharing files.

CO-5: Review web-based collaborating tools, web conference tools and collaborating via blogs and wikis.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**CLOUD COMPUTING OVERVIEW**: Applications – Intranets and the cloud – Why Cloud Computing Matters – Benefits – Limitations – Companies in the Cloud Today – Cloud Services.	12	CO-1	K, K2
II	**CLOUD COMPUTING TECHNOLOGY:** Hardware and Infrastructure – Clients – Security- Network – Services – Accessing the Cloud - Platforms – Web Applications – Web APIs –Web Browsers –Cloud Storage – Overview – Cloud Storage Providers –Standards – Application – Client –	12	CO-2	K2

	Infrastructure – Service.			
III	**CLOUD COMPUTING AT WORK**: Software as a service – Overview– Driving Forces – Company offerings – Industries – Software plus Services–Overview-Mobile Device Integration – Providers – Microsoft Online.	12	CO-3	K2, K3
IV	**DEVELOPING APPLICATIONS:** Google – Microsoft – Intuit Quick Base – Cast Iron Cloud – Bungee Connect - Local clouds and Thin Clients – Virtualization – Server Solutions – Thin Clients.	12	CO-4	K4, K5
V	**MIGRATING TO THE CLOUD**: Cloud Services for Individuals – Cloud services aimed at the mid-market – Enterprise-Class Cloud Offerings – Migration.	12	CO-5	K5, K6

TEXT BOOKS:

1. Antony. T. Velte, Toby J. Velte, Robert Elsenpeter, Cloud Computing: A Practical Approach, Tata McGraw- Hill Pub, Edition 2010.
2. Essentials of Cloud Computing, K. Chandrasekaran
3. Cloud Computing, Pandey & Choudhary

REFERENCE BOOKS:

1. Roger Jennings, Cloud Computing with Windows Azure Platform, Wiley India Pvt. Ltd, 2009.
2. Barrie Sosinsky, Cloud Computing Bible, Wiley India Pvt. Ltd., 2011.

Elective Paper Theory – III			
Title of the paper withsubject code	**ETHICAL HACKING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To enable students learn a secure platform for computers and users, free from disruptions and invasions from unauthorized users and programs.
- To introduce students about various testing internal systems, searching for security breaches, finding weak points and training other developers in security analysis
- To provide application of security tools to test network and systems security.

COURSE OUTCOMES:

CO-1: Understand the concepts of Ethical Hacking, Enterprise Information security Architecture.

CO-2: Discuss various forms of foot printing, Network scanning and protocols and techniques in HTTP Tunneling and IP Spoofing.

CO-3: Discuss how system hacking works and steganography applications and detection tools.

CO-4: Review various Malware threats and its countermeasures and Malware analysis

CO-5: Review various case study tools, techniques and counter measures for sniffing attacks and session hijacking.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**INTRODUCTION TO ETHICAL HACKING**: Information security overview – skills of an ethical hacker – Hacking concepts and phases - Types of attacks – Information Security threats, attack vectors, and controls – Information Assurance (IA) – Information Security Laws and Standards – Security Policies types, HR/legal implications – Physical Security – Threat Modelling – Enterprise Information Security Architecture (EISA) – Network Security Zoning.	12	CO-1	K1, K2
II	**FOOT PRINTING & RECONNAISSANCE**: Foot printing concepts, threats, attack vectors and controls, Foot printing through Search Engines, Foot Printing through Social Networking sites, Website Foot printing, Competitive Intelligence, WHOIS Foot printing, Foot Printing tools. Scanning Networks: Scanning Methodology, techniques, and countermeasures - Techniques for IDS evasion, scanning,	12	CO-2	K2, K3

	HTTP tunneling, and IP spoofing			
III	**SYSTEM HACKING**: Cracking passwords, escalating privileges, executing applications, hiding files and covering tracks – Steganography application and classification, tools, methods/attacks on Steganography, Steganography detection tools.	12	CO-3	K3
IV	**MALWARE THREATS**: Introduction to malware – Trojans attacks, how to infect a system, crypters, how to deploy, latest types, analysis, countermeasures - Viruses—stages, types, latest virus maker, analysis, countermeasures - Worms—types, makers, analysis, countermeasures - Malware analysis - Antivirus tools - Penetration testing.	12	CO-4	K3, K4
V	**SNIFFING ATTACKS**: MAC, DHCP, and spoofing - Poisoning: ARP and DNS – Tools Social Engineering: Concepts, techniques, impersonation, identity theft, and Counter measures - Phases of an attack - Common targets of an attack -Impersonation scenario - Computer based, mobile based, social networking-based Denial of Service: Concepts, case study, tools, attack techniques, and Countermeasures Botnet - Scanning methods for vulnerable machines - Detection Techniques and tools. Session Hijacking: Concepts, case study, tools, attack techniques, and Countermeasures - Five stages of a web malware attack - Application level session hijacking - Network level session hijacking - TCP/IP Hijacking.	12	CO-5	K5,K6

TEXT BOOKS:

1. Kimberly Graves, CEH: Certified Ethical Hacker Study Guide, Wiley; 2010.
2. Ethical Hacking and Penetration Testing Guide by Rafay Baloch
3. The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy by Patrick Engebretson

REFERENCE BOOKS:

1. Hacking: The Art of Exploitation by Jon Erickson
2. The Web Application Hacker's Handbook: Discovering and Exploiting Security Flaws by Dafydd Stuttard and Marcus Pinto

Elective Paper Theory – III			
Title of the paper withsubject code	**WEB MINING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- Introduce students to the basic concepts and techniques of Information Retrieval, Web Search, Data Mining, and Machine Learning for extracting knowledge from the web.
- Develop skills of using recent data mining software for solving practical problems of Web Mining.
- Gain experience of doing independent study and research.

COURSE OUTCOMES:

CO – 1: Understand the web retrieval and web search model.

CO – 2: Analyze the web page pre-processing procedure for web mining.

CO – 3: Demonstrate the web content mining in social network analysis and build a basic crawler algorithm

CO – 4: Comprehend the Web structure mining integrating with web interface query

CO – 5: Design a recommender system for web usage mining.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	**INTRODUCTION:** WWW – History of Web and Internet – Web Mining – Types of Web Mining – Information Retrieval and Web Search - Information Retrieval Models : Boolean Model - Vector Space Model - Statistical Language Model - Evaluation Measures	12	CO-1	K1
II	**WEB PAGE PRE-PROCESSING**: Stopword Removal – Stemming - Pre-Processing Tasks for Text - Web Page Pre-Processing - Duplicate Detection - Inverted Index and Its Compression - Latent Semantic Indexing - Web Spamming	12	CO-2	K1, K2
III	**WEB CONTENT MINING**: Social Network Analysis - Co-Citation and Bibliographic Coupling – PageRank – HITS - Community Discovery - Web Crawling - A Basic Crawler Algorithm - Universal Crawlers - Focused Crawlers - Topical Crawlers - Crawler Ethics and Conflicts	12	CO-3	K3

IV	**WEB STRUCTURE MINING**: Structured Data Extraction - Types of Data Rich Pages - Wrapper Induction - Instance-Based Wrapper Learning - String Matching and Tree Matching - Multiple Alignment - Information Integration - Schema Matching - Pre-Processing for Schema Matching- Schema-Level Matching - Domain and Instance-Level Matching - Integration of Web Query Interfaces - Opinion Search and Retrieval - Opinion Spam Detection	12	CO-4, CO-5	K3,K4
V	**WEB USAGE MINING**: Data Collection and Pre-Processing - Data Modeling for Web Usage Mining - Discovery and Analysis of Web Usage Patterns - Recommender Systems and Collaborative Filtering - Query Log Mining	12	CO-5	K5,K6

TEXT BOOKS:

1. Liu, Bing. Web data mining: exploring hyperlinks, contents, and usage data, 2nd Edition,Springer

REFERENCE BOOKS:

1. K.P. Soman, Shyam Diwakar, V.Ajay, 2006, Insight into Data Mining Theory and Practice, Prentice Hall of India Pvt. Ltd - New Delhi.

Core Practical – 5			
Title of the paper withsubject code	**WEB DEVELOPMENT USING OPEN-SOURCE TECHNOLOGY LAB**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**3**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To understand Web based programming and scripting languages.
- To learn the basic web concepts using open-source technologies such as PHP, JAVA SCRIPT, MYSQL.
- To learn how to interconnect PHP and MYSQL.

COURSE OUTCOMES:

CO1: Understanding of how PHP is used

CO2: Develop and Publish Android applications using Graphical user interface

CO4: Develop an application to display your personal details using GUI Components

CO5: Understand how to develop an application that uses to send messages from one mobile to another mobile.

CO6: Handling online Database Transactions.

CO7: Designing an application for Google map locator

SL NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Creating simple webpage using PHP	CO-1 CO-2 CO-3 CO-4 CO-5	K1,K2,K3, K4,K5,K6
2	Use of conditional statements in PHP		
3	Use of looping statements in PHP		
4	Creating different types of arrays		
5	Usage of array functions		
6	Creating user defined functions		
7	Creation of files		
8	File manipulation using PHP		
9	Creation of sessions		
10	Creation of cookies		
11	Creating simple applications using PHP		
12	Creating simple table with constraints		
13	Insertion, Updation and Deletion of rows in MYSQL tables		
14	Searching of data by different criteria		
15	Sorting of data		
16	Demonstration of joining tables		
17	Usage of sub queries		
18	Usage of aggregate functions		
19	Working with set operators		
20	Working with string, numeric and date functions		
21	Database connectivity in PHP with MySQL		
22	Validating Input		
23	Formatting the Output.		

Core Paper Theory – 14			
Title of the paper withsubject code	**RELATIONAL DATABASE MANAGEMENT SYSTEM**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VII**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- Gain a good understanding of the architecture and functioning of Database Management Systems
- Understand the use of Structured Query Language (SQL) and its syntax.
- Apply Normalization techniques to normalize a database.
- Understand the need of transaction processing and learn techniques for controlling the consequences of concurrent data access.

COURSE OUTCOMES:

CO-1: Understand the basics of Database management, architecture, Architecture, Data models and ER diagrams.

CO-2: Infer the concepts of Relational model and relational calculus. Apply the rules for converting ER model to a relational model and implement SQL queries on the relational model.

CO-3: Summarize the normal forms for the relational model based on functional dependencies, multi-values dependencies and join dependencies.

CO-4: Discuss various SQL commands for DDL, DML such as Join, Set and Aggregate functions. Understand the PL/SQL structures, operations and procedures such as exception handling and triggers.

CO-5: Evaluate the concepts of transaction and concurrency controls using Locking protocols.

UNIT NO.	SYLLABUS	HOURS	COs	cognitive
I	**INTRODUCTION TO DBMS**: Data and Information - Database – Database Management System – Objectives - Advantages – Components - Architecture. ER Model: Building blocks of ER Diagram – Relationship Degree – Classification – ER diagram to Tables – ISA relationship – Constraints – Aggregation and Composition – Advantages	12	CO-1	K1

II	**RELATIONAL MODEL**: CODD's Rule- Relational Data Model - Key - Integrity – relational Algebra Operations – Advantages and limitations – Relational Calculus – Domain Relational Calculus - QBE.	12	CO-1, CO-2	K1, K2
III	**STRUCTURE OF RELATIONAL DATABASE**: Introduction to Relational Database Design - Objectives – Tools –Redundancy and Data Anomaly – Functional Dependency - Normalization – 1NF – 2NF – 3NF – BCNF. Transaction Processing – Database Security.	12	CO-3	K3, K4
IV	**SQL**: Commands – Data types – DDL - Selection, Projection, Join and Set Operations – Aggregate Functions – DML – Modification - Truncation - Constraints – Subquery. **PL/SQL**: Structure - Elements – Operators Precedence – Control Structure – Iterative Control - Cursors - Procedure - Function - Packages – Exceptional Handling - Triggers.	12	CO-4	K4
V	**TRANSACTIONS AND CONCURRENCY MANAGEMENT**: Transactions - Concurrent Transactions - Locking Protocol - Serializable Schedules - Locks Two Phase Locking (2PL) - Deadlock and its Prevention - Optimistic Concurrency Control.	12	CO-5	K5,K6

TEXT BOOKS:

1. S. Sumathi, S. Esakkirajan, "*Fundamentals of Relational Database Management System*", Springer International Edition 2007.
2. Fundamental of Database Systems, E. Ramez and Navathe, Pearson
3. Database Management Systems, R.P. Mahapatra & Govind Verma, Khanna Publishing House

REFERENCE BOOKS:

1. Abraham Silberchatz, Henry F. Korth, S. Sudarshan, "*Database System Concepts*", McGrawHill2019, 7th Edition.
2. Alexis Leon & Mathews Leon, "*Fundamentals of DBMS*", Vijay Nicole Publications

2014, 2nd Edition.

WEB REFERENCES:

- NPTEL & MOOC courses titled Relational Database Management Systems
- https://nptel.ac.in/courses/106106093/
- https://nptel.ac.in/courses/106106095/

Core Paper Theory – 15			
Title of the paper withsubject code	**MOBILE APPLICATION DEVELOPMENT**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VII**	**4**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To make the student understand the basic concepts of mobile application development, be aware of Characteristics of mobile applications, User-interface design, basics of graphics and multimedia.
- To gain knowledge about testing and publishing of Android application

COURSE OUTCOMES:

CO-1: Comprehend the mobile application development platforms and mobile application development life cycle along with mobile application front-end and back-end.

CO-2: Understand the IDE of the mobile application development such as screen orientation user interface

CO-3: Understand various types of view in mobile application development and how to apply data to files and create databases.

CO-4: Apply the knowledge in creating own content providers such as messaging, email, mapping a location.

CO-5: Design own web services through HTTP and threading.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	Mobile Application Development - MobileApplications and Device Platforms - Alternatives for Building Mobile Apps - Comparing Native vs. Hybrid Applications -The Mobile	12	CO-1	K1

	Application Development Lifecycle-The Mobile Application Front-End-The Mobile Application Back-End-Key Mobile Application Services-What is Android-Android version history-Obtaining the Required Tools- Launching Your First Android Application-Exploring the IDE-Debugging Your Application-Publishing Your Application			
II	Understanding Activities-Linking Activities Using Intents-Fragments-Displaying Notifications- Understanding the Components of a Screen-Adapting to Display Orientation-Managing Changes to Screen Orientation- Utilizing the Action Bar-Creating the User Interface Programmatically Listening for UI Notifications	12	CO-1, CO-2	K2, K3
III	Using Basic Views-Using Picker Views -Using List Views to Display Long Lists-Understanding Specialized Fragments -Using Image Views to Display Pictures -Using Menus with Views-Using WebView- Saving and Loading User Preferences-Persisting Data to Files-Creating and Using Databases.	12	CO-3	K4,K6
IV	Sharing Data in Android-Creating Your Own Content Providers -Using the Content Provider- SMS Messaging -Sending Email-Displaying Maps- Getting Location Data-Monitoring a Location.	12	CO-4, CO-5	K5
V	Consuming Web Services Using HTTP-Consuming JSON Services- Creating Your Own Services - Binding Activities to Services -Understanding Threading.	12	CO-5	K5, K6

TEXT BOOKS:

1. Jerome DiMarzio, "*Beginning Android Programming with Android Studio*", 4thEdition.
2. Mobile Application Development, Dr. Madhu Goel, Chetna Sharma, ER. SHOBHIT
3. Composing Mobile App, Learn | Explore | Apply Paperback – 1 January 2014 by Anubhav Pradhan, Anil V. Deshpande

REFERENCE BOOKS:

1. Dawn Griffiths, David Griffiths, "*Head First Android Development: A Brain-Friendly Guide",* 2017.
2. Neil Smyth , "*Android Studio 3.0 Development Essentials: Android",* 8th Edition.
3. Pradeep Kothari, "*Android Application Development (With Kitkat Support)",* Black Book 2014.

Core Paper Theory – 16			
Title of the paper withsubject code	**FUNDAMENTALS OF MACHINE LEARNING**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VII**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

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

COURSE OUTCOMES:

CO-1: Understand the concepts of Linear Regression methods and classification methods and their types of learning standard.

CO-2: Apply Linear learning methods such as resampling procedures for model selection and regularization procedures for dimensionality reduction.

CO-3: Analyze Non-linear learning methods such as polynomial regression, regression splines and tree-based methods.

CO-4: Evaluate Support Vector Machines for regression and classification.

CO-5: Design an unsupervised learning using principal component analysis and clustering methods.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**LEARNING-STANDARD LINEAR METHODS**: Statistical Learning: What Is Statistical Learning, Assessing Model Accuracy. Linear Regression: Simple Linear Regression, Multiple Linear Regressions, Other Considerations in the Regression Model, The Marketing Plan, Comparison of Linear Regression with K-Nearest Neighbors. Classification: An Overview of Classification, Why Not Linear Regression? - Logistic Regression, Linear Discriminant Analysis, A Comparison of Classification Methods.	12	CO-1	K1
II	**SELECTION AND IMPROVEMENTS OF LINEAR LEARNING METHODS**: Resampling Methods: Cross-	12	CO-1, CO-2	K2

	Validation, The Bootstrap. Linear Model Selection and Regularization: Subset Selection, Shrinkage Methods, Dimension Reduction Methods, Considerations in High Dimensions.			
III	**NON-LINEAR LEARNING METHODS**: Polynomial Regression, Step Functions, Basis Functions, Regression Splines, Smoothing Splines, Local Regression, Generalized Additive Models, Tree-Based Methods: The Basics of Decision Trees. Bagging, Random Forests, Boosting.	12	CO-3	K3,K4
IV	**SUPPORT VECTOR MACHINES, PRINCIPAL COMPONENT ANALYSIS AND CLUSTERING**: Support Vector Machines: Maximal Margin Classifier. Support Vector Classifiers: Support Vector Machines, SVMs with More than Two Classes Relationship to Logistic Regression.	12	CO-4, CO-5	K4, K5
V	**UNSUPERVISED LEARNING**: The Challenge of Unsupervised Learning, Principal Components Analysis, Clustering Methods: K-Means Clustering, Hierarchical Clustering, Practical Issues in Clustering.	12	CO-5	K5, K6

TEXT BOOKS:

1. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
2. Tom M Mitchell, ―Machine Learning‖, First Edition, McGraw Hill Education, 2013.
3. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.

REFERENCE BOOKS:

1. Jason Bell, ―Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014
2. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)‖, Third Edition, MIT Press, 2014

Elective Paper Theory – IV			
Title of the paper withsubject code	**PRINCIPLES OF ALGORITHM DESIGN**		
Category of the course	Year	Semester	Credits
Elective	**IV**	**VII**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- Analyze the asymptotic performance of algorithms.
- Write rigorous correctness proofs for algorithms.
- Demonstrate a familiarity with major algorithms and data structures.
- Apply important algorithmic design paradigms and methods of analysis.
- Synthesize efficient algorithms in common engineering design situations.

COURSE OUTCOMES:

CO-1: Understanding of steps in design of algorithms and analysis of time complexity and space complexity using asymptotic notation.

CO-2: Describe and differentiate 5 broad types of design methods such as Divide and Conquer, Greedy, Backtracking, Branch and Bound, Dynamic Programming

CO-3: Demonstrate knowledge about significance of each of the methods and differentiating various methods in solving specific problems.

CO-4: Evaluating the performance of the methods in solving problems using time complexity analysis with asymptotic notation.

CO-5: Design an algorithm for travelling salesman problem using 5 methods.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**INTRODUCTION**: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation, Probabilistic analysis, Amortized analysis.	12	CO-1	K1
II	Disjoint Sets- disjoint set operations, union and find algorithms, spanning trees, connected components and biconnected components. **DIVIDE AND CONQUER**: General method , applications - Binary search, Quick sort, Merge sort, Strassen's matrix multiplication.	12	CO-1, CO-2	K2

III	**GREEDY METHOD**: General method, applications-Job sequencing with deadlines, 0/1 knapsack problem, Minimum cost spanning trees, Single source shortest path problem. **DYNAMIC PROGRAMMING**: General method, applications-Matrix chain multiplication, Optimal binary search trees, 0/1 knapsack problem, All pairs shortest path problem, Travelling sales person problem, Reliability design.	12	CO-3	K2,K3
IV	**BACKTRACKING**: General method, applications-n-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles. **BRANCH AND BOUND:** General method, applications - Travelling sales person problem, 0/1 knapsack problem.	12	CO-4, CO-5	K4,K5
V	**LC BRANCH AND BOUND SOLUTION:** FIFO Branch and Bound solution. NP-Hard and NP-Complete problems: Basic concepts, non-deterministic algorithms, NP - Hard and NP Complete classes, Cook's theorem.	12	CO-5	K5,K6

TEXT BOOKS:

1. Ellis Horowitz, Sartaj Sahni, S. Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, University Press, 2008.
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

REFERENCE BOOKS:

1. Donald E. Knuth, "The Art of Computer Programming", Volumes 1 & 3 Pearson Education, 2009. 2.
2. Steven S. Skiena, "The Algorithm Design Manual", Second Edition, Springer, 2008

Elective Paper Theory – IV			
Title of the paper withsubject code	**PARALLEL COMPUTING**		
Category of the course	Year	Semester	Credits
Elective	**IV**	**VII**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To understand the need and fundamentals of parallel computing paradigms
- To learn the nuances of parallel algorithm design
- To understand the programming principles in parallel and distributed computing architectures
- To learn few problems that are solved using parallel algorithms

COURSE OUTCOMES:

CO-1: Define the scope of parallel computing, design paradigms and model of parallel computing.

CO-2: Perform classification of parallel computing based on Divide and Conquer strategies.

CO-3: Apply the parallel programming design paradigms and programming models and standards.

CO-4: Deduce shared memory concepts used in parallel computing models such as openMP.

CO-5: Design a Multi-core programming Tread building blocks and cilk++ programming.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**INTRODUCTION TO PARALLEL COMPUTING:** Why Parallel Computing & Scope of Parallel Computing, Sieve of Eratosthenes, Control and Data Approach, PRAM model of parallel computation, Design paradigms of Parallel Computing, examples, Bulk Synchronous Parallel (BSP) model.	12	CO-1	K1
II	**CLASSIFICATION:** Flynn's Taxonomy, MPP, SMP, CC-NUMA, Clustering of Computers, Beowulf Cluster, Use of MPI in Cluster Computing. Debugging, Evaluating and tuning of Cluster Programs, Partitioning and Divide and Conquer Strategies. Cluster: dedicated high performance (HP), high availability (HA), CoPs, PoPs, CoWs; distributed, on-demand, high-throughput, collaborative, data-intensive computing, Interconnection networks.	12	CO-1, CO-2	K2,K3

III	**AN OVERVIEW OF PARALLEL PROGRAMMING PARADIGMS**: Foster's design paradigm for Multi computing programming, Programmability Issues, Programming Models: Message passing, Message passing standards: PVM (Parallel Virtual Machine), MPI (Message Passing Interface) and its routines, Advanced Features of MPI	12	CO-3	K3
IV	**OVERVIEW OF PROGRAMMING WITH SHARED MEMORY: OVERVIEW OF PROGRAMMING WITH SHARED MEMORY:** OpenMP (History, Overview, Programming Model, OpenMP Constructs, Performance Issues and examples, Explicit Parallelism: Advanced Features of OpenMP)	12	CO-4, CO-5	K4,K5
V	**MULTI-CORE PROGRAMMING**: Multi-Core programming: Introduction to Multi cores Programming Software Multi-threading using Tread Building Blocks (TBB) and Cilk++ programming, GPGPU programming with CUDA	12	CO-5	K5,K6

TEXT BOOKS:

1. Quinn, M. J., Parallel Computing: Theory and Practice (McGraw-Hill Inc.).
2. Bary Wilkinson and Michael Allen: Parallel Programming Techniques using Networked of workstations and Parallel Computers, Prentice Hall, 1999.
3. R. Buyya High Performance Cluster Computing: Programming and Applications, Prentice Hall,

REFERENCE BOOKS:

1. William Gropp, Rusty Lusk, Tuning MPI Applications for Peak Performance, Pittsburgh (1996).
2. W. Gropp, E. Lusk, N. Doss, A. Skjellum, A high performance portable implementation of the message passing Interface (MPI) standard, Parallel Computing.
3. Gibbons, A., W. Rytter, Efficient Parallel Algorithms (Cambridge Uni. Press).
4. Shameem A and Jason, Multicore Programming, Intel Press, 2006.
5. CUDA Programming A Developer's Guide to Parallel Computing with GPUs Shane Cook, Morgan Kaufmann

Elective Paper Theory – IV			
Title of the paper with subject code	**TEXT MINING**		
Category of the course	Year	Semester	Credits
Elective	**IV**	**VII**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To understand the knowledge of text mining and pre-processing techniques
- To understand and apply the data mining classification techniques
- To understand and apply Probabilistic Model for text mining.
- To apply the text mining approaches with case studies.

COURSE OUTCOME:

CO – 1 : Understand the basic issues and types of text mining

CO – 2 : Appreciate the different aspects of text categorization and clustering.

CO– 3 : Understand the role played by text mining in information retrieval extraction.

CO – 4 : Analyze the currents trends in text mining.

CO – 5 : Design a text analytic framework to analyze text data for specific domain

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	Text Mining - Definition - General Architecture - Core Text mining Operations. Pre-processing- Textual information to numerical vectors - Collecting documents - document standardization and Representation - tokenization - lemmatization - stemming - Parsing text - keywords, n-grams - POS, Corpus - sentence boundary determination - vector generation for prediction.	12	CO-1	K1
II	Text Categorization - Definition - knowledge engineering, Machine Learning – Classification - Decision Tree Classifiers - Rule - based Classifiers - Probabilistic and Naive Bayes Classifiers - Linear Classifiers - Classification of Linked and Web Data - Meta-Algorithms - Clustering – Definition - Distance - based Algorithms -Word and Phrase - based Clustering.	12	CO-1, CO-2	K1, K2
III	Information Retrieval and Text Mining - Key Word Search - Measuring Similarity - Web - based document search - Document Matching - Inverted Lists - Evaluation of	12	CO-3	K2, K3

	Performance. Information extraction - Architecture - Co-reference - Named Entity and Relation Extraction - Template filling and database construction - Applications.			
IV	Text Summarization Techniques - Topic Representation - Influence of Context - Indicator representations and Machine Learning for Summarization - Selecting summary sentences - Visualization Approaches - Architectural Considerations - Common Visualization Approaches for text mining - Applications.	12	CO-4, CO-5	K5,K6
V	Probabilistic Models for Text Mining - Mixture Models - Stochastic Processes in Bayesian Nonparametric Models - Graphical Model - Hidden Markov Models - Stochastic Context-Free Grammars - Maximal Entropy Modeling - Maximal Entropy Markov Models - Conditional Random Fields.	12	CO-5	K6

TEXT BOOKS:

1. Ronen Feldman, James Sanger, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Cambridge University press, 2006.

REFERENCE BOOKS:

1. Sholom Weiss, Nitin Indurkhya, Tong Zhang, Fred Damerau, "The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data", Springer, 2010.

2. Charu C. Aggarwal ,ChengXiangZhai,Mining Text Data, Springer; 2012.

3. Markus Hofmann, Andrew Chisholm, "Text Mining and Visualization: Case Studies Using Open-Source Tools", CRC press, Taylor & Francis, 2016.

Core Practical – 6			
Title of the paper withsubject code	**RELATIONAL DATABASEMANAGEMENT SYSTEM LAB**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VII**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- Gain a good understanding of the architecture and functioning of Database Management Systems
- Understand the use of Structured Query Language (SQL) and its syntax.

COURSE OUTCOMES:

CO - 1: Brief knowledge about SQL Fundamentals.
CO - 2: Able to handle with different Data Base languages.
CO - 3: Table View, Log & Triggers.
CO - 4: Introduction to different Database packages (Oracle/ MySql, etc) Commit & Rollback.
CO - 5: Handling online Transactions.

LIST OF EXERCISES

UNIT NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	DDL commands with constraints.	CO-1 CO-2 CO-3 CO-4 CO-5	K1,K2,K3, K4,K5,K6
2	DML Commands with constraints.		
3	SQL Queries: Queries, sub queries, Aggregate function		
4	PL/SQL : Exceptional Handling		
5	PL/SQL : Cursor		
6	PL/SQL : Trigger		
7	PL/SQL : Packages		
8	Payroll calculation for using PL/SQL		
9	Creating stored procedures and functions		
10	Design and Develop Application for Library Management		
11	Design and Develop Application for Student Mark Sheet Processing		

Core Practical – 7			
Title of the paper withsubject code	**MOBILE APPLICATION DEVELOPMENT LAB**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VII**	**3**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To give overall view of Mobile application development
- Develop and Publish Android applications using Graphical user interface
- Develop and Publish Android application which can use Location and network services

COURSE OUTCOMES:

CO1: Brief knowledge about Mobile Application Development Fundamentals.

CO2: Develop and Publish Android applications using Graphical user interface

CO4: Develop an application to display your personal details using GUI Components

CO5: Understand how to develop an application that uses to send messages from one mobile to another mobile.

CO6: Handling online Database Transactions.

CO7: Designing an application for Google map locator

Practical Exercises

UNIT NO.	SYLLABUS	COS	COGNITIVE LEVEL
1	Develop an application that finds greatest among three numbers using GUI Components	CO-1 CO-2 CO-3 CO-4 CO-5	K1,K2,K3, K4,K5,K6
2	Develop an application to display your personal details using GUI Components		
3	Develop an application that uses the radio button		
4	Develop an application that uses the image button		
5	Develop an application that uses Alert Dialog Box		
6	Develop an application that uses Layout Managers.		
7	Develop an application that uses audio mode (NORMAL, SILENT, VIBRATE)		

8	Develop an application that uses to send messages from one mobile to another mobile.		
9	Develop an application that uses to send email		
10	Develop an application for mobile calls.		
11	Develop an application for Student Mark sheet processing		
12	Develop an application for Login Page in Database.		
13	Develop an application for Google map locator (optional)		

WEB REFERENCES:

Develop the App online

https://flutter.dev/

http://ai2.appinventor.mit.edu

Core Paper Theory – 17			
Title of the paper withsubject code	**SOFTWARE TESTING**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VIII**	**4**
Paper mainly focusses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To provide knowledge about various Software Testing concepts.
- To enable students learn different Software Testing Techniques and types.
- To acquaint students with case Tools for software testing.

COURSE OUTCOMES:

CO-1: Investigate the reason for bugs and analyze the principles in software testing to prevent and remove bugs

CO-2: identify the needs of software test automation, and define and develop a test tool to support test automation.

CO-3: Apply Flow/Graphs and Path Testing and Transaction Flow Testing Techniques as testing strategies

CO-4: Deduce Domain testing and syntax testing metrics and state graph methodologies.

CO-5: Device verification and validation tools for various levels of testing for software products such win runner tool.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	Purpose of testing – Testing versus Debugging – Designer versus Tester – Modularity versus Efficiency – Model for testing – Taxonomy for bugs.	12	CO-1	K1
II	Path testing basics – Predicates, path predicates and achievable paths – Path sensitizing – Path instrumentation – Implementation and application of path testing – Transaction flows – Transaction flow testing techniques.	12	CO-1, CO-2	K2,K3
III	Data flow testing basics – Data flow testing strategies – Domains and paths – Domains testing – Domains and interface testing – Path product and path expressions – Reduction procedure.	12	CO-3	K3,K4

IV	A grammar for formats – Test case generation – Implementation and application – Decision tables – State graphs – State testing.	12	CO-4 ,CO-5	K5,,K6
V	Strategies for programmers – Strategies for independent testers – Tests as software product – JUnit – Pytest.	12	CO-5	K6

TEXT BOOKS:

1.B. Beizer , 2003, Software Testing Techniques, II Edn., DreamTech India, New Delhi.
2.K.V.KK. Prasad , 2005, Software Testing Tools, DreamTech. India, New Delhi.
3. R.Rajani, and P.P.Oak, 2004, Software Testing, Tata Mcgraw Hill, New Delhi.

REFERENCE BOOKS:

1. I. Burnstein, 2003, Practical Software Testing, Springer International Edn.
2. E. Kit, 1995, Software Testing in the Real World: Improving the Process, Pearson Education, Delhi.

ONLINE REFERENCE

1. https://junit.org/junit5/docs/current/user-guide/index.html
2. https://docs.pytest.org/en/6.2.x/

Core Paper Theory – 18			
Title of the paper withsubject code	**UNIX AND PERL PROGRAMMING**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VIII**	**4**
Paper mainly focuses on	**EMPLOYABILIBY**		

COURSE OBJECTIVES:

- Written technical communication and effective use of concepts and terminology.
- Facility with UNIX command syntax and semantics.
- Ability to read and understand specifications, scripts and programs.
- Individual capability in problem solving using the tools presented within the class
- Students will demonstrate a mastery of Perl Programming and scripting methods.

COURSE OUTCOMES:

CO-1: Understand all the UNIX utilities, the basic UNIX process structure and the UNIX file system

CO-2: Articulate simple UNIX filters, UNIX pipes and redirection, UNIX environment, traps, signals, and Regular Expressions.

CO-3: Deduce least one Shell scripting language and Classify system calls in UNIX

CO-4: Review the concepts of process, threads, and file structure,

CO-5: Compose a Shell scripting for creating an application with Inter process Communication using pipes, shared memory, semaphores and messages.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	Understanding Unix –commands, locating, internal and external, arguments, options , flexibility– General purpose utilities-banner, cal, date, calendar, who, tty, etc – Navigating the file system-the file, what is in it, parent-child, pwd, home, absolute path, cd, mkdir, rmdir, ls, etc	12	CO-1	K1
II	ordinary files – cat, cp, rm, mv, more, lp, file, wc, od, split, cmp, etc-The shell-sh, pattern matching, escaping, quoting, redirection, special files, pipes, tees, command substitution, shell variables, korn, bash and c shells – The environment-system variables, .profile, stty, PWD, aliases, command history, command editing, set options, miscellaneous features.	12	CO-1, CO-2	K2,K3
III	Basic file attributes –-l, -d, file permissions, chmod - simple filters-sample database, pr, head, tail, cut, paste, sort, uniq, nl, tr – regular expressions and grep-grep, regular expressions, egrep, fgrep	12	CO-3	K3,K4

IV	The process-sh, parents and children, ps, system process, mechanism, internal and external commands, jobs in background, kill, nice, job control, at and batch, cron- shell programming-scripts, read, command line arguments, exit status, operators, exit, if,case, expr, ksh, sleep and wait, while, until, for, redirection, here document, set, trap – more file filters – file systems, inode, chown, chgrp, listing, ln, the directory , the device	12	CO-4, CO-5	K5,K6
V	System administration I –root, privileges, operation, managing disk spaces, find, dd, backups, cpio, tar– advanced filters-sed, line addressing, inserting and changing, context, selected lines, -f, substitution, properties of regular expressions, awk, spilitting a line, printf, operators, number processing, BEGIN and END, positional parameters, getline, built-in variables, arrays, functions, interface with the shell, control flow - PERL-starting, chop, interpreter, variables and operators, command line, current line and number, lists, arrays, associative arrays, regular expressions and substitution, file handling, file tests, subroutines, printing	12	CO-5	K5,K6

TEXT BOOKS:

1. UNIX : Concepts and Applications, Sumitabha Das, 4th Edition, TMH
2. Learning Perl, *Randal L. Schwartz, brian d foy, and Tom Phoenix, 8th Edition, 2021*
3. *The UNIX Programming Environment,* Kernighan, Brian W., Pike, Rob, Prentice-Hall, 1984

REFERENCES BOOKS:

1. UNIX : The Textbook, Robert M. Koretsky, , Chapman and Hall/CRC; 3rd edition, 2016
2. Beginning Perl, Curtis "Ovid" Poe , Wiley, 2012

Extra Disciplinary Paper Theory – 1			
Title of the paper withsubject code	**THEORY OF COMPUTATION**		
Category of the course	Year	Semester	Credits
Extra Disciplinary	**IV**	**VIII**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To understand formal languages and finite automata.
- To understand conversion of regular expression to Finite Automata.
- To understand context free grammars and pushdown automata.
- To investigate the problems that cannot be solved by computers.

COURSE OUTCOMES:

CO-1: Describe foundations for computation and conversion steps for regular expression, finite automata and grammars.

CO-2: Analyze the types of Grammars, concentrate on Regular languages and Context Free grammars and its properties.

CO-3: Apply the pumping lemma for validating regular language and context free language and demonstrate algorithms for conversion between languages.

CO-4: Evaluate linear automata and push-down automata for a given regular language and context free language.

CO-5: Produce simple programs for a Turing Machine and List examples of undecidable problems

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**FINITE AUTOMATA (FA)**: Introduction, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), language of a DFA. Nondeterministic Finite Automata (NFA)- Definition of NFA, language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of Deterministic Finite Automata, Finite automata with output (Moore and Mealy machines) and Inter conversion.	12	CO-1	K1
II	**REGULAR EXPRESSIONS (RE):** Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions-	12	CO-1, CO-2	K3

	Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions. REGULAR GRAMMARS: Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Proving languages to be non-regular -Pumping lemma, applications, Closure properties of regular languages.			
III	**CONTEXT FREE GRAMMER (CFG):** Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings. Ambiguity in CFG's, Minimization of CFG's, CNF, GNF, Pumping Lemma for CFL's, Enumeration of Properties of CFL (Proof's omitted).	12	CO-3	K3,K4
IV	**PUSHDOWN AUTOMATA:** Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA. TURING MACHINES ™: Formal definition and behaviour, Languages of a TM, TM as accepters, and TM as a computer of integer functions, Types of TMs.	12	CO-4, CO-5	K4,K5
V	**RECURSIVE AND RECURSIVELY ENUMERABLE LANGUAGES (REL):** Properties of recursive and recursively enumerable languages, Universal Turing machine, The Halting problem, Undecidable problems about TMs. Context sensitive language and linear bounded automata (LBA), Chomsky hierarchy, Decidability, Post's correspondence problem (PCP), undecidability of PCP.	12	CO-5	K6

TEXT BOOKS:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman (2007), Introduction to Automata Theory Languages and Computation, 3rdedition, Pearson Education, India.
2. Elements of the Theory of Computation Book by Christos Ch Papadēmētriou and Harry R. Lewis
3. An Introduction to Formal Languages and Automata Book by Peter Linz

REFERENCE BOOKS:

1. K. L. P Mishra, N. Chandrashekaran (2003), Theory of Computer Science-Automata Languages and Computation, 2nd edition, Prentice Hall of India, India.
2. Introduction to Languages and the Theory of Computation Book by John C. Martin

Core Paper Theory – 19			
Title of the paper withsubject code	**MOBILE COMPUTING**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VIII**	**4**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To develop an understanding of the ways that mobile technologies.
- To consider the impact of mobile computing on the field of education.

COURSE OUTCOMES:

CO – 1: Explain the basics of mobile Computing
CO – 2: Describe the functionality of Mobile IP and Transport Layer
CO – 3: Classify different types of mobile telecommunication systems
CO – 4: Demonstrate the Adhoc networks concepts and its routing protocols
CO – 5: Make use of mobile operating systems in developing mobile applications

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**INTRODUCTION**: Medium Access Control: Motivation for Specialized MAC - SDMA - FDMA - TDMA - CDMA - Comparison of Access mechanisms - Tele communications: GSM - DECT - TETRA - UMTS - IMT - 200 - Satellite Systems: Basics - Routing - Localization - Handover - Broadcast Systems: Overview - Cyclic Repetition of Data - Digital Audio Broadcasting - Digital Video Broadcasting.	12	CO-1	K1
II	**WIRELESS NETWORKS**: Wireless LAN: Infrared Vs Radio Transmission - Infrastructure Networks - Ad hoc Networks - IEEE 802.11 - HIPERLAN - Bluetooth - Wireless ATM: Working Group - Services - Reference Model - Functions - Radio Access Layer - Handover - Location Management - Addressing Mobile Quality of Service - Access Point Control Protocol.	12	CO-1 CO-,2	K2
III	**MOBILE NETWORK LAYER:** Mobile IP: Goals - Assumptions and Requirement - Entities - IP packet Delivery - Agent Advertisement and Discovery - Registration - Tunneling and Encapsulation - Optimization - Reverse Tunneling - IPv6 - DHCP - Ad hoc Networks.	12	CO-3	K2,K3
IV	**MOBILE TRANSPORT LAYER**: Traditional TCP - Indirect TCP - Snooping TCP - Mobile TCP - Fast retransmit/ Fast	12	CO-4, CO-5	K3,K4

	Recovery - Transmission/ Timeout Freezing - Selective Retransmission - Transaction Oriented TCP.			
V	**WAP**: Architecture - Datagram Protocol - Transport Layer Security - Transaction Protocol - Session Protocol - Application Environment - Wireless Telephony Application.	12	CO-5	K5,K6

TEXT BOOKS:

1. J.Schiller, Mobile Communication, Addison Wesley, 2000. Reference 1. William C.Y.Lee, Mobile Communication Design Fundamentals, John Wiley, 1993.
2. William Stallings, Wireless Communication and Networks, PHI/ Pearson Education, 2003.
3. Singhal, WAP-Wireless Application Protocol, Pearson Education, 2003.

REFERENCE BOOKS:

1. Asoke K Talukder, Roopa R Yavagal, “Mobile computing”, TMG, 2006

Elective Paper Theory – V			
Title of the paper withsubject code	**SOFTWARE PROJECT MANAGEMENT**		
Category of the course	Year	Semester	Credits
Elective	**IV**	**VII**	**3**
Paper mainly focusses on	**ENTREPRENEURSHIP**		

COURSE OBJECTIVES:

- To define and highlight importance of software project management.
- To formulate and define the software management metrics & strategy in managing projects

COURSE OUTCOMES:

CO-1: Define Estimation of project cost and prepare cost-benefit evaluation among projects

CO-2: Perform project scheduling, activity network analysis and risk management

CO-3: Apply schedule and cost control techniques for project monitoring including contract management.

CO-4: Deduce quality models in software projects for maintaining software quality and reliability.

CO-5: Design a suitable project organization structure, leadership, decision and motivation styles, proper safety and ethical practices and be responsible to the society.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**PROJECT EVALUATION AND PROJECT PLANNING** Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.	12	CO-1	K1
II	**PROJECT LIFE CYCLE AND EFFORT ESTIMATION** Software process and Process Models – Choice of Process models - Rapid Application development –Dynamic System Development Method –Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model.	12	CO-1 CO-2	K2, K3

III	**ACTIVITY PLANNING AND RISK MANAGEMENT** Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Resource Allocation – Creation of critical paths – Cost schedules.	12	CO-3	K3
IV	**PROJECT MANAGEMENT AND CONTROL** Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management.	12	CO-4, CO-5	K4,K5
V	**STAFFING IN SOFTWARE PROJECTS** Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham – Ethical and Professional concerns – Working in teams – Decision making – Organizational structures – Dispersed and Virtual teams – Communications genres – Communication plans – Leadership - Legal Issues in Software - Case Study.	12	CO-5	K5,K6

TEXT BOOKS:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012
2. Software Project Management by Archana Kumar, Ane Books Pvt. Ltd
3. Gopalaswamy Ramesh, ―Managing Global Software Projects‖ – McGraw Hill Education (India), Fourteenth Reprint 2013.

REFERENCES:

1. Robert K. Wysocki ―Effective Software Project Management‖ – Wiley Publication, 2011.
2. Walker Royce: ―Software Project Management‖- Addison-Wesley, 1998.

WEB REFERENCES:

- NPTEL & MOOC courses titled Software Project Management
- www.smartworld.com/notes/software-project-management

Elective Paper Theory – V			
Title of the paper withsubject code	**DISTRIBUTED DATABASE MANAGEMENT SYSTEMS**		
Category of the course	Year	Semester	Credits
Elective	**IV**	**VIII**	**3**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To know advanced concepts in databases in large scale analytics.
- To learn concepts behind parallel, distributed, active, spatial, temporal and object databases.
- To learn reasoning and query processing.
- To understand the concurrency control in distributed databases

COURSE OUTCOMES:

CO-1: Explain the techniques used for data fragmentation, replication, and allocation during the distributed database design process.

CO-2: Analyze simple strategies for executing a distributed query to select the strategy that minimizes the amount of data transfer.

CO-3: Apply the two-phase commit protocol to deal with committing a transaction that accesses databases stored on multiple nodes.

CO-4: Validating distributed concurrency control based on the distinguished copy techniques and the voting methods.

CO-5: Build Architecture for deploying Distributed Database model to replace a centralized University examination system.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	Features of Distributed versus Centralized Databases – Why Distributed Databases – Distributed Database Management Systems (DDBMSs)- Levels of Distribution Transparency- Reference Architecture for Distributed Databases – Types of Data Fragmentation – Distribution Transparency for read-only Applications – Distribution transparency for Update Applications – Distributed Database Access Primitives – Integrity Constraints in Distributed Databases - A Framework for Distributed Database Design – The Design of Database Fragmentation – The Allocation of Fragments.	12	CO-1	K1

II	Equivalence Transformations for Queries – Transforming Global Queries into Fragment Queries – Distributed Grouping and Aggregate Function Evaluation – Parametric Queries - Optimization of Access Strategies - A Framework for Query Optimization – Join Queries – General eries. A Framework for Transaction Management – Supporting Atomicity of Distributed Transactions – Concurrency Control for Distributed Transactions – Architectural Aspects of Distributed Transactions.	12	CO-1 CO-,2	K2,K3
III	Foundations of Distributed Concurrency Control – Distributed Deadlocks – Concurrency Control Based on Timestamps – Optimistic Methods for Distributed Concurrency Control - Reliability – Basic Concepts Nonblocking Commitment Protocols – Reliability and Concurrency Control.	12	CO-3	K3
IV	Distributed object database management systems – Fundamental object concepts and Models – Object – Abstract Data Types – Composition (Aggregation) – Class – Collection – Subtyping and Inheritance. – Object Distribution Design – Horizontal Class Partitioning – Vertical Class Partitioning – Path Partitioning – Class Partitioning Algorithms – Allocation – Replication – Query Processing Issues – Query Execution – Correctness Criteria – Transaction Models and Object Structures – Transactions Management in Object DBMSs – Transactions as Objects – Conclusion.	12	CO-4, CO-5	K4,K5
V	Parallel Database Systems – Database Server Approach – Database Servers and Distributed Databases – Parallel System Architectures – Objectives – Functional Aspects – Parallel Data Processing – Parallel Query Optimization – Data Placement – Query Parallelism – Parallel Execution Problems – Initialization – Interferences and Convoy Effect – Load Balancing – Parallel Execution for Hierarchical Architecture – Problem Formulation – Basic Concepts – Load Balancing Strategy – Performance Evaluation – Conclusion.	12	CO-5	K6

TEXT BOOKS:

1. Stefano Ceri, Giuseppe Pelagatti, Distributed Databases Principles & Systems,McGraw-Hill.
2. M.Tamer Ozsu, Patrick Valduriez, Distributed database systems, 2nd Edition, Prentice Hall of India, New Delhi.
3. Raghu Ramakrishnan, ―Database Management Systems‖, Fourth Edition, McGraw-Hill College Publications, 2015.

REFERENCE BOOKS:

1. Abraham Silberschatz, Henry F. Korth and S. Sudharshan, ―Database System Concepts‖, Sixth Edition, McGraw-Hill Education, 2010.

   C.J.Date, A.Kannan and S.Swamynathan, ―An Introduction to Database Systems‖, Eighth Edition, Pearson Education, 2006.

Elective Paper Theory – V			
Title of the paper withsubject code	**JAVA WEB SERVICES**		
Category of the course	Year	Semester	Credits
Elective	**IV**	**VIII**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To examine some of the most important technologies that are being used today by web developers to build a wide variety of web applications.
- To develop Java based web programming.
- To build web services using proven developer tools and message formats.
- To explore several new standards that may play a significant role in the World Wide Web of tomorrow

COURSE OUTCOMES:

CO-1: Understand the concepts of XML and Document Type Definitions and its types.
CO-2: Discuss various forms of Data interchange format such as JSON Syntax and schema.
CO-3: Discuss how Maven lifecycle, phases, plugins and snapshots.
CO-4: Review Gradle tasks, standard coordinates, properties and repositories.
CO-5: Review various Spring Boot REST API – adding database access to Boot app, configuring and deploying the Boot app.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**XML:** Introducing XML-Benefits, What XML Is Not, Portable Data, How XML Works, - XML Fundamentals-Documents and Files, Elements, Tags, and Character Data, XML Trees, Mixed Content, Attributes, Names, References, CDATA, Processing, Declaration, Well-Formedness, - Document Type Definitions (DTDs)- Validation, Declaration, Parsed General Entities, Parameter Entities, Conditional Inclusion, Examples – Namespaces – need, Syntax, How Parsers Handle Namespaces, Namespaces and DTDs	12	CO-1	K1,K2
II	**JSON:** What Is JSON?- Data Interchange Format, Language Independent, Key Terms - JSON Syntax-Object Literals, Syntax, Validation, MediaType, - JSON Data Types-Object Data Type, String, Number, Boolean, Null, Array, - JSON Schema-Introduction, Validation	12	CO-1 CO-,2	K2,K3

III	**MAVEN:** Introduction - 3: Maven Lifecycle- phases, and goals, pom, profiles, platform-independent builds - Essential Maven Plugins-clean, compiler, version, resources, filtering - Dependency Management – scope, dependencies, SNAPSHOT, errors	12	CO-3	K3
IV	**GRADLE:** Hello, Gradle! . Build Files in Groovy, Domain-Specific Build Languages, Building a Java Program, command line - Gradle Tasks- Declaring, Task Action, Configuration, objects, types, - Ant and Gradle-Hello Ant, Importing, Ant Target and Gradle Task - Maven and Gradle-The Maven POM and Gradle Build, Maven Goals, Gradle Tasks, The Standard Maven Coordinates, Gradle Properties, Dependencies, Repositories,Default Tasks , The Maven Plug-in	12	CO-4, CO-5	K4,K5
V	**SPRING BOOT:** Creating Spring Boot REST API- Adding Database Access to Boot App - Configuring and Inspecting Boot App - Deploying Application	12	CO-5	K6

TEXT BOOKS:

1. XML in a NUTSHELL, *Elliotte Rusty Harold and W. Scott Means,* O'Reilly, 3rd Edition,
2. Introduction to JavaScript Object Notation, *Lindsay Bassett,* O'Reilly Media, 2015
3. Apache Maven Cookbook, Raghuram Bharathan, Packt Publishing, 2015

REFRENCE BOOKS:

1. Building and Testing with Gradle, *Tim Berglund and Matthew McCullough,* O'Reilly Media, 2011
2. Spring Boot: Up and Running, *Mark Heckler, ,* O'Reilly Media, 2021

Core Paper Practical – 9			
Title of the paper withsubject code	**UNIX AND PERL PROGRAMMING LAB**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VIII**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- Facilitate with UNIX command syntax and semantics.
- Ability to read and understand specifications, scripts and programs.
- Students will demonstrate a mastery of Perl Programming and scripting methods.

COURSE OUTCOMES:

CO-1: Understand all the UNIX utilities, the basic UNIX process structure and the UNIX file system

CO-2: Articulate simple UNIX filters, UNIX pipes and redirection, UNIX environment, traps, signals, and Regular Expressions.

CO-3: Deduce least one Shell scripting language and Classify system calls in UNIX

CO-4: Review the concepts of process, threads, and file structure,

CO-5: Compose a Shell scripting for creating an application with Inter process Communication using pipes, shared memory, semaphores and messages.

List of Exercises:

SL NO	**SYLLABUS**	**COS**	**COGNITIVE LEVEL**
	Shell Programming		
1	Write a program called nf to display the number of files in your current directory		
2	Write a program called whos to display a sorted list of the logged-in users.		
3	Write a program called home that takes the name of a user as its single argument and prints that user's home directory.		
4	Use the date and who commands to write a program called conntime that prints the number of hours and minutes that a user has been logged on to the system (assume that this is less than		

	24 hours).	CO-1 CO-2 CO-3 CO-4 CO-5	K1,K2,K3, K4,K5,K6
5	Write a program called collect that runs in the background and counts the number of users logged in at the end of each interval and also the number of processes run during that interval. Allow the interval to be specified with a -t option (see the previous exercise), with the default 10 minutes.		
PERL Programming			
6	Write a program that computes the circumference of a circle		
7	Write a program that reads a list of strings (on separate lines) until end-of-input		
8	Write a program to calculate the sum of the numbers using subroutine		
9	Write a program that asks the user to enter a list of strings on separate lines		
10	Write a program that prints out any input line that mentions "India"		
11	Write a program which asks the user for a source file name, a destination file name, a search pattern, and a replacement string.		
12	Write a program which takes a list of files named on the command line and reports for each one whether it's readable, writable, executable, or doesn't exist.		
13	Write a program that works like rm, deleting any files named on the command line.		
14	Write a program that changes to some particular (hardcoded) directory, like the system's root directory, then executes the ls -l command to get a long-format directory listing in that directory.		
15	Write a program to identify the oldest file named on the command line and report its age in days		

Core Paper Theory – 20			
Title of the paper withsubject code	**COMMUNICATION NETWORK AND WIRELESS TECHNOLOGY**		
Category of the course	Year	Semester	Credits
Core	**V**	**IX**	**4**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- Introduction to planning and design of wireless networks
- Introduction to cellular network and its applications.
- To study advanced technologies like Wireless LAN, WIFI.
- Understanding the wireless sensor network architecture and the protocol stack.

COURSE OUTCOMES:

CO-1: Comprehend the basics of communication network topologies, network switching types, OSI model.

CO-2: Understand the cellular network architecture and its evolution from first generation to third generation CDMA.

CO-3: Understand various types of Modulation technique such as ASK, FSK, PSK, QAM and PCM.

CO-4: Apply the knowledge in Wireless LANs along with the transmission techniques and IEEE 802 Architecture for wireless LAN.

CO-5: Design own Wireless networks using various WI-FI IEEE standards.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**BASICS OF COMMUNICATION NETWORK:** Introduction – Transmission Fundamentals: Signals, Analog and Digital Data Transmission, Channel Capacity, Transmission Media, Multiplexing – Communication Network: LAN, MAN and WAN, Switching Techniques – Circuit and Packet Switching, Asynchronous Transfer Mode – Protocols and TCP/IP Suite: TCP/IP Protocol Architecture, OSI Model, Internetworking.	12	CO-1	K1
II	**CELLULAR NETWORK:** Cellular Network Architecture - Principles of Cellular Network – First Generation Analog – Second Generation TDMA – Third Generation CDMA – Antennas and Wave Propagation: Antennas, Propagation Modes, Line-of-Sight Transmission – Multipath Fading Environments.	12	CO-1, CO-2	K2,K3

III	**MODULATION TECHNIQUE:** Signal Encoding Criteria – Digital data, Analog Signals: Performance of ASK, FSK, PSK, Minimum Shift Keying and QAM – Analog Data, Analog Signals: AM and Angle Modulation – Analog Data, Digital Signals: Performance, PCM and DM – Spread Spectrum – Frequency KHopping Spread Spectrum.	12	CO-3	K3,K4
IV	**WIRELESS LAN:** Wireless LAN – Overview: Application, Requirements - Infrared LANs: –Strength and Weaknesses, Transmission Techniques – Spread Spectrum LANs – Configuration and Transmission Issues – IEEE 802 Architecture: Protocol Architecture, MAC Frame Format, Logical Link Control.	12	CO-4 CO-,5	K4,K5
V	**WI-FI AND IEEE 802.11 WIRELESS LAN STANDARD:** IEEE 802.11: Wi-Fi Alliance, IEEE 802.11 Architecture, IEEE 802.11 Services – IEEE 802.11 Medium Access Control: Reliable Data Delivery, Medium Access Control, MAC Frame – IEEE 802.11 Physical Layer - IEEE 802.11a/b/g Standards – Other IEEE 802.11 Standards.	12	CO-5	K5,K6

TEXT BOOKS:

1. William Stallings. 2009, "Wireless Communications and Networks", Second Edition, Pearson Education, Inc.
2. Vijay K. Garg. 2010, "Wireless Communications and Networking", Elsevier Science.
3. Wireless Communications and Networking Vijay K. Garg.

REFERENCE BOOKS:

1. Andrea Goldsmith. 2005, "Wireless Communications", Cambridge University Press.
2. Andreas F. Molisch. 2005, "Wireless Communications", IEEE Press, Wiley Ltd. Publication.

Core Paper Theory – 21			
Title of the paper withsubject code	**DIGITAL IMAGE PROCESSING**		
Category of the course	Year	Semester	Credits
Core	**V**	**IX**	**4**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- Provide the student with the fundamentals of digital image processing.
- Give the students a taste of the applications of the theories taught in the subject. This will be achieved through some selected lab sessions.
- Introduce the students to some advanced topics in digital image processing.
- Give the students a useful skill base that would allow them to carry out further study should they be interested and to work in the field.

COURSE OUTCOMES:

CO-1: Understand the concepts of Image sensing steps and Image representation for analog and Digital Image.

CO-2: Apply Image processing techniques for noise removal and image enhancement from Digital Image.

CO-3: Analyze Image transformation techniques for analog and digital image.

CO-4: Evaluate Image compression models such as Huffman coding, JPEG, etc. for a given Digital Image.

CO-5: Design a Fourier Transform model to convert an analog image to a digital image.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	Introduction – The origin - Fundamental steps components - Image Sampling and Quantization – Some basic relationship between pixels – Linear and nonlinear operations. Image Enhancement in spatial domain – Some Basic Gray level transformation – Histogram processing- Enhancement using Arithmetic Logic operations – Basics of spatial filtering – smoothing – sharpening – Image Enhancement in frequency domain.	12	CO-1	K1
II	Color Image processing – color models – pseudo color Image processing – Smoothing – Sharpening – Color transformation - Color segmentation.	12	CO-2	K2,K3
III	Wavelets – Multiresolution Processing – Image compression models – Lossy compression – Image Compression standards	12	CO-3	K3,K4

IV	Image segmentation – Edge Linking – Boundary Detection – Thresholding – Region Based segmentation by morphological watersheds.	12	CO-4, CO-5	K4,K5
V	Morphological Image Processing: Erosion and Dilation, Opening and Closing, The Hit-Or- Miss Transformation, Basic Morphological Algorithms, Gray-Scale Morphology. Object Recognition: Patterns and Pattern Classes, Recognition Based on Decision-Theoretic Methods, Structural Methods.	12	CO-5	K5,K6

TEXT BOOKS:

1. R. C. Gonzalez and R. E. Woods, Digital image processing, 3/e , PH, 2007.
2. Digital Image Processing by S Sridhar
3. Digital Image Processing by Jayaraman S, Veerakumar T, Esakkirajan S

REFERENCE BOOKS:

1. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson, 1989.
2. Digital Image Processing by Kenneth R Castleman, Pearson Education

Extra Disciplinary Paper Theory – 2			
Title of the paper withsubject code	**E-COMMERCE**		
Category of the course	Year	Semester	Credits
Core	**V**	**IX**	**4**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To provide an introduction to information systems for business and management.
- To familiarize students with organizational and managerial foundations of systems, the technical foundation for understanding information systems

COURSE OUTCOMES:

CO – 1: Understand the basic concepts and technologies used in the field of management information systems

CO – 2: Have the knowledge of the different types of management information systems

CO – 3: Understand the processes of developing and implementing information systems

CO – 4: Be aware of the ethical, social, and security issues of information systems

CO – 5: Design an E-commerce model for retail business with electronic data interchange and security issues.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**E-COMMERCE AND ITS TECHNOLOGICAL ASPECTS:** Overview of developments in information technology and defining e-commerce: The scope of E commerce, Electronic Market, Electronic Data Interchange, Internet Commerce, Benefits and limitations of E-Commerce, Produce a generic framework for E-Commerce, Architectural framework of Electronic Commerce, Web based E Commerce Architecture.	12	CO-1	K1
II	**CONSUMER ORIENTED E COMMERCE:** E-Retailing: Traditional retailing and e retailing, Benefits of e retailing, Key success factors, Models of e retailing, Features of e retailing. E services: Categories of e-services, Web-enabled services, matchmaking services, Information-selling on the web, e entertainment, Auctions and other specialized services. Business to Business Electronic Commerce.	12	CO-1, CO-2	K2

III	**ELECTRONIC DATA INTERCHANGE**: Benefits of EDI, EDI technology, EDI standards, EDI communications, EDI Implementation, EDI Agreements, EDI Security. Electronic Payment Systems, Need of Electronic Payment System: Study and examine the use of Electronic Payment system and the protocols used, Study Electronic Fund Transfer and secure electronic transaction protocol for credit card payment. Digital economy: Identify the methods of payments on the net – Electronic Cash, cheques and credit cards on the Internet.	12	CO-3	K3,K4
IV	**SECURITY IN E COMMERCE:** Threats in Computer Systems: Virus, Cyber Crime Network Security: Encryption, Protecting Web server with a Firewall, Firewall and the Security Policy, Network Firewalls and Application Firewalls, Proxy Server. Issues in E Commerce Understanding Ethical, Social and Political issues in E-Commerce: A model for Organizing the issues, Basic Ethical Concepts, Analyzing Ethical Dilemmas, Candidate Ethical principles Privacy and Information Rights: Information collected at E-Commerce Websites, The Concept of Privacy, Legal protections Intellectual Property Rights: Types of Intellectual Property protection, Governance.	12	CO-4, CO-5	K5
V	**Issues in E Commerce** Understanding Ethical, Social and Political issues in E-Commerce: A model for Organizing the issues, Basic Ethical Concepts, Analyzing Ethical Dilemmas, Candidate Ethical principles Privacy and Information Rights: Information collected at E-Commerce Websites, The Concept of Privacy, Legal protections Intellectual Property Rights: Types of Intellectual Property protection, Governance.	12	CO-5	K5,K6

TEXT BOOKS:

1. Elias. M. Awad, " Electronic Commerce", Prentice-Hall of India Pvt Ltd.
2. RaviKalakota, Andrew B. Whinston, "Electronic Commerce-A Manager's guide", Addison-Wesley.
3. Efraim Turban, Jae Lee, David King, H.Michael Chung, “Electronic Commerce–A ManagerialPerspective", Addison-Wesley.

REFERENCE BOOKS:

1. Elias M Award, “Electronic Commerce from Vision to Fulfilment”, 3rd Edition, PHI,
2. Judy Strauss, Adel El-Ansary, Raymond Frost, “E-Marketing”, 3RDEdition, Pearson Education.

Elective Paper Theory – VI			
Title of the paper withsubject code	**ARTIFICIAL INTELLIGENCE**		
Category of the course	Year	Semester	Credits
Elective	**V**	**IX**	**3**
Paper mainly focusses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To Acquire Knowledge on various AI Techniques and Expert Systems
- To have enriched knowledge regarding heuristic search, Knowledge representation

COURSE OBJECTIVES:

CO-1: knowledge of the building blocks of AI as presented in terms of intelligent agents and Expert Systems.

CO-2: Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.

CO-3: Develop intelligent algorithms for knowledge representation using AI programming languages. and also design intelligent systems for Game Playing

CO-4: Experiment different types of learning methods in artificial intelligence and related algorithms.

CO-5: Formulate the capability to represent various real life problem domains using logic-based techniques and use this to perform inference or planning.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	Introduction: Intelligent Agents – Agents and environments - Good behavior – The nature of environments – structure of agents - Problem Solving - problem solving agents – example problems –searching for solutions – uniformed search strategies - avoiding repeated states – searching with partial information.	12	CO-1	K1
II	Searching Techniques: Informed search and exploration – Informed search strategies – heuristic function – local search algorithms and optimistic problems – local search in continuous spaces – online search agents and unknown environments - Constraint satisfaction problems (CSP) – Backtracking search	12	CO-1, CO-2	K1,K2

	and Local search for CSP – Structure of problems - Adversarial Search – Games – Optimal decisions in games – Alpha – Beta Pruning – imperfect real-time decision – games that include an element of chance.			
III	Knowledge Representation: First order logic – representation revisited – Syntax and semantics for first order logic – Using first order logic – Knowledge engineering in first order logic - Inference in First order logic – prepositional versus first order logic – unification and lifting – forward chaining – backward chaining - Resolution - Knowledge representation - Categories and objects – Actions - Simulation and events.	12	CO-3	K3,K4
IV	Learning: Learning from observations - forms of learning - Inductive learning - Learning decision trees - Ensemble learning - Knowledge in learning – Logical formulation of learning – Explanation based learning – Learning using relevant information – Inductive logic programming - Statistical learning methods - Learning with complete data - Learning with hidden variable - EM algorithm.	12	CO-4, CO-5	K4,K5
V	Applications: Communication – Communication as action – Formal grammar for a fragment of English – Syntactic analysis – Augmented grammars – Semantic interpretation – Ambiguity and disambiguation – Discourse understanding – Grammar induction - Probabilistic language processing - Probabilistic language models – Information retrieval – Information Extraction – Machine translation.	12	CO-5	K5,K6

TEXT BOOKS:

1. Russell Stuart, Norvig Peter, 2004,"Artificial Intelligence – A Modern Approach", 2nd Edition, Pearson Education.
2. A classical approach to Artificial Intelligence, Munesh Chandra Trivedi, Khanna Publications
3. Artificial Intelligence and Machine Learning, Chandra S.S. & H.S. Anand, PHI Publications

REFERENCE BOOKS:

1. Rich Elaine , Knight Kevin, "Artificial Intelligence", 2003,2nd Edition, Tata McGraw-Hill,
2. Nilsson J.Nils, "Artificial Intelligence: A new Synthesis" ,2000, Harcourt Asia Pvt. Ltd.,
3. Luger F. George, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", 2002,Pearson Education.

Elective Paper Theory – VI			
Title of the paper withsubject code	**CRYPTOGRAPHY AND NETWORK SECURITY**		
Category of the course	Year	Semester	Credits
Elective	**V**	**IX**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- To understand security design principles
- To learn secure programming techniques
- To understand the mathematics behind cryptography
- To know the standard algorithms used to provide confidentiality, integrity and authenticity

COURSE OUTCOMES:

CO-1: Demonstrate knowledge of mathematics of cryptography, traditional symmetric key cipers and modern key cipers.

CO-2: Analyze and formalize the Data Encryption Standard (DES) and Advanced Encryption Standard (AES)

CO-3: Develop Asymmetric Key Cryptography for message integrity and authentication.

CO-4: Experiment different types of cryptographic hash function and digital signature.

CO-5: Formulate the Entity authentication and key management using Asymmetric and Symmetric key distribution

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**INTRODUCTION:** Security Goals – Attacks – Services and Mechanism – Techniques. Mathematics of Cryptography: Integer Arithmetic – Modular Arithmetic – Matrices – Linear Congruence - Traditional Symmetric Key Ciphers: Instruction – Substitution Ciphers – Transposition Ciphers – Stream and Block Ciphers. **Introduction to Modern Symmetric Key Ciphers**: Modern Block Ciphers – Modern Stream Ciphers.	12	CO-1	K1,K2
II	**DATA ENCRYPTION STANDARD (DES)**: Introduction – DES Structure – DES Analysis – Multiple DES – Security of DES. Advanced Encryption Standard (AES): Introduction – Transformations – Key Expansion – Ciphers – Examples – Analysis of AES.	12	CO-1, CO-2	K2,K3

III	**ASYMMETRIC KEY CRYPTOGRAPHY**: Introduction – RSA Crypto System. Message Integrity and Message Authentication: Message Integrity – Random Oracle Model – Message Authentication.	12	CO-3	K3
IV	**CRYPTOGRAPHIC HASH FUNCTIONS:** Introduction – SHA – WHIRLPOOL. **DIGITAL SIGNATURE:** Comparison – Process – Services – Attacks on Digital Signature – Digital Signature Schemes.	12	CO-4, CO-5	K4,L5
V	**ENTITY AUTHENTICATION:** Introduction – Passwords – Challenge Response – Zero Knowledge – Bio Metrics. **KEY MANAGEMENT:** Symmetric Key Distribution – Kerberos – Symmetric Key Agreement – Public Key Distribution.	12	CO-5	K5,K6

TEXT BOOKS:

1. Cryptography and Network Security – Behrouz A. Forouzan, TheMcGraw Hill, 2011.
2. Cryptography and Network Security – William Stallings, PHI, 2008.
3. Cryptography and Network Security – Atul Kahate, McGraw Hill Education, 2013.

REFERENCE BOOKS:

1. Network Security The Complete Reference – Roberta Bragg, Mark Rhodes Ousley and Strassberg – McGraw Hill Education, 2003.
2. Bruce Schneier, ―Applied Cryptography Protocols, Algorithms and Source Code in C‖, Second Edition, John Wiley and Sons Inc., 2006.

Elective Paper Theory – VI			
Title of the paper withsubject code	**ARTIFICIAL NEURAL NETWORKS**		
Category of the course	Year	Semester	Credits
Elective	**V**	**IX**	**3**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To learn and apply artificial neural networks in problem solving and use of heuristics based on human experience
- To introduce various neural network algorithms such as perceptron algorithms, Backpropagation algorithms, etc.
- To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inferencing systems

COURSE OUTCOMES:

CO-1: Comprehend the relationship between biological neuron and artificial neuron and its working procedures.

CO-2: Apply Artificial Neural Network to implement Forward propagation and Back Propagation algorithms with various weight training methods.

CO-3: Analyze associative memory such as Hopfield Net and Bidirectional Associative memory using neural network approach.

CO-4: Evaluate various supervised and unsupervised learning methods using single level and multilevel neural networks.

CO-5: Review the various applications of neural network models by comparing and contrasting different types of neural network models

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	Introduction: Biological neurons - McCulloch and Pitts models of neuron - Types of activation function - Network architectures - Knowledge representation.	12	CO-1	K1
II	Single Layer Perceptron: Perceptron convergence theorem, Method of steepest descent - least mean square algorithms- Multilayer Perceptron: Derivation of the back-propagation algorithm, Learning Factors.	12	CO-1, CO-2	K2,K3
III	Supervised and Unsupervised Learning – Statistical Learning – AI Learning – Neural Network Learning – Rule Based Neural Networks – Network Training –Decision Tree Based NN – Constraint Based NN.	12	CO-3	K3,K4

IV	Heuristics- Hierarchical Models – Hybrid Models – Parallel Models – Differentiation Models- Control Networks.	12	CO-4, CO-5	K5.K6
V	Structures and Sequences – Spatio-temporal NN – Learning Procedures – Knowledge based Approaches.	12	CO-5	K5,K6

TEXT BOOKS:

1. Limin Fu - Neural Networks in Computer Intelligence – McGraw Hill International Edition – 1994.
2. Robert J Schalkoff – Artificial Neural Networks – McGraw Hill – 1997.
3. Simon Haykin, ìNeural Network a - Comprehensive Foundationî, Pearson Education

REFERENCE BOOKS:

1. Zurada J.M., Introduction to Artificial Neural Systems, Jaico publishers
2. Thimothy J. Ross, ìFuzzy Logic with Engineering Applicationsî, McGraw Hill
3. Ahmad Ibrahim, ìIntroduction to Applied Fuzzy Electronicsî, PHI

Elective Paper Theory – VII			
Title of the paper withsubject code	**DISTRIBUTED COMPUTING**		
Category of the course	Year	Semester	Credits
Elective	**V**	**IX**	**3**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- To enable students learn the need of distributed computing and its features such as message passing, IPC, synchronization and network requirements.
- To inculcate the concepts of shared memory in distributed environment along with deadlock issues.
- To impart knowledge on distributed filesystem model, atomic transactions and security issues in distributed computing

COURSE OUTCOMES:

CO-1: Demonstrate knowledge of evolution and designing model of distributed computing
CO-2: Analyze and formalize the IPC message passing and synchronization in multi-datagram messages.
CO-3: Develop distributed shared memory architecture, design and implementation issues in distributed shared memory.
CO-4: Experiment distributed file system, file models and design principles
CO-5: Formulate the security issues in distributed computing and cryptography for authentication access control.

UNIT NO.	SYLLABUS	HOURS	COs	COGNITIVE LEVEL
I	**FUNDAMENTALS:** What is Distributed Operating System-Evolution of Distributed Computing system –Distributed Computing System models-Why are Distributed Computing Systems gaining popularity-What is a Distributed Computing System-Issues in Designing Distributed Computing System – Introduction to Distributed Computing Environment. Introduction to Computer Networks-Network types-LAN-WAN-Communication protocols- Internetworking-ATM Technology.	12	CO-1	K1

II	**MESSAGE PASSING:** Introduction – Desirable features-Issues in IPC Message Passing-Synchronization-Buffering – Multidatagram Messages-Encoding and Decoding-Process Addressing – Failure Handling-Group Communication.	12	CO-1, CO-2	K2,K3
III	**DISTRIBUTED SHARED MEMORY:** Introduction – General Architecture of DSM system- Design and Implementation Issues of DSM – Granularity-Structure of Shared Memory- Replacement Strategy-Thrashing-Heterogeneous DSM – Advantages. Synchronization: Introduction Clock Synchronization – Event Ordering –Mutual Exclusion – Deadlock-Election Algorithm.	12	CO-3	K3,K4
IV	**DISTRIBUTED FILE SYSTEM:** Introduction-Desirable features- File models-File Accessing Models- File Sharing Semantics – File Caching Schemes – File Replication-Fault Tolerance- Atomic Transactions-Design Principles.	12	CO-4, CO-5	K4.K5
V	**SECURITY:** Introduction – Potential Attacks to Computer system –Cryptography- Authentication Access Control- Digital Signatures – Design Principles.	12	CO-5	K5,K6

TEXT BOOKS:

1 A.S. Tanenbaum - Modern Operating Systems - Prentice Hall

2. Sunita Mahajan and Seema shah, "Distributed computing", Oxford, Second edition.

3. Andrew S. Tanenbaum & Maarten van steen, "Distributed systems: Principle andparadigms", Prentice Hall of India Pvt. Ltd.

REFERENCE BOOKS:

1. James Martin, "Computer Networks and Distributed Processing, Software Techniquesand Architectures", Pearson Education.
2. Garg, Vijay K. *Elements of distributed computing*. John Wiley & Sons, 2002.
3. Garrido, José M., and Richard Schlesinger. *Principles of modern operating systems*.Jones & Bartlett Learning, 2008.

Elective Paper Theory – VII			
Title of the paper withsubject code	**BIG DATA ANALYTICS**		
Category of the course	Year	Semester	Credits
Elective	**V**	**IX**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- Understand the Big Data Platform and its Use cases
- Understand Map Reduce Jobs
- Provide hands on Hodoop Eco System
- Apply analytics on Structured, Unstructured Data.

COURSE OUTCOMES:

CO – 1: Identify Big Data and its Business Implications.
CO – 2: List the components of Hadoop and Hadoop Eco-System
CO – 3: Manage Job Execution in Hadoop Environment
CO – 4: Develop Big Data Solutions using Hadoop Eco System
CO – 5: Apply Machine Learning Techniques using

UNIT NO.	SYLLABUS	HOURS	Cos	COGNITIVE LEVEL
I	**INTRODUCTION TO BIG DATA AND HADOOP:** Types of Digital Data-Introduction to Big Data-Big Data Analytics-History of Hadoop-Apache Hadoop-Analyzing Data with Unix tools-Analyzing Data with Hadoop - Hadoop Streaming- Hadoop Echo System-IBM Big Data Strategy- Introduction to Info sphere Big Insights and Big Sheets.	12	CO-1	K1
II	**HDFS (Hadoop Distributed File System):** The Design of HDFS- HDFS Concepts- Command Line Interface- Hadoop file system interfaces-Data flow-Data Ingest with Flume and Scoop and Hadoop archives- Hadoop I/O: Compression-Serialization-Avro and File-Based Data structures.	12	CO-1, CO-2	K2,K3
III	**Map Reduce:** Anatomy of a Map Reduce Job Run-Failures-Job Scheduling-Shuffle and Sort- Task Execution- Map Reduce Types and Formats-Map Reduce Features.	12	CO-3	K3,K4

IV	**Hadoop Eco System** **Pig** : Introduction to PIG- Execution Modes of Pig- Comparison of Pig with Databases-Grun Pig Latin-User Defined Functions-Data Processing operators. **Hive:** Hive Shell- Hive Services-Hive Meta store- Comparison with Traditional Databases- HiveQL-Tables- Querying Data and User Defined Functions. **Hbase** : HBasics Concepts- Clients- Example- Hbase Versus RDBMS. **Big SQL** : Introduction.	12	CO-4, CO-5	K5
V	**Data Analytics with R:** Machine Learning – Introduction-Supervised Learning- Unsupervised Learning- Collaborative Filtering- Big Data Analytics with Big R.	12	CO-5	K6

TEXT BOOKS:

1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.

2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

REFERENCE BOOKS:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
3. Tom Plunkett, Mark Hornick, "Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", McGraw-Hill/Osborne Media (2013), Oracle epress.
4. Anand Rajaraman and Jef rey David Ulman, "Mining of Massive Datasets", Cambridge University Press, 2012.

Elective Paper Theory – VII			
Title of the paper withsubject code	**INTRODUCTION TO NATURAL LANGUAGE PROCESSING**		
Category of the course	Year	Semester	Credits
Elective	**V**	**IX**	**3**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OBJECTIVES:

- This course introduces the fundamental concepts and techniques of natural language processing (NLP).
- Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information.
- The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.

COURSE OUTCOMES:

CO-1: Describe the fundamental concepts and techniques of natural language processing.

CO-2: Distinguish among the various techniques of NLP, taking into account the assumptions, strengths, and weaknesses of each.

CO-3: Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions.

CO-4: Analyze large volume text data generated from a range of real-world applications.

CO-5: Device a statistical machine translation of text format of the given data.

UNIT NO.	SYLLABUS	HOURS	COS	COGNITIVE LEVEL
I	Introduction: Words – Morphology and Finite State transducers – Computational Phonology and Pronunciation Modelling – Probabilistic models of pronunciation and spelling.	12	CO-1	K1
II	Ngram Models of syntax – Hidden markov models and Speech recognition – Word classes and Part of Speech Tagging. Context free Grammars for English – Parsing with Context free Grammar	12	CO-1, CO-2	K2

III	Features and unification – Lexicalized and Probabilistic Parsing -Language and Complexity. Semantics: Representing meaning – Semantic analysis – Lexical semantics.	12	CO-3	K3
IV	Word sense disambiguation and Information retrieval. Pragmatics: Discourse – Dialog and Conversational agents.	12	CO-4, CO-5	K4.K5
V	Natural language generation, Statistical alignment and Machine translation: Text alignment – word alignment – statistical machine translation	12	CO-5	K6

TEXT BOOK:

1. Daniel and Martin J. H., "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2009.

REFERENCE BOOKS:

1. Manning C. D. and Schutze H., "Foundations of Statistical Natural Language processing", First Edition, MIT Press, 1999
2. Allen J., "Natural Language Understanding", Second Edition, Pearson Education, 2003.

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Core Paper Practical – 10			
Title of the paper withsubject code	**DIGITAL IMAGE PROCESSING USING PYTHON LAB**		
Category of the course	Year	Semester	Credits
Core	**V**	**IX**	**3**
Paper mainly focuses on	**EMPLOYABILITY**		

COURSE OBJECTIVES:

- Provide the student with the fundamentals of digital image processing.
- Give the students a taste of the applications of the theories taught in the subject. This will be achieved through some selected lab sessions.

COURSE OUTCOMES:

CO-1: Understand the Practical python programs of Image representation for analog and Digital Image.
CO-2: Apply Image processing techniques in python for noise removal and image enhancement from Digital Image.
CO-3: Analyze python programs for Image transformation techniques for analog and digital image.
CO-4: Evaluate Image compression models such as Huffman coding.
CO-5: Design a Fourier Transform model to convert an analog image to a digital image.

List of exercises:

SL NO	**SYLLABUS**	**COS**	**COGNITIVE LEVEL**
1	Basic image manipulation (reading, writing, quantization, sub sampling) using Python	CO-1 CO-2 CO-3 CO-4 CO-5	K1,K2,K3, K4,K5,K6
2	Basic Intensity transformation using Python		
3	Histogram Processing using Python		
4	Filtering in spatial domain-2D FFT and smoothing filters using Python		
5	Image coding using transformations with SPIHT algorithm using Python		
6	Color image Enhancement with spatial sharpening using Python.		

PROGRAM OUTCOMES

PO-1. Enriching the knowledge in theoretical and practical aspects.

PO-2. Developing research aptitude among the students and encouraging them to take up research projects and publish research papers.

PO-3. Enabling the students to come out successfully in competitive examinations.

PO-4. Developing students' skills, based on current trends by offering Job oriented, Entrepreneurial, certificate courses and Value-added courses.

PROGRAMME SPECIFIC OUTCOME FOR MSC COMPUTER SCIENCE AND TECHNOLOGY

PSO-6. Ability to apply knowledge of basic sciences, mathematics, statistics and physics into computer science for solving real world problems.

PSO-7. Ability to learn various software tools, programming languages and apply algorithmic models thus making them more employable.

PSO-8. Students equipped with state-of-the-art technologies and cutting-edge solutions so as to enable them to foray into Entrepreneurship.

PSO-9. Students enriched with requisite and holistic skills to embrace themselves for competitive exams like NET, SET and other exams for career prospects.

PSO-10. Students with a drive and passion for Research aptitude and motivated enough for venturing into Advanced Research.

PO – PSO MATRIX

	PSO-1	**PSO-2**	**PSO-3**	**PSO-4**	**PSO-5**
PO-1	✓				
PO-2					✓
PO-3				✓	
PO-4		✓	✓		

Core Paper Theory – 1			
Title of the paper with subject code	C AND C++ PROGRAMMING		
Category of the course	Year	Semester	Credits
Core	**I**	**I**	**4**

COURSE OUTCOMES:

CO1: Understand the basic concept of C Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions, Pointers, Structures and File programming

CO2: Acquire knowledge about the object-oriented paradigm.

CO3: Role of constants, variables, identifiers, operators, type conversion and other building blocks of C Language.

CO4: Use of inheritance, polymorphism and encapsulation concepts in object-oriented programming.

CO 5: Role of Functions involving the idea of modularity.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1				✓	
CO-2	✓	✓		✓	
CO-3	✓	✓			
CO-4	✓	✓		✓	
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**C AND C++ PROGRAMMING LAB**		
Category of the course	Year	Semester	Credits
Core	**I**	**II**	**3**

COURSE OBJECTIVE:

- To learn the fundamental programming concepts and methodologies which are essential to building good C/C++ programs.
- To practice the fundamental programming methodologies in the C/C++ programming language via laboratory experiences. Microsoft Visual Studio is the programming environment that will used.
- To code, document, test, and implement a well-structured, robust computer program using the C/C++ programming language.

PSO – CO MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓				
CO2	✓	✓			
CO3	✓	✓			
CO4		✓	✓		✓
CO5		✓	✓	✓	✓

Title of the paper with subject code	**DIGITAL AND MICROPROCESSOR**		
Category of the course	Year	Semester	Credits
Core	**II**	**III**	**4**

COURSE OBJECTIVES:

- To learn the fundamental programming concepts and methodologies which are essential to building good C/C++ programs.
- To practice the fundamental programming methodologies in the C/C++ programming language via laboratory experiences. Microsoft Visual Studio is the programming environment that will used.
- To code, document, test, and implement a well-structured, robust computer program using the C/C++ programming language.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				
CO-3	✓				
CO-4	✓	✓		✓	
CO-5	✓	✓	✓	✓	✓

Title of the paper withsubject code	**OBJECT ORIENTED ANALYSIS AND DESIGN**		
Category of the course	Year	Semester	Credits
Core	**II**	**III**	**4**
Paper mainly focuses on	**SKILL DEVELOPMENT**		

COURSE OUTCOMES:

CO-1: Recall the object-oriented concepts for analysis and design of systems and gather functional requirements.

CO-2: Analyze the real-world problems using the use case diagrams.

CO-3: Apply knowledge of OOPs concepts in Object Oriented Design and analyze the case study for the UML notations.

CO-4: Draw activity and state chart diagram for real word applications for evaluating a class diagram and object diagram for user requirements

CO-5: Design case studies and model it in different views with respect user requirement such as use case, logical, component and deployment and etc, and preparation of document of the project for the unified Attendance application.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✓			✓	
CO-3	✓			✓	
CO-4	✓				
CO-5	✓	✓	✓		✓

Core Paper Theory – 1			
Title of the paper with subject code	**PYTHON PROGRAMMING**		
Category of the course	**Year**	**Semester**	**Credits**
Core	**II**	**III**	**4**

COURSE OUTCOMES:

CO-1: Understand the fundamentals of Tokens, Data types, operators, library functions and Input / Output statements of Python-language.

CO-2: Comprehend the branching constructs and looping constructs of python-language and write simple programs implementing each of the constructs.

CO-3: Analyze Complex data types, List, Tuple, Sets and Dictionary. Review User-defined functions, recursive functions with an example program illustrating its use.

CO-4: Demonstrate the object-oriented programming concepts, modules and exception handling in python.

CO-5: Review the concepts of file operations. Create programs to illustrate the usage of file pointer and file handling for input and output of data.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1				✓	
CO-2	✓	✓		✓	
CO-3	✓	✓			
CO-4	✓	✓		✓	
CO-5	✓	✓	✓	✓	✓

Core Practical – 2			
Title of the paper with subject code	**PYTHON PROGRAMMING LAB**		
Category of the course	**Year**	**Semester**	**Credits**
Core	**II**	**III**	**3**

COURSE OUTCOMES:

CO-1: Understand the basic concept of Python Programming, and its different modules that includes conditional and looping expressions, Arrays, Strings, Functions and File programming

CO-2: Acquire knowledge about the basic concept of writing a program.

CO-3: Role of constants, variables, identifiers, operators, type conversion and other building blocks of Python Language.

CO-4: Use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.

CO-5: Role of Functions involving the idea of modularity.

PSO – CO MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓				
CO2	✓	✓			
CO3	✓	✓			
CO4		✓	✓		✓
CO5		✓	✓	✓	✓

Core Paper Theory – 4			
Title of the paper with subject code	**DATA ANALYTICS WITH R**		
Category of the course	**Year**	**Semester**	**Credits**
Core	**II**	**IV**	**4**

COURSE OUTCOMES:

CO-1: Understand how to download R-package and handling of R packages. Exploring the data types in R.

CO-2: Analyze the data and data frames in R and operators available in R

CO-3: Demonstrate the concepts of linear regression, logistic regression and its types.

CO-4: Understand the decision tree representation in R and clustering concepts.

CO-5: Synthesis association rules and clustering algorithms in Data mining concepts.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2					
CO-3	✓	✓	✓		
CO-4	✓	✓	✓		✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**COMPUTER ARCHITECTURE AND ORGANIZATION**		
Category of the course	**Year**	**Semester**	**Credits**
Core	**II**	**IV**	**4**

COURSE OUTCOMES:

CO-1: Demonstrate basic components of computer system and its accessories.

CO-2: Comprehend various types of memory organization and its advantages and disadvantages.

CO-3: Deduce the principles of computer architecture concepts such as instruction formats, addressing modes, registers and RISC vs CISC pipelining concepts

CO-4: Apply computer arithmetic algorithms and memory organization structures.

CO-5: Deduce microprogrammed control concepts.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	
Unit-5				✓	✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				
CO-3	✓			✓	
CO-4	✓	✓		✓	
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**COMPUTER GRAPHICS**		
Category of the course	Year	Semester	Credits
Core	**II**	**IV**	**4**

COURSE OUTCOME:

CO-1: Understand the principles of graphical components generated on computer displays.

CO-2: Infer output primitives and algorithms for line drawing, Circle generation and Ellipse drawing.

CO-3: Apply two dimensional transformations on objects and two-dimensional viewing of line, curve, and polygon.

CO-4: Evaluate various color models and animations such as graphics programming packages such as OPENGL

CO-5: Build a camera using a program to create shaded objects and to render textures and drawing shadows on an image.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2				✓	
CO-3	✓			✓	
CO-4	✓			✓	
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**MULTIMEDIA SYSTEMS**		
Category of the course	Year	Semester	Credits
Core	**II**	**IV**	**4**

COURSE OUTCOMES:

CO – 1: Describe the types of media and define multimedia system.

CO – 2: Describe the process of digitizing (quantization) of different analog signals (text, graphics, sound and video).

CO – 3: Use and apply tools for image processing, video, sound and animation.

CO - 4: Apply methodology to develop a multimedia system.

CO – 5: Apply acquired knowledge in the field of multimedia in practice and independently continue to expand knowledge in this field.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1	✓				
CO-2	✓				
CO-3	✓				
CO-4		✓		✓	
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**DATA ANALYTICS WITH R LAB**		
Category of the course	Year	Semester	Credits
Core	**II**	**IV**	**3**

COURSE OUTCOMES:

CO1: Understand R programming language concepts such as branching and looping constructs.

CO2: Understand various Data analytical procedures using R applications.

CO3: Implement correlation analysis and covariance analysis using R applications.

CO4: Understand the Min-Max normalization and Z-score normalizations.

CO5: Apply decision and iteration control structures to implement algorithms

PSO – CO MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓			
CO2	✓	✓			
CO3	✓	✓			
CO4		✓	✓	✓	✓
CO5		✓	✓	✓	✓

Title of the paper with subject code	**JAVA PROGRAMMING AND DATA STRUCTURES**		
Category of the courseP	Year	Semester	Credits
Core	**III**	**V**	**4**

COURSE OUTCOMES:

CO-1: Conceive the Programming constructs such as branching statements and looping statements of JAVA language, Class, object, and file stream classes.

CO-2: Recall the principles of Object-Oriented Programming paradigm, its advantages, disadvantages and applications. Understand how JAVA programming language can be used to implement the OOP's concepts through Class, Object, inheritance, polymorphism.

CO-3: Understanding the concepts of Packages, Exception handling and Multithreading in JAVA.

CO-4: Comprehend the basic data structures such as stack, queue, Linked-list, applications of stacks.

CO-5: Understanding of Trees, Graphs and their traversals. Calculate the single source shortest path using Dijkstra's Algorithm by representing the problem as graph.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓	✓			
CO-3	✓	✓		✓	
CO-4	✓	✓		✓	✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**OPERATING SYSTEM**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**

CO-1: Understand the fundamentals of Operating System structures, focusing on process scheduling, memory management, file systems and I/O systems. Summarize various process-scheduling algorithms for a processor

CO-2: Identify the problem of race condition in time sharing operating system and the need for process synchronization. Relate the effects of synchronization on creation of deadlock. Discuss the methods of deadlock avoidance, prevention and ignoring.

CO-3: Compare and contrast different memory management methods and discuss how virtual memory is implemented by memory management unit using page replacement algorithm.

CO-4: Summarize the file structures and directory structure concepts along with its protection, implementation and recovery of file system. Deduce how file systems is implemented in Unix OS and Window OS.

CO-5: Demonstrate how I/O subsystems work and discuss how Mass storage structure work such as disk scheduling and management.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓			✓	
CO-3	✓	✓			✓
CO-4	✓	✓		✓	✓
CO-5	✓		✓	✓	✓

Title of the paper with subject code	**SOFTWARE ENGINEERING**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**4**

COURSE OUTCOMES:

CO-1: Understand the Software Engineering concepts for creation of software project and product.

CO-2: Plan a Software Project involving project scheduling and tracking along with risk analysis of the project undertaken.

CO-3: Discuss the Software Configuration Management system for a software project. Analyze the sequence of steps in software project and do a analysis modeling.

CO-4: Review various Design concepts in Software engineering such as Architectural design and User Interface design.

CO-5: Demonstrate the Component level design and testing techniques and strategies for the software along with the metrics for the software design.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓			✓	
CO-3	✓	✓		✓	
CO-4	✓	✓	✓	✓	✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**INTERNET-OF-THINGS**		
Category of the course	Year	Semester	Credits
Elective	**III**	**V**	**5**

COURSE OUTCOMES:

CO-1: Understanding the diverse fields where IoT is being used and wider range of IoT-applications

CO-2: Comprehend how M2M value chains are converted to IoT value chains

CO-3: Analyze IoT architecture, reference model and different types of views in IoT model.

CO-4: Deduce how IoT can be applied to factories, Retail Industry, Business models and other smart applications.

CO-5: Review various Governance policies in privacy and security issues.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				✓
CO-3	✓		✓		✓
CO-4	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**SYSTEM SOFTWARE**		
Category of the course	**Year**	**Semester**	**Credits**
Elective	**III**	**V**	**5**

COURSE OUTCOMES:

CO-1: Recall the basic functioning of compilers, assemblers, interpreters and steps involved in executing a High level program.

CO-2: Design, Analyze and Implement one pass, two pass or multi pass assembler

CO-3: Design, Analyze and Implement loader, linker and macros.

CO-4: Assess various system software tools for editing, debugging and creating an user interface.

CO-5: Critique the features of modern editing /debugging tools.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓			✓	
CO-3	✓			✓	
CO-4	✓			✓	✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**WEB FRAMEWORKS**		
Category of the course	Year	Semester	Credits
Elective	**III**	**V**	**5**

COURSE OUTCOME:

CO – 1: Designing a simple responsive web application.

CO – 2: Analyzing CRUD operations using ReactJS

CO – 3: Understanding Life cycle model for the ReactJS

CO – 4: Demonstrating Event-driven programming model for ReactJS.

CO – 5: Designing Server-side Scripting of ReactJS.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5				✓	✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2		✓			
CO-3		✓	✓		
CO-4	✓	✓	✓	✓	
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**DATA STRUCTURES USING JAVA LAB**		
Category of the course	Year	Semester	Credits
Core	**III**	**V**	**3**

COURSE OUTCOMES:

CO1: Apply object-oriented programming features to program design and implementation

CO2: Understand object-oriented concepts and how they are supported by JAVA

CO3: Understand implementation issues related to object-oriented techniques.

CO4: Demonstrate the ability to analyze, use, and create functions, classes, to overload operators.

CO5: Demonstrate the ability to understand and use inheritance and interface when creating or using classes.

CO6: Determine which algorithm or data structure to use in different scenarios and be familiar with writing recursive methods.

CO7: Demonstrate understanding of the abstract properties of various data structures such as stacks, queues, lists, trees and graphs and use various data structures effectively in application programs.

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓	✓			
CO-3	✓	✓		✓	
CO-4	✓	✓		✓	✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**COMPUTER NETWORKS**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**4**

COURSE OUTCOMES:

CO-1: Recall the concepts of communication, types of networks, transmission mode, types of medium, protocols and addresses.

CO-2: Apply layered protocol approach to communication representing OSI Reference model explaining the functional characteristics of each layer.

CO-3: Analyzing the protocols respective to the physical, data link, network, transport, session, presentation and application layers.

CO-4: Evaluate error control using error detection and correction, flow control using sliding window mechanism, IP addressing and subnet masking.

CO-5: Create an appropriate networking architecture for an organizational structure along with relevant protocols to support the network.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓			✓	
CO-3	✓	✓		✓	
CO-4	✓	✓	✓	✓	✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**WEB DEVELOPMENT USING OPEN-SOURCE TECHNOLOGY**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**5**

COURSE OUTCOMES:

CO-1: Understand the basics of PHP statements, operators, branching and looping statements.

CO-2: Analyze the usage of Arrays and functions in PHP. Comprehend the concepts of files.

CO-3: Analyze the features of client-side scripting languages such as Java Script such as keywords, operators, functions and DOM extensions.

CO-4: Deduce MySQL database data types, creating and manipulating table operations and data manipulation table aggregation functions.

CO-5: Design application programs with PHP as front-end and MySQL as back-end tool.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✓				
CO-3	✓	✓	✓		
CO-4	✓	✓	✓		
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**SOFTWARE QUALITY ASSURANCE**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**

COURSE OUTCOMES:

CO-1: Analyze software documentations using inspections and walkthrough

CO-2: Associate various software metrics to context

CO-3: List the components of test plan

CO-4: Device a Testing Group

CO-5: Explain standards, assessments and certificates.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1	✓				
CO-2	✓				
CO-3			✓		
CO-4	✓	✓	✓	✓	✓
CO-5	✓	✓	✓		

Title of the paper with subject code	**DATA MINING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**

COURSE OUTCOMES:

CO-1: Understanding the data mining concepts and different types of data warehouse such as Relational, Transactional, Object oriented, spatio-temporal, multimedia databases.

CO-2: Comprehend the data preprocessing techniques such as data reduction, data integration, data transformation, data reduction and discretization.

CO-3: Analyze various data mining techniques such as association rule mining, Multilevel, Multidimensional, and Constraint Based Association Mining and implement Apriori algorithm.

CO-4: Compare and contrast the classification and prediction techniques such as Tree induction, Bayesian Classification and Back Propagation.

CO-5: Review various Clustering Methods such as Hierarchical Methods, Density Based Methods, Web Mining, Spatial Mining and Temporal Mining.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				✓
CO-3	✓		✓		✓
CO-4	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**MICROSERVICES ARCHITECTURE**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**

COURSE OUTCOMES:

CO - 1: Comprehend the need for Microservices architecture and its systematic evolution.

CO - 2: Apply Microservices architecture technologies to enterprise domain.

CO - 3: Design and analyze various Microservices architecture patterns and techniques.

CO - 4: Analyze the node.JS webservice connection with Express.

CO – 5: Compare and evaluate best strategies and practices of Microservices architecture.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓		✓		
CO-3	✓		✓		
CO-4	✓		✓	✓	✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**CLOUD COMPUTING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**

COURSE OUTCOMES:

CO-1: Understand the concepts of cloud computing, need for cloud computing, advantages and disadvantages.

CO-2: Discuss various forms of cloud services, platform as service, software as service, infrastructure as service and cloud service deployment.

CO-3: Discuss how cloud computing can be used for collaborating contact list, community, corporations, group projects and events.

CO-4: Review various cloud services available can be used for collaborating for online planning, schedule management, task management, project management, database and sharing files.

CO-5: Review web-based collaborating tools, web conference tools and collaborating via blogs and wikis.

Subject Code	**O-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2					
CO-3			✓		✓
CO-4	✓		✓		✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**ETHICAL HACKING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**

COURSE OUTCOMES:

CO-1: Understand the concepts of Ethical Hacking, Enterprise Information security Architecture.

CO-2: Discuss various forms of foot printing, Network scanning and protocols and techniques in HTTP Tunneling and IP Spoofing.

CO-3: Discuss how system hacking works and steganography applications and detection tools.

CO-4: Review various Malware threats and its countermeasures and Malware analysis

CO-5: Review various case study tools, techniques and counter measures for sniffing attacks and session hijacking.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2			✓		
CO-3		✓	✓		✓
CO-4	✓	✓	✓		✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**WEB MINING**		
Category of the course	Year	Semester	Credits
Elective	**III**	**VI**	**5**

COURSE OUTCOMES:

CO – 1: Understand the web retrieval and web search model.

CO – 2: Analyze the web page pre-processing procedure for web mining.

CO – 3: Demonstrate the web content mining in social network analysis and build a basic crawler algorithm

CO – 4: Comprehend the Web structure mining integrating with web interface query

CO – 5: Design a recommender system for web usage mining.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2			✓		✓
CO-3		✓	✓		✓
CO-4	✓	✓	✓		✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**WEB DEVELOPMENT USING OPEN-SOURCE TECHNOLOGY LAB**		
Category of the course	Year	Semester	Credits
Core	**III**	**VI**	**3**

COURSE OUTCOMES:

CO1: Understanding of how PHP is used

CO2: Develop and Publish Android applications using Graphical user interface

CO4: Develop an application to display your personal details using GUI Components

CO5: Understand how to develop an application that uses to send messages from one mobile to another mobile.

CO6: Handling online Database Transactions.

CO7: Designing an application for Google map locator

PSO – CO MATRIX

	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓			
CO2	✓	✓			
CO3	✓	✓			
CO4		✓			
CO5		✓			
CO6	✓	✓	✓	✓	✓
CO7	✓	✓	✓	✓	✓

Title of the paper with subject code	**RELATIONAL DATABASE MANAGEMENT SYSTEMS**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VII**	**4**

COURSE OUTCOMES:

CO-1: Understand the basics of Database management, architecture, Architecture, Data models and ER diagrams.

CO-2: Infer the concepts of Relational model and relational calculus. Apply the rules for converting ER model to a relational model and implement SQL queries on the relational model.

CO-3: Summarize the normal forms for the relational model based on functional dependencies, multi-values dependencies and join dependencies.

CO-4: Discuss various SQL commands for DDL, DML such as Join, Set and Aggregate functions. Understand the PL/SQL structures, operations and procedures such as exception handling and triggers.

CO-5: Evaluate the concepts of transaction and concurrency controls using Locking protocols.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employ ability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✓	✓		✓	
CO-3	✓	✓		✓	
CO-4	✓	✓	✓	✓	
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**MOBILE APPLICATION DEVELOPMENT**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VII**	**4**

COURSE OUTCOMES:

CO-1: Comprehend the mobile application development platforms and mobile application development life cycle along with mobile application front-end and back-end.

CO-2: Understand the IDE of the mobile application development such as screen orientation user interface

CO-3: Understand various types of view in mobile application development and how to apply data to files and create databases.

CO-4: Apply the knowledge in creating own content providers such as messaging, email, mapping a location.

CO-5: Design own web services through HTTP and threading.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1	✓				
CO-2	✓	✓	✓		
CO-3		✓	✓		
CO-4		✓	✓		
CO-5		✓	✓		✓

Title of the paper with subject code	**FUNDAMENTALS OF MACHINE LEARNING**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VII**	**4**

COURSE OUTCOMES:

CO-1: Understand the concepts of Linear Regression methods and classification methods and their types of learning standard.

CO-2: Apply Linear learning methods such as resampling procedures for model selection and regularization procedures for dimensionality reduction.

CO-3: Analyze Non-linear learning methods such as polynomial regression, regression splines and tree-based methods.

CO-4: Evaluate Support Vector Machines for regression and classification.

CO-5: Design an unsupervised learning using principal component analysis and clustering methods.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓		✓	✓	✓
CO-3	✓		✓		✓
CO-4	✓	✓	✓		✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**PRINCIPLES OF ALGORITHM DESIGN**		
Category of the course	Year	Semester	Credits
Elective	**IV**	**VII**	4

COURSE OUTCOMES:

CO-1: Comprehend the five phases of the compiler design and describe the nitty-gritty of functions of each of the phases.

CO-2: Application of Regular Expression and Finite Automata for Lexical analysis of the language to describe the tokens and to recognize the tokens respectively by the compilers.

CO-3: Analysis of parsing procedures by compare and contrast of various bottom-up and top-down parsing methods.

CO-4: Evaluate the intermediate codes of the compiler and inspect optimization techniques for the intermediate code.

CO-5: Synthesize a machine code of a trivial compiler for the design of Identifier token by constructing Regular Expression, Automata, Grammars, building a parser and an optimized intermediate code for the identifier

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓			✓	✓
CO-3	✓				✓
CO-4	✓		✓	✓	✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**PARALLEL COMPUTING**		
Category of the course	Year	Semester	Credits
Elective	**IV**	**VII**	**4**

COURSE OUTCOMES:

CO-1: Define the scope of parallel computing, design paradigms and model of parallel computing.

CO-2: Perform classification of parallel computing based on Divide and Conquer strategies.

CO-3: Apply the parallel programming design paradigms and programming models and standards.

CO-4: Deduce shared memory concepts used in parallel computing models such as openMP.

CO-5: Design a Multi-core programming Tread building blocks and cilk++ programming.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				✓
CO-3	✓			✓	✓
CO-4	✓		✓		✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**TEXT MINING**		
Category of the course	Year	Semester	Credits
Elective	**IV**	**VII**	**4**

COURSE OUTCOME:

CO – 1 : Understand the basic issues and types of text mining

CO – 2 : Appreciate the different aspects of text categorization and clustering.

CO – 3 : Understand the role played by text mining in information retrieval extraction.

CO – 4 : Analyze the currents trends in text mining.

CO – 5 : Design a text analytic framework to analyze text data for specific domain

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2			✓		✓
CO-3		✓	✓		✓
CO-4	✓	✓	✓		✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**RELATIONAL DATABASE MANAGEMENT SYSTEMS LAB**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VII**	**3**

COURSE OUTCOMES:

CO - 1: Brief knowledge about SQL Fundamentals.

CO - 2: Able to handle with different Data Base languages.

CO - 3: Table View, Log & Triggers.

CO - 4: Introduction to different Database packages (Oracle/ MySql, etc) Commit & Rollback.

CO - 5: Handling online Transactions.

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employ ability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓	✓		✓	
CO-3	✓	✓		✓	
CO-4	✓	✓	✓	✓	
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**MOBILE APPLICATION DEVELOPMENT LAB**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VIII**	**3**

COURSE OUTCOMES:

CO-1: Comprehend the mobile application development platforms and mobile application development life cycle along with mobile application front-end and back-end.

CO-2: Understand the IDE of the mobile application development such as screen orientation user interface

CO-3: Understand various types of view in mobile application development and how to apply data to files and create databases.

CO-4: Apply the knowledge in creating own content providers such as messaging, email, mapping a location.

CO-5: Design own web services through HTTP and threading.

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1	✓				
CO-2	✓	✓	✓		
CO-3		✓	✓		
CO-4		✓	✓		
CO-5		✓	✓		✓

Title of the paper with subject code	**SOFTWARE TESTING**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VIII**	**4**

COURSE OUTCOMES:

CO-1: Investigate the reason for bugs and analyze the principles in software testing to prevent and remove bugs

CO-2: identify the needs of software test automation, and define and develop a test tool to support test automation.

CO-3: Apply Flow/Graphs and Path Testing and Transaction Flow Testing Techniques as testing strategies

CO-4: Deduce Domain testing and syntax testing metrics and state graph methodologies.

CO-5: Device verification and validation tools for various levels of testing for software products such win runner tool.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓	✓			
CO-3	✓	✓	✓		
CO-4	✓	✓	✓	✓	
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**UNIX AND PERL PROGRAMMING**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VIII**	**4**

COURSE OUTCOMES:

CO-1: Understand all the UNIX utilities, the basic UNIX process structure and the UNIX file system

CO-2: Articulate simple UNIX filters, UNIX pipes and redirection, UNIX environment, traps, signals, and Regular Expressions.

CO-3: Deduce least one Shell scripting language and Classify system calls in UNIX

CO-4: Review the concepts of process, threads, and file structure,

CO-5: Compose a Shell scripting for creating an application with Inter process Communication using pipes, shared memory, semaphores and messages.

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2	✓			✓	
CO-3	✓			✓	
CO-4	✓	✓		✓	✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**THEORY OF COMPUTATION**		
Category of the course	Year	Semester	Credits
Extra Disciplinary	**IV**	**VIII**	4

COURSE OUTCOMES:

CO-1: Describe foundations for computation and conversion steps for regular expression, finite automata and grammars.

CO-2: Analyze the types of Grammars, concentrate on Regular languages and Context Free grammars and its properties.

CO-3: Apply the pumping lemma for validating regular language and context free language and demonstrate algorithms for conversion between languages.

CO-4: Evaluate linear automata and push-down automata for a given regular language and context free language.

CO-5: Produce simple programs for a Turing Machine and List examples of undecidable problems

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓			✓	
CO-3	✓			✓	✓
CO-4	✓	✓		✓	✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**MOBILE COMPUTING**		
Category of the course	Year	Semester	Credits
CORE	**IV**	**VIII**	4

COURSE OUTCOMES:

CO – 1: Explain the basics of mobile Computing

CO – 2: Describe the functionality of Mobile IP and Transport Layer

CO – 3: Classify different types of mobile telecommunication systems

CO – 4: Demonstrate the Adhoc networks concepts and its routing protocols

CO – 5: Make use of mobile operating systems in developing mobile applications

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				
CO-3	✓				
CO-4	✓				✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**SOFTWARE PROJECT MANAGEMENT**		
Category of the course	Year	Semester	Credits
Elective	**IV**	**VIII**	**3**

COURSE OUTCOMES:

CO-1: Define Estimation of project cost and prepare cost-benefit evaluation among projects

CO-2: Perform project scheduling, activity network analysis and risk management

CO-3: Apply schedule and cost control techniques for project monitoring including contract management.

CO-4: Deduce quality models in software projects for maintaining software quality and reliability.

CO-5: Design a suitable project organization structure, leadership, decision and motivation styles, proper safety and ethical practices and be responsible to the society.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1	✓				
CO-2			✓		
CO-3			✓		
CO-4	✓	✓	✓	✓	✓
CO-5	✓	✓	✓		

Title of the paper with subject code	**DISTRIBUTED DATABASE MANAGEMENT SYSTEM**		
Category of the course	Year	Semester	Credits
Elective	**IV**	**VIII**	**3**

COURSE OUTCOMES:

CO-1: Explain the techniques used for data fragmentation, replication, and allocation during the distributed database design process.

CO-2: Analyze simple strategies for executing a distributed query to select the strategy that minimizes the amount of data transfer.

CO-3: Apply the two-phase commit protocol to deal with committing a transaction that accesses databases stored on multiple nodes.

CO-4: Validating distributed concurrency control based on the distinguished copy techniques and the voting methods.

CO-5: Build Architecture for deploying Distributed Database model to replace a centralized University examination system.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				
CO-3	✓			✓	
CO-4	✓			✓	✓
CO-5	✓	✓	✓		✓

Elective Paper Theory – 1			
Title of the paper with subject code	**JAVA WEB SERVICES**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VIII**	**3**

COURSE OUTCOMES:

CO-1: Understand the concepts of XML and Document Type Definitions and its types.

CO-2: Discuss various forms of Data interchange format such as JSON Syntax and schema.

CO-3: Discuss how Maven lifecycle, phases, plugins and snapshots.

CO-4: Review Gradle tasks, standard coordinates, properties and repositories.

CO-5: Review various Spring Boot REST API – adding database access to Boot app, configuring and deploying the Boot app.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	
Unit-5				✓	✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employa bility)**	**PSO-3 (Entrepreneur ship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1	✓				
CO-2		✓			
CO-3		✓	✓		
CO-4	✓	✓	✓	✓	
CO-5	✓	✓	✓		✓

Title of the paper withsubject code	**UNIX AND PERL PROGRAMMING LAB**		
Category of the course	Year	Semester	Credits
Core	**IV**	**VIII**	**3**

COURSE OUTCOMES:

CO-1: Understand all the UNIX utilities, the basic UNIX process structure and the UNIX file system

CO-2: Articulate simple UNIX filters, UNIX pipes and redirection, UNIX environment, traps, signals, and Regular Expressions.

CO-3: Deduce least one Shell scripting language and Classify system calls in UNIX

CO-4: Review the concepts of process, threads, and file structure,

CO-5: Compose a Shell scripting for creating an application with Inter process Communication using pipes, shared memory, semaphores and messages.

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1	✓				
CO-2	✓	✓			
CO-3		✓			
CO-4		✓			
CO-5		✓	✓	✓	✓

Title of the paper with subject code	**COMMUNICATION NETWORK AND WIRELESS TECHNOLOGY**		
Category of the course	Year	Semester	Credits
Core	**V**	**IX**	**4**

COURSE OUTCOMES:

CO-1: Comprehend the basics of communication network topologies, network switching types, OSI model.

CO-2: Understand the cellular network architecture and its evolution from first generation to third generation CDMA.

CO-3: Understand various types of Modulation technique such as ASK, FSK, PSK, QAM and PCM.

CO-4: Apply the knowledge in Wireless LANs along with the transmission techniques and IEEE 802 Architecture for wireless LAN.

CO-5: Design own Wireless networks using various WI-FI IEEE standards.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1	✓				
CO-2	✓	✓	✓		
CO-3		✓	✓		
CO-4		✓	✓		
CO-5		✓	✓	✓	✓

Title of the paper with subject code	**DIGITAL IMAGE PROCESSING**		
Category of the course	Year	Semester	Credits
Core	**V**	**IX**	**4**

COURSE OUTCOMES:

CO-1: Understand the concepts of Image sensing steps and Image representation for analog and Digital Image.

CO-2: Apply Image processing techniques for noise removal and image enhancement from Digital Image.

CO-3: Analyze Image transformation techniques for analog and digital image.

CO-4: Evaluate Image compression models such as Huffman coding, JPEG, etc. for a given Digital Image.

CO-5: Design a Fourier Transform model to convert an analog image to a digital image.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2		✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				
CO-3	✓			✓	✓
CO-4	✓		✓	✓	✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**ECOMMERCE**		
Category of the course	Year	Semester	Credits
Core	**V**	**IX**	**4**

COURSE OUTCOMES:

CO – 1: Understand the basic concepts and technologies used in the field of management information systems

CO – 2: Have the knowledge of the different types of management information systems

CO – 3: Understand the processes of developing and implementing information systems

CO – 4: Be aware of the ethical, social, and security issues of information systems

CO – 5: Design an E-commerce model for retail business with electronic data interchange and security issues.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓		✓		
CO-3	✓		✓		
CO-4	✓	✓	✓		
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**ARTIFICIAL INTELLIGENCE**		
Category of the course	Year	Semester	Credits
Elective	**V**	**IX**	**3**

COURSE OBJECTIVES:

CO-1: knowledge of the building blocks of AI as presented in terms of intelligent agents and Expert Systems.

CO-2: Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.

CO-3: Develop intelligent algorithms for knowledge representation using AI programming languages. and also design intelligent systems for Game Playing

CO-4: Experiment different types of learning methods in artificial intelligence and related algorithms.

CO-5: Formulate the capability to represent various real life problem domains using logic-based techniques and use this to perform inference or planning.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				✓
CO-3	✓		✓	✓	✓
CO-4	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**CRYPTOGRAPHY AND NETWORK SECURITY**		
Category of the course	Year	Semester	Credits
Elective	**V**	**IX**	**3**

COURSE OUTCOMES:

CO-1: Demonstrate knowledge of mathematics of cryptography, traditional symmetric key cipers and modern key cipers.

CO-2: Analyze and formalize the Data Encryption Standard (DES) and Advanced Encryption Standard (AES)

CO-3: Develop Asymmetric Key Cryptography for message integrity and authentication.

CO-4: Experiment different types of cryptographic hash function and digital signature.

CO-5: Formulate the Entity authentication and key management using Asymmetric and Symmetric key distribution

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2			✓		✓
CO-3	✓		✓	✓	✓
CO-4	✓	✓	✓	✓	✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**ARTIFICIAL NEURAL NETWORK**		
Category of the course	Year	Semester	Credits
Elective	**V**	**IX**	**3**

COURSE OUTCOMES:

CO-1: Comprehend the relationship between biological neuron and artificial neuron and its working procedures.

CO-2: Apply Artificial Neural Network to implement Forward propagation and Back Propagation algorithms with various weight training methods.

CO-3: Analyze associative memory such as Hopfield Net and Bidirectional Associative memory using neural network approach.

CO-4: Evaluate various supervised and unsupervised learning methods using single level and multilevel neural networks.

CO-5: Review the various applications of neural network models by comparing and contrasting different types of neural network models

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				✓
CO-3	✓		✓	✓	✓
CO-4	✓	✓	✓	✓	✓
CO-5	✓	✓	✓	✓	✓

Title of the paper with subject code	**DISTRIBUTED COMPUTING**		
Category of the course	Year	Semester	Credits
Elective	**V**	**IX**	**3**

COURSE OUTCOMES:

CO-1: Demonstrate knowledge of evolution and designing model of distributed computing

CO-2: Analyze and formalize the IPC message passing and synchronization in multi-datagram messages.

CO-3: Develop distributed shared memory architecture, design and implementation issues in distributed shared memory.

CO-4: Experiment distributed file system, file models and design principles

CO-5: Formulate the security issues in distributed computing and cryptography for authentication access control.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				
CO-3	✓				✓
CO-4	✓			✓	✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**BIG DATA ANALYTICS**		
Category of the course	Year	Semester	Credits
Elective	**V**	**IX**	**3**

COURSE OUTCOMES:

CO – 1: Identify Big Data and its Business Implications.

CO – 2: List the components of Hadoop and Hadoop Eco-System

CO – 3: Manage Job Execution in Hadoop Environment

CO – 4: Develop Big Data Solutions using Hadoop Eco System

CO – 5: Apply Machine Learning Techniques using

Subject Code	CO-1	CO-2	CO-3	CO-4	CO-5
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	PSO-2 (Employability)	PSO-3 (Entrepreneurship)	PSO-4 (Competitive Exams & Further studies)	PSO-5 (Research)
CO-1					
CO-2			✓		✓
CO-3			✓		✓
CO-4	✓		✓	✓	✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**INTRODUCTION TO NATURAL LANGUAGE PROCESSING**		
Category of the course	Year	Semester	Credits
Core	**V**	**IX**	**3**

COURSE OUTCOMES:

CO-1: Describe the fundamental concepts and techniques of natural language processing.

CO-2: Distinguish among the various techniques of NLP, taking into account the assumptions, strengths, and weaknesses of each.

CO-3: Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions.

CO-4: Analyze large volume text data generated from a range of real-world applications.

CO-5: Device a statistical machine translation of text format of the given data.

Subject Code	**CO-1**	**CO-2**	**CO-3**	**CO-4**	**CO-5**
Unit-1	✓				
Unit-2	✓	✓			
Unit-3			✓		
Unit-4				✓	✓
Unit-5					✓

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1	✓				
CO-2			✓		✓
CO-3			✓		✓
CO-4	✓		✓	✓	✓
CO-5	✓	✓	✓		✓

Title of the paper with subject code	**DIGITAL IMAGE PROCESSING LAB**		
Category of the course	Year	Semester	Credits
Core	**V**	**IX**	**3**

COURSE OUTCOMES:

CO-1: Understand the Practical python programs of Image representation for analog and Digital Image.

CO-2: Apply Image processing techniques in python for noise removal and image enhancement from Digital Image.

CO-3: Analyze python programs for Image transformation techniques for analog and digital image.

CO-4: Evaluate Image compression models such as Huffman coding.

CO-5: Design a Fourier Transform model to convert an analog image to a digital image.

PSO- CO MATRIX

	PSO-1 (Applied Knowledge)	**PSO-2 (Employability)**	**PSO-3 (Entrepreneurship)**	**PSO-4 (Competitive Exams & Further studies)**	**PSO-5 (Research)**
CO-1					
CO-2	✓				
CO-3	✓			✓	✓
CO-4	✓		✓	✓	✓
CO-5	✓	✓	✓	✓	✓

9. Teaching – Learning Process:

The Teaching-Learning process for the B.Sc. Computer Science programme has been in alignment with the course objectives and outcomes put forth for the programme. It has been ensured that the process is in compliance with the Programme Specific Outcomes and Course Outcomes envisaged for the programme. To enable effective and efficient teaching process various teaching aids have been used including online classes through Google Meet. To facilitate better learning process for the students the Institution has offered online repository such as Google Classroom for online sharing of reading resources and contents to the students.

To meet the set objectives of the course and enable students achieve the expected outcomes of the course the following teaching processes are utilized:

Class Room Teaching:

Time tested regular Class room teaching and face-to-face teaching using chalk and talk method is used to imbibe the theoretical foundations to the students. Using Live Classroom teaching provides teachers with a handle to monitor the mindset of the students and grasp of the teaching. LCD/Projectors can be used in classroom for providing simulated/animated explanations of the concepts of the curriculum.

Laboratory Teaching:

Laboratory Teaching provides hands-on practical sessions for the students to have deep understanding of the theoretical concepts that they learn in classrooms. Laboratory is furnished with state-of-the-art technologies and higher-end software to help students to solve the problems practically.

Forums:

Student forum in the name of ITALERT Forum is organized every week where Industry experts are invited to provide Guest Lectures for the students to learn the latest trends and technologies prevalent in the industry. Forums are also used for peer-to-peer learning as students take seminars, involve themselves in group discussions on technical topics.

MOOCS:

Students are advised to take up MOOC course such as NPTEL and other industry endorsed online courses to provide blended learning to cater to the needs of the ever-evolving field of Computer Science.

Project:

Students are subjected to carryout Project-based assignments for every core subject. Students are a given a real-time problem. They are to apply the theoretical concepts to the problems, analyse the technical details of the problem, evaluate the possible solutions to the problem and have to propose a computational solution for the given problem.

Final year students in their final semester are mandated to complete a real-time mini-project for the successful completion of the degree.

Assignments:

Home assignments are regularly given to students that comprises of

- Data collection from real-world to prepare themselves to gain insights to the data by comparing the data from various sources and preparing a report for the collected data.
- Solve theoretical problems using practical approaches to provide exposure to real-world problems and industry practices.

10. Assessment Methods:

Assessment methods play a pivotal role in evaluation of student's progress. More importantly the Assessments methods employed are structured in such a way that students can themselves introspect as to what is expected of them by the Institution and by the Industry. Assessment methods provide students with window to know where they lack as a learner and more importantly how to improve upon themselves from the inputs of the curriculum. In bachelors programme of Computer Science, the assessment and evaluation method focus on testing the intuitive understanding of the fundamental concepts of software and hardware along with programming skills in various languages and more importantly the ability to apply the knowledge to real-life applications. The assessment methods try to validate and enhance the well-rounded skillsets of the students such as employable skills, entrepreneurship skills, research-relevance skills and programming-conscious skills.

10.1. Continuous Assessment:

The Continuous assessment occurs on a regular and continuous basis, it is an ongoing formative and summative process, involving the monitoring of students. This assessment is inherently integrated with teaching and involves of series of process like systematic collection of marks or grades that gradually flow into the final score. The assessment marks or grades collected through various stages of the semester eventually contribute to the final grade of the students.

The continuous Assessment process tests the students on various grounds and aspects such as:

- Continuous Internal Assessment – I
- Continuous Internal Assessment – II
- Continuous Internal Assessment – III
- Attendance
- Class Participation or seminars
- Assignments

The student is subjected to three internal assessment written exams in a semester. The student's regular class attendance proves to be an important factor in the evaluation of the student's credentials. The assessment also takes cognizance of the student's active participation in the class room discussions in the form of seminars and group discussions. The prompt submission of home assignments is monitored for assessing the student's final evaluation of their credentials. The overall marks secured in the Continuous Assessment Process contributes for 25% of the total marks secured in the end-semester examinations.

11. Keywords:

Learning Outcome, Graduate Descriptor, Qualification Descriptor, Skill Enhancement, Core Compulsory Courses, Discipline Specific Elective, Continuous Assessment, Assessment methods, CO, PSO, Teaching-Learning process.