MADURAI KAMARAJ UNIVERSITY
B.Sc COMPUTER SCIENCE

Further clarification in the UG curriculum 2023 - 2024

In view of representation from various colleges, with regard to SEC1 (NME) in First year, it is clarified that as it is SEC course, it may either taken as NME if a college opts with the support of other departments or it may handle in the respective department itself. SEC may be converted to NAAN MUTHALVAN courses if need arises.

B.Sc. Computer Science Curriculum

First Year

Semester-I

Part	List of Courses	Credit	Hours per week (L/T/P)	Internal Marks	External Marks
Part-I	Language – Tamil	3	6	25	75
Part-II	English	3	6	25	75
Part-III	CC1 - Programming in C	5	5	25	75
	CC2 - Practical : Programming in C Lab	5	5	25	75
	Elective Course 1 -Discrete Mathematics – I – EC1(Annexure I) (Generic / Discipline Specific)	3	4	25	75
Part-IV	Skill Enhancement Course/***Nan Muthalvan Course***- SEC-1 - Fundamentals of Information Technology (Annexure II) -(Non Major Elective)	2	2	25	75
	Foundation Course FC - Problem Solving Techniques	2	2	25	75
		23	**30**		

Semester-II

Part	List of Courses	Credit	Hours per week(L/T/P)	Internal Marks	External Marks
Part-I	Language –Tamil	3	6	25	75
Part-II	English	3	6	25	75
Part-III	CC3 - Data Structures and Algorithms	5	5	25	75
	CC4 - Practical: Data Structures and Algorithms Lab(C++)	5	5	25	75

	Elective Course 2 - Numerical Methods – EC2(Annexure I) (Generic / Discipline Specific)	3	4	25	75
Part-IV	Skill Enhancement Course- /***Nan Muthalvan Course*** SEC-2 - Office Automation(Annexure II) -(Non Major Elective)	2	2	25	75
	Skill Enhancement Course / SEC-3 - Advanced Excel (Annexure II) - (Discipline Specific / Generic)	2	2	25	75
		23	**30**		

Second Year
Semester-III

Part	**List of Courses**	**Credit**	**Hours per week(L/T/P)**	**Internal Marks**	**External Marks**
Part-I	Language – Tamil	3	6	25	75
Part-II	English	3	6	25	75
Part-III	CC5- Python Programming	5	5	25	75
	CC6 - Practical : Python Programming Lab	5	5	25	75
	Elective Course 3 - Statistical Methods and its Application-I- EC3 (Annexure I) (Generic / Discipline Specific)	3	4	25	75
Part-IV	Skill Enhancement Course/***Nan Muthalvan Course*** -SEC-4 - Multimedia Systems (Annexure II) (Entrepreneurial Based)	1	1	25	75
	Skill Enhancement Course -SEC-5 - PHP Programming (Annexure II) (Discipline Specific/ Generic)	2	2	25	75
	Environmental Studies	-	1		
		22	**30**		

Semester-IV

Part	**List of Courses**	**Credit**	**Hours per week (L/T/P)**	**Internal Marks**	**External Marks**
Part-I	Language – Tamil	3	6	25	75

Part-II	English	3	6	25	75
Part-III	CC7 - Java Programming	5	5	25	75
	CC8 - Practical: Java Programming Lab	5	5	25	75
	Elective Course - EC4 - Resource Management Techniques/ Digital Logic Fundamentals (Annexure I) - (Generic / Discipline Specific)	3	3	25	75
Part-IV	Skill Enhancement Course – SEC-6 - Web Designing-(Annexure II)	2	2	25	75
	Skill Enhancement Course/***Nan Muthalvan Course*** - SEC-7 – Software Testing-(Annexure II)	2	2	25	75
	Environmental Studies	2	1	25	75
		25	**30**		

Third Year
Semester-V

Part	**List of Courses**	**Credit**	**Hours per week (L/T/P)**	**Internal Marks**	**External Marks**
Part-III	CC9 - Software Engineering	4	5	25	75
	CC10 - Database Management System	4	5	25	75
	CC11 - Practical: Database Management System Lab	4	5	25	75
	Elective Course – EC5-Operating Systems – (Annexure I) (Generic / Discipline Specific)	3	4	25	75
	Elective Course – EC6- Big Data Analytics – (Annexure I) (Generic / Discipline Specific)	3	4	25	75
	CC12 - Core /Project with Viva voce	4	5	25	75
Part-IV	Value Education	2	2	25	75
	Internship / Industrial Training (Summer vacation at the end of IV semester activity)	2	-		
		26	**30**		

Semester-VI

Part	**List of Courses**	**Credit**	**Hours per week (L/T/P)**	**Internal Marks**	**External Marks**
Part-III	CC13 - Computer Networks	4	6	25	75
	CC14 - .NET Programming	4	6	25	75
	CC15 - Practical: .NET Programming Lab	4	6	25	75
	Elective Course – EC7- Image Processing –	3	5	25	75

	(Annexure I) (Generic / Discipline Specific)				
	Elective Course – EC8- Artificial Intelligence – (Annexure I) (Generic / Discipline Specific)	3	5	25	75
Part-IV	Professional Competency Skill Enhancement Course/***Nan Muthalvan Course*** SEC8- Data Analytics using R Lab – (Annexure I)	2	2	25	75
Part -V	Extension Activity	1	-	-	-
		21	**30**		

Total Credits: 140

APPENDIX – BB

MADURAIKAMARAJUNIVERSITY

(University with Potential for Excellence)

B.Sc.ComputerScience (Semester)

CHOICE BASED CREDIT SYSTEMREVISEDSYLLABUS

(With effect from 2023-24)

SCHEME OF EXAMINATIONS, REGULATIONS AND SYLLABUS

1. **Course objectives :**

- To prepare the students to manage the software components in a computer independently and to be a Programmer.
- To motivate the students to take up higher studies in Computer Scienceandotherstreams.

2. **Eligibility for Admission:**

A candidate should have studied +2 level Mathematics as one of the subjects in the 10 +2 stream.

3. **Duration of the Course:**

The students shall undergo the prescribed course of study for a period of notlessthan three academic years(Six semesters).

4. **Medium of Instruction:**English.

5. **Eligibility for the Degree:**

- A Candidate shall be eligible for the award of the degree on completion of theprescribed course of study and passing all the prescribed externalexaminations.
- Attendance progress, internal examinations, conduct certificate from the Head of the Institution shall be required for taking the external examination.
- The passing minimum and the ranking are as per the existing rule of the Choice Based Credit System for the affiliated college of the University.

1. Introduction

B.Sc. Computer Science

Education is the key to development of any society. Role of higher education is crucial for securing right kind of employment and also to pursue further studies in best available world class institutes elsewhere within and outside India. Quality education in general and higher education in particular deserves high priority to enable the young and future generation of students to acquire skill, training and knowledge in order to enhance their thinking, creativity, comprehension and application abilities and prepare them to compete, succeed and excel globally. Learning Outcomes-based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome-oriented with well-defined aims, objectives and goals to achieve. LOCF also aims at ensuring uniform education standard and content delivery across the state which will help the students to ensure similar quality of education irrespective of the institute and location.

Computer Science is the study of quantity, structure, space and change, focusing on problem solving, application development with wider scope of application in science, engineering, technology, social sciences etc. throughout the world in last couple of decades and it has carved out a space for itself like any other disciplines of basic science and engineering. Computer science is a discipline that spans theory and practice and it requires thinking both in abstract terms and in concrete terms. Nowadays, practically everyone is a computer user, and many people are even computer programmers. Computer Science can be seen on a higher level, as a science of problem solving and problem solving requires precision, creativity, and careful reasoning. The ever-evolving discipline of computer science also has strong connections to other disciplines. Many problems in science, engineering, health care, business, and other areas can be solved effectively with computers, but finding a solution requires both computer science expertise and knowledge of the particular application domain. Computer science has a wide range of specialties. These include Computer Architecture, Software Systems, Graphics, Artificial Intelligence, Computational Science, and Software Engineering. Drawing from a common core of computer science knowledge, each specialty area focuses on specific challenges. Computer Science is practiced by mathematicians, scientists and engineers. Mathematics, the origins of Computer Science, provides reason and logic. Science provides the methodology for learning and refinement. Engineering provides the techniques for building hardware and software.

Programme Outcome, Programme Specific Outcome and Course Outcome

Computer Science is the study of quantity, structure, space and change, focusing on problem solving, application development with wider scope of application in science, engineering, technology, social sciences etc. The key core areas of study in Mathematics include Algebra, Analysis (Real & Complex), Differential Equations, Geometry, and Mechanics. The Students completing this programme will be able to present Software application clearly and precisely, make abstract ideas precise by formulating them in the Computer languages. Completion of this programme will also enable the learners to join teaching profession, enhance their employability for government jobs, jobs in software industry, banking, insurance and investment sectors, data analyst jobs and jobs in various other public and private enterprises.

2. Programme Outcomes (PO) of B.Sc. degree programme in Computer Science

- Scientific aptitude will be developed in Students
- Students will acquire basic Practical skills & Technical knowledge along with domain knowledge of different subjects in the Computer Science & humanities stream.
- Students will become employable; Students will be eligible for career opportunities in education field, Industry, or will be able to opt for entrepreneurship.
- Students will possess basic subject knowledge required for higher studies, professional and applied courses.
- Students will be aware of and able to develop solution oriented approach towards various Social and Environmental issues.
- Ability to acquire in-depth knowledge of several branches of Computer Science and aligned areas. This Programme helps learners in building a solid foundation for higher studies in Computer Science and applications.
- The skills and knowledge gained leads to proficiency in analytical reasoning, which can be utilized in modelling and solving real life problems.
- Utilize computer programming skills to solve theoretical and applied problems by critical understanding, analysis and synthesis.
- To recognize patterns and to identify essential and relevant aspects of problems.
- Ability to share ideas and insights while seeking and benefitting from knowledge and insight of others.
- Mould the students into responsible citizens in a rapidly changing interdependent society.

The above expectations generally can be pooled into 6 broad categories and can be modified according to institutional requirements:

PO1: Knowledge

PO2: Problem Analysis

PO3: Design / Development of Solutions

PO4: Conduct investigations of complex problems

PO5: Modern tool usage

PO6: Applying to society

3. Programme Specific Outcomes of B.Sc. Degree Programme in Computer Science

PSO1: Think in a critical and logical based manner

PSO2: Familiarize the students with suitable software tools of computer science and industrial applications to handle issues and solve problems in mathematics or statistics and realtime application related sciences.

PSO3: Know when there is a need for information, to be able to identify, locate, evaluate, and effectively use that information for the issue or problem at hand.

PSO4: Understand, formulate, develop programming model with logical approaches to a Address issues arising in social science, business and other contexts.

PSO5: Acquire good knowledge and understanding to solve specific theoretical and applied problems in advanced areas of Computer science and Industrial statistics.

PSO6: Provide students/learners sufficient knowledge and skills enabling them to undertake further studies in Computer Science or Applications or Information Technology and its allied areas on multiple disciplines linked with Computer Science.

PSO7: Equip with Computer science technical ability, problem solving skills, creative talent and power of communication necessary for various forms of employment.

PSO8: Develop a range of generic skills helpful in employment, internships& societal activities.

PSO9: Get adequate exposure to global and local concerns that provides platform for further exploration into multi-dimensional aspects of computing sciences.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs) can be carried out accordingly, assigning the appropriate level in the grids: (put tick mark in each row)

PO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
PO1	✓					
PO2		✓				

PO3			✓			
PO4				✓		
PO5					✓	
PO6						✓

4. Highlights of the Revamped Curriculum

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising mathematical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced mathematical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Computer Science based problem solving skills are included as mandatory components in the 'Training for Competitive Examinations' course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Industrial Statistics course is newly introduced in the fourth semester, to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the

latest – Statistics with R Programming, Data Science, Machine learing. Internet of Things and Artificial Intelligence etc..

5. Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Mathematics and simulating mathematical concepts to real world.	• Instil confidence among students • Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Training on Computing / Computational skills enable the students gain knowledge and exposure on latest computational aspects
		• Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc.
		• Entrepreneurial skill training will provide an opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Training to girls leads to women empowerment
		• Discipline centric skill will improve the Technical knowhow of solving real life problems using ICT tools
III, IV, V & VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	• Strengthening the domain knowledge • Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature • Students are exposed to Latest topics on Computer Science / IT, that require strong mathematical background • Emerging topics in higher education / industry / communication network / health sector etc. are

		introduced with hands-on-training, facilitates designing of mathematical models in the respective sectors
IV	Industrial Statistics	• Exposure to industry moulds students into solution providers • Generates Industry ready graduates • Employment opportunities enhanced
II year Vacation activity	Internship / Industrial Training	• Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational institutions, enable the students gain professional experience and also become responsible citizens.
V Semester	Project with Viva – voce	• Self-learning is enhanced • Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Introduction of Professional Competency component	• Curriculum design accommodates all category of learners; 'Mathematics for Advanced Explain' component will comprise of advanced topics in Mathematics and allied fields, for those in the peer group / aspiring researchers; • 'Training for Competitive Examinations' –caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: **For Advanced Learners / Honors degree**		• To cater to the needs of peer learners / research aspirants

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course – \CC IX	4	5	6.1 Core Course – CC XIII	4	6
Part.2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X	4	5	6.2 Core Course – CC XIV	4	6
1.3 Core Course – CC I	5	5	2..3 Core Course – CC III	5	5	3.3 Core Course – CC V	5	5	4.3 Core Course – CC VII Core Industry Module	5	5	5. 3.Core Course CC -XI	4	5	6.3 Core Course – CC XV	4	6
1.4 Core Course – CC II	5	5	2.4 Core Course – CC IV	5	5	3.4 Core Course – CC VI	5	5	4.4 Core Course – CC VIII	5	5	5. 4.Core Course –/ Project with viva-voce CC -XII	4	5	6.4 Elective - VII Generic/ Discipline Specific	3	5
1.5 Elective I Generic/ Discipline Specific	3	4	2.5 Elective II Generic/ Discipline Specific	3	4	3.5 Elective III Generic/ Discipline Specific	3	4	4.5 Elective IV Generic/ Discipline Specific	3	3	5.5 Elective V Generic/ Discipline Specific	3	4	6.5 Elective VIII Generic/ Discipline Specific	3	5
1.6 Skill Enhancement Course SEC-1	2	2	2.6 Skill Enhancement Course SEC-2	2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	1	4.6 Skill Enhancement Course SEC-6	2	2	5.6 Elective VI Generic/ Discipline Specific	3	4	6.6 Extension Activity	1	-
1.7 Skill Enhancement -(Foundation Course)	2	2	2.7 Skill Enhancement Course –SEC-3	2	2	3.7 Skill Enhancement Course SEC-5	2	2	4.7 Skill Enhancement Course SEC-7	2	2	5.7 Value Education	2	2	6.7 Professional Competency Skill	2	2
						3.8 E.V.S.	-	1	4.8 E.V.S	2	1	5.8 Summer Internship /Industrial Training	2				
	23	**30**		**23**	**30**		**22**	**30**		**25**	**30**		**26**	**30**		**21**	**30**
Total – 140 Credits																	

B.Sc Computer Science
Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credit and Hours Distribution System for all UG courses including Lab Hours

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses [in Total]	13	14
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-2	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
		23	**30**

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	-	1
		22	**30**

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	13
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2

	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
	E.V.S	2	1
		25	**30**

Third Year
Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based	22	26
Part-4	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	2
		26	**30**

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based & LAB	18	28
Part-4	Extension Activity	1	-
	Professional Competency Skill	2	2
		21	**30**

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	13	22	18	92
Part IV	4	4	3	6	4	1	22
Part V	-	-	-	-	-	2	2
Total	23	23	22	25	26	21	**140**

***Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V has to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

MethodsofEvaluation		
Internal Evaluation	ContinuousInternalAssessmentTest	25 Marks
	Assignments	
	Seminars	
	AttendanceandClassParticipation	
External Evaluation	EndSemesterExamination	75 Marks
	Total	100 Marks
MethodsofAssessment		
Recall(K1)	Simpledefinitions,MCQ,Recallsteps,Conceptdefinitions	
Understand/Comprehend(K2)	MCQ,True/False,Shortessays,Conceptexplanations,Shortsummaryor Overview	
Application (K3)	Suggestidea/conceptwithexamples,Suggestformulae, Solveproblems, Observe,Explain	
Analyze(K4)	Problem-solvingquestions,Finishaprocedureinmanysteps,Differentiate	
	betweenvariousideas,Mapknowledge	
Evaluate(K5)	Longer essay/Evaluationessay,Critiqueorjustifywithprosandcons	
Create(K6)	Checkknowledgeinspecificoroffbeatsituations,Discussion,Debatingor Presentations	

B.Sc. Computer Science Curriculum

First Year

Semester-I

Part	List of Courses	Credit	Hours per week (L/T/P)	Internal Marks	External Marks
Part-I	Language – Tamil	3	6	25	75
Part-II	English	3	6	25	75
Part-III	CC1 - Programming in C	5	5	25	75
	CC2 - Practical : Programming in C Lab	5	5	25	75
	Elective Course 1 -Discrete Mathematics – I – EC1(Annexure I) (Generic / Discipline Specific)	3	4	25	75
Part-IV	Skill Enhancement Course- SEC-1 - Fundamentals of Information Technology (Annexure II) -(Non Major Elective)	2	2	25	75
	Foundation Course FC - Problem Solving Techniques	2	2	25	75
		23	**30**		

Semester-II

Part	List of Courses	Credit	Hours per week(L/T/P)	Internal Marks	External Marks
Part-I	Language –Tamil	3	6	25	75
Part-II	English	3	6	25	75
Part-III	CC3 - Data Structures and Algorithms	5	5	25	75
	CC4 - Practical: Data Structures and Algorithms Lab(C++)	5	5	25	75
	Elective Course 2 - Numerical Methods – EC2(Annexure I) (Generic / Discipline Specific)	3	4	25	75
Part-IV	Skill Enhancement Course- SEC-2 - Office Automation(Annexure II) -(Non Major Elective)	2	2	25	75
	Skill Enhancement Course – SEC-3 - Advanced Excel (Annexure II) - (Discipline Specific / Generic)	2	2	25	75
		23	**30**		

Second Year
Semester-III

Part	List of Courses	Credit	Hours per week(L/T/P)	Internal Marks	External Marks
Part-I	Language – Tamil	3	6	25	75
Part-II	English	3	6	25	75
Part-III	CC5- Python Programming	5	5	25	75
	CC6 - Practical : Python Programming Lab	5	5	25	75
	Elective Course 3 - Statistical Methods and its Application-I- EC3 (Annexure I) (Generic / Discipline Specific)	3	4	25	75
Part-IV	Skill Enhancement Course -SEC-4 - Multimedia Systems (Annexure II) (Entrepreneurial Based)	1	1	25	75
	Skill Enhancement Course -SEC-5 - PHP Programming (Annexure II) (Discipline Specific/ Generic)	2	2	25	75
	Environmental Studies	-	1		
		22	**30**		

Semester-IV

Part	List of Courses	Credit	Hours per week (L/T/P)	Internal Marks	External Marks
Part-I	Language – Tamil	3	6	25	75
Part-II	English	3	6	25	75
Part-III	CC7 - Java Programming	5	5	25	75
	CC8 - Practical: Java Programming Lab	5	5	25	75
	Elective Course - EC4 - Resource Management Techniques/ Digital Logic Fundamentals (Annexure I) - (Generic / Discipline Specific)	3	3	25	75
Part-IV	Skill Enhancement Course – SEC-6 - Web Designing-(Annexure II)	2	2	25	75
	Skill Enhancement Course - SEC-7 – Software Testing-(Annexure II)	2	2	25	75
	Environmental Studies	2	1	25	75
		25	**30**		

Third Year
Semester-V

Part	List of Courses	Credit	Hours per week (L/T/P)	Internal Marks	External Marks
Part-III	CC9 - Software Engineering	4	5	25	75
	CC10 - Database Management System	4	5	25	75
	CC11 - Practical: Database Management System Lab	4	5	25	75
	Elective Course – EC5-Operating Systems – (Annexure I) (Generic / Discipline Specific)	3	4	25	75
	Elective Course – EC6- Big Data Analytics – (Annexure I) (Generic / Discipline Specific)	3	4	25	75
	CC12 - Core /Project with Viva voce	4	5	25	75
Part-IV	Value Education	2	2	25	75
	Internship / Industrial Training (Summer vacation at the end of IV semester activity)	2	-		
		26	**30**		

Semester-VI

Part	List of Courses	Credit	Hours per week (L/T/P)	Internal Marks	External Marks
Part-III	CC13 - Computer Networks	4	6	25	75
	CC14 - .NET Programming	4	6	25	75
	CC15 - Practical: .NET Programming Lab	4	6	25	75
	Elective Course – EC7- Image Processing – (Annexure I) (Generic / Discipline Specific)	3	5	25	75
	Elective Course – EC8- Artificial Intelligence – (Annexure I) (Generic / Discipline Specific)	3	5	25	75
Part-IV	Professional Competency Skill Enhancement Course SEC8- Data Analytics using R Lab – (Annexure I)	2	2	25	75
Part -V	Extension Activity	1	-	-	-
		21	**30**		

Total Credits: 140

Annexure I

Suggested topics in Core component

1. Programming in C
2. Programming in C Lab
3. Object oriented Programming using C++
4. Object oriented Programming using C++ Lab
5. Mobile Application Development
6. Mobile Application Development Lab
7. Data Analytics using R
8. Data Analytics using RLab
9. Machine Learning
10. Machine Learning Lab
11. Data Mining and Warehousing
12. Software Metrics
13. Network Security

Suggested topics in Elective Course

Generic Specific

1. Discrete Mathematics – I
2. Discrete Mathematics-II
3. Statistical Methods and its Application-I
4. Statistical Methods and its Application-II
5. Digital Logic Fundamentals
6. Numerical Methods
7. Optimization Techniques
8. Nano Technology
9. Introduction to Linear Algebra
10. Graph Theory and its Application
11. Resource Management Techniques and more

Elective course – (EC1- EC8)-Discipline Specific

1. Natural Language Processing
2. Analytics for Service Industry
3. Cryptography
4. RDBMS with PL/SQL
5. Big Data Analytics
6. IOT and its Applications
7. Software Project Management

8. Image Processing
9. Human Computer Interaction
10. Fuzzy Logic
11. Artificial Intelligence
12. Robotics and its Applications
13. Computational Intelligence
14. Cloud Computing
15. Artificial Neural Network
16. Introduction to Data Science
17. Agile Project Management
18. Virtual Reality
19. Operating systemand more

Annexure II

Suggested topics in Skill Enhancement (SEC1-SEC8) Course

Skill Enhancement Course

1. Fundamentals of Information Technology
2. Introduction to HTML
3. Web Designing
4. PHP Programming
5. Software Testing
6. Understanding Internet
7. Office Automation
8. Quantitative Aptitude
9. Multimedia Systems
10. Advanced Excel
11. Biometrics
12. Cyber Forensics
13. Pattern Recognition
14. Enterprise Resource Planning
15. Simulation and Modelling
16. Organization Behavior and more

FIRST SEMESTER

CORE PAPER

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC1	**PROGRAMMING IN C**	Core	5	-	-	-	4	5	25	75	100

Learning Objective	
LO1	To familiarize the students with the Programming basics and the fundamentals of C, Datatypes in C, Mathematical and logical operations.
LO2	To understand the concept using if statements and loops
LO3	This unit covers the concept of Arrays and Functions
LO4	This unit covers the concept of Structurs and unions and Preprocessors
LO5	To understand the concept of implementing pointers.

UNIT	Contents	No. of Hours
I	**Overview of C**: Importance of C, sample C program, C program structure, executing C program. Constants, Variables, and Data Types: Character set, C tokens, keywords and identifiers, constants, variables, data types, declaration of variables, Assigning values to variables---Assignment statement, declaring a variable as constant, as volatile. **Operators and Expression**: Arithmetic, Relational, logical, assignment, increment, decrement, conditional, bitwise and special operators, arithmetic expressions, operator precedence, type conversions, mathematical functions **Managing Input and Output Operators**: Reading and writing a character, formatted input, formatted output.	15
II	**Decision Making and Branching**: Decision making with If, simple IF, IF ELSE, nested IF ELSE , ELSE IF ladder, switch, GOTO statement. **Decision Making and Looping**: While, Do-While, For, Jumps in loops.	15

III	**Arrays**: Declaration and accessing of one & two-dimensional arrays, initializing two-dimensional arrays, multidimensional arrays. **Functions**: The form of C functions, Return values and types, calling a function, categories of functions, Nested functions, Recursion, functions with arrays, call by value, call by reference, storage classes-character arrays and string functions.	15
IV	**Structures and Unions**: Defining, giving values to members, initialization and comparison of structure variables, arrays of structure, arrays within structures, structures within structures, structures and functions, unions. **Preprocessors**: Macro substitution, file inclusion.	15
V	**Pointers:** definition, declaring and initializing pointers, accessing a variable through address and through pointer, pointer expressions, pointer increments and scale factor, pointers and arrays, pointers and functions, pointers and structures.	15
	Total	**75**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	Remember the program structure of C with its syntax and semantics	PO1,PO3,PO5
CO2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)	PO2,PO3,PO6
CO3	Apply the programming principles learnt in real-time problems	PO3,PO4,PO5
CO4	Analyze the various methods of solving a problem and choose the best method	PO4,PO5,PO6
CO5	Code, debug and test the programs with appropriate test cases	PO5,PO6

Text Book	
1	E. Balagurusamy, Programming in ANSI C, Fifth Edition, Tata McGraw-Hill, 2010.
Reference Books	
1.	Byron Gottfried, Schaum's Outline Programming with C, Fourth Edition, Tata

	McGraw-Hill, 2018.
2.	Kernighan and Ritchie, The C Programming Language, Second Edition, Prentice Hall, 1998
3.	YashavantKanetkar, Let Us C, Eighteenth Edition, BPB Publications,2021
Web Resources	
1.	https://codeforwin.org/
2.	https://www.geeksforgeeks.org/c-programming-language/
3.	http://en.cppreference.com/w/c
4.	http://learn-c.org/
5.	https://www.cprogramming.com/

Mapping with Programme Outcomes:

CO/PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO 1	3	3	3	3	3	3
CO 2	3	3	3	2	3	3
CO 3	2	3	2	3	3	2
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	3	2
Weight age of course contributed to each PSO	14	15	14	14	15	13

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC 2	**PROGRAMMING IN C LAB**	Core	-	-	4	-	4	4	25	75	100

Course Objective	
LO1	To familiarize the students with the Programming basics and the fundamentals of C, Datatypes in C, Mathematical and logical operations.
LO2	To understand the concept using if statements and loops
LO3	This unit covers the concept of Arrays and Functions
LO4	This unit covers the concept of Structurs and unions and Preprocessors
LO5	To understand the concept of implementing pointers and files

UNIT	**List of Excercises**	**No. of Hours**	**Course Objectives**
I	**Unit I : Variables, Data types, Constants and Operators** 1.Evaluation of expression ex: ((x+y) ^2 * (x+z))/w 2.Temperature conversion problem (Fahrenheit to Celsius) 3.Program to convert days to months and days (Ex: 364 days = 12 months and 4 days) 4.Solution of quadratic equation 5.Salesman salary (Given: Basic Salary, Bonus for every item sold, commission on the total monthly sales)	12	
II	**Unit II: Decision making Statements** 6.Maximum of three numbers 7.Calculate Square root of five numbers (using gototatement) 8.Pay-Bill Calculation for different levels of employee (Switch statement) 9. Fibonacci series 10.Floyds Triangle 11.Pascal's Triangle	12	

III	**Unit III: Arrays, Functions and Strings** 12.Prime numbers in an array 13.Sorting data (Ascending and Descending) 14.Matrix Addition and Subtraction 15.Matrix Multiplication 16.Function with no arguments and no return values 17.Function that convert lower case letters to upper case 18. Factorial using recursion. 19.Perform String Operations using Switch Case.	12
IV	**Unit IV : Structures and Macros** 20.Structure that describes a Hotel (name, address, grade, avg room rent, number of rooms) Perform some operations (list of hotels of a given grade etc.) 21. Using Pointers in Structures. 22.Cricket team details using Union. 23.Write a macro that calculates the max and min of two numbers 24.Nested macro to calculate Cube of a number.	12
V	**Unit V : Pointers and Files** 25.Evaluation of Pointer expressions 26.Function to exchange two pointer values 27.Creation, insertion and deletion in a linked list 28.Program to read a file and print the data. 29.Program to receive a file name and a line of text as command line arguments and write the text to the file 30. Program to copy the content of one file to another file.	12
	Total	**60**

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	Remember the program structure of C with its syntax and semantics	PO1,PO3,PO5
2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)	PO2,PO3,PO6
3	Apply the programming principles learnt in real-time problems	PO3,PO4
4	Analyze the various methods of solving a problem and choose the best method	PO4,PO5,PO6
5	Code, debug and test the programs with appropriate test cases	PO4,PO6
Text Book		
1	E. Balagurusamy, Programming in ANSI C, Fifth Edition, Tata McGraw-Hill, 2010.	
Reference Books		
1.	Byron Gottfried, Schaum's Outline Programming with C, Fourth Edition, Tata McGraw-Hill, 2018.	
2.	Kernighan and Ritchie, The C Programming Language, Second Edition, Prentice Hall, 1998	
3.	YashavantKanetkar, Let Us C, Eighteenth Edition, BPB Publications,2021	
Web Resources		
1.	https://codeforwin.org/	
2.	https://www.geeksforgeeks.org/c-programming-language/	
3.	http://en.cppreference.com/w/c	
4.	http://learn-c.org/	
5.	https://www.cprogramming.com/	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	2	3	3	3	3	3
CO 3	3	3	2	3	3	2
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	3	3
Weight age of course contributed to each PSO	14	15	14	15	15	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
FC	**Problem Solving Techniques**	FC	2	-	-	-	2	2	25	75	100

Learning Objectives	
LO1	Familiarize with writing of algorithms, fundamentals of C and philosophy of problem solving.
LO2	Implement different programming constructs and decomposition of problems into functions.
LO3	Use data flow diagram, Pseudo code to implement solutions.
LO4	Define and use of arrays with simple applications
LO5	Understand about operating system and their uses

UNIT	Contents	No. Of. Hours
I	**Introduction:** History, characteristics and limitations of Computer. Hardware/Anatomy of Computer: CPU, Memory, Secondary storage devices, Input Devices and Output devices. Types of Computers: PC, Workstation, Minicomputer, Main frame and Supercomputer. Software: System software and Application software. **Programming Languages:** Machine language, Assembly language, High-level language,4 GL and 5GL-Features of good programming language. Translators: Interpreters and Compilers.	**6**

II	**Data:** Data types, Input, Processing of data, Arithmetic Operators, Hierarchy of operations and Output. Different phases in Program Development Cycle (PDC).**Structured Programming: Algorithm:** Features of good algorithm, Benefits and drawbacks of algorithm. **Flowcharts:** Advantages and limitations of flowcharts, when to use flowcharts, flowchart symbols and types of flowcharts.**Pseudocode:** Writing a pseudocode. Coding, documenting and testing a program: Comment lines and types of errors. **Program design:** Modular Programming.	**6**
III	**Selection Structures:** Relational and Logical Operators - Selecting from Several Alternatives – Applications of Selection Structures. **Repetition Structures:** Counter Controlled Loops –Nested Loops– Applications of Repetition Structures.	**6**
IV	**Data:** Numeric Data and Character Based Data. **Arrays:** One Dimensional Array - Two Dimensional Arrays – Strings as Arrays of Characters.	**6**
V	**Data Flow Diagrams:** Definition, DFD symbols and types of DFDs. **Program Modules:** Subprograms-Value and Reference parameters- Scope of a variable - Functions – Recursion. **Files:** File Basics-Creating and reading a sequential file- Modifying Sequential Files.	**6**
	TOTAL HOURS	**30**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Study the basic knowledge of Computers. Analyze the programming languages.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Study the data types and arithmetic operations. Know about the algorithms. Develop program using flow chart and pseudocode.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Determine the various operators. Explain about the structures. Illustrate the concept of Loops	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Study about Numeric data and character-based data. Analyze about Arrays.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Explain about DFD Illustrate program modules. Creating and reading Files	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	**Stewart Venit,** "Introduction to Programming: Concepts and Design", Fourth Edition, 2010, Dream Tech Publishers.
Web Resources	
1.	https://www.codesansar.com/computer-basics/problem-solving-using-computer.htm
2.	http://www.nptel.iitm.ac.in/video.php?subjectId=106102067
3.	http://utubersity.com/?page_id=876

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	3	3	3	3
CO 3	3	2	3	3	3	3
CO 4	3	3	2	3	3	3
CO 5	3	3	3	3	3	2
Weightage of course contributed to each PSO	15	14	14	15	15	14

S-Strong-3 M-Medium-2 L-Low-1

Semester II

Title of the Course/ Paper	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC3	**DATA STRUCTURES AND ALGORITHMS**	Core	5	-	-	-	5	5	25	75	100
Learning Objectives											
LO1	To understand the concepts of ADTs										
LO2	To learn linear data structures-lists, stacks, queues										
LO3	To learn Tree structures and application of trees										
LO4	To learn graph strutures and and application of graphs										

LO5	To understand various sorting and searching	
UNIT	**Contents**	**No. of Hours**
I	Abstract Data Types (ADTs)- List ADT-array-based implementation-linked list implementationsingly linked lists-circular linked lists-doubly-linked lists-applications of lists-Polynomial Manipulation- All operations-Insertion-Deletion-Merge-Traversal	15
II	Stack ADT-Operations- Applications- Evaluating arithmetic expressions – Conversion of infix topostfix expression-Queue ADT-Operations-Circular Queue- Priority Queue- deQueueapplications of queues.	15
III	Tree ADT-tree traversals-Binary Tree ADT-expression trees-applications of trees-binary search tree ADT- Threaded Binary Trees-AVL Trees- B-Tree- B+ Tree – Heap-Applications of heap.	15
IV	Definition- Representation of Graph- Types of graph-Breadth first traversal – Depth first traversal-Topological sort- Bi-connectivity – Cut vertex- Euler circuits-Applications of graphs.	15
V	Searching- Linear search-Binary search-Sorting-Bubble sort-Selection sort-Insertion sort-Shell sort-Radix sort-Hashing-Hash functions-Separate chaining- Open Addressing-RehashingExtendible Hashing	15
	Total	**75**

Course Outcomes		**Programmeme Outcome**
CO	On completion of this course, students will	
CO1	Understand the concept of Dynamic memory management, data types, algorithms, Big O notation	PO1,PO6
CO2	Understand basic data structures such as arrays, linked lists, stacks and queues	PO2
CO3	Describe the hash function and concepts of collision and its resolution methods	PO2,PO4
CO4	Solve problem involving graphs, trees and heaps	PO4,PO6
CO5	Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data	PO5,PO6

Text Book	
1	1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson Education 2014, 4th Edition.
2	ReemaThareja, “Data Structures Using C”, Oxford Universities Press 2014, 2nd Edition
Reference Books	
1.	Thomas H.Cormen,ChalesE.Leiserson,RonaldL.Rivest, Clifford Stein, “Introduction to Algorithms”, McGraw Hill 2009, 3rd Edition.
2.	Aho, Hopcroft and Ullman, “Data Structures and Algorithms”, Pearson Education 2003
Web Resources	
1.	https://www.programiz.com/dsa
2.	https://www.geeksforgeeks.org/learn-data-structures-and-algorithms-dsa-tutorial/

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	1	3	3	3
CO 3	3	3	3	2	3	2
CO 4	3	2	3	2	3	3
CO 5	3	3	3	3	3	3
Weightage of course contributed to each PSO	15	14	13	13	15	14

S-Strong-3 M-Medium-2 L-Low-1

Title of the Course/ Paper	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC4	**DATA STRUCTURES AND ALGORITHMS LAB** [Note: Practicals may be offered through C / C++ / Python]	Core	-	-	5	-	5	5	25	75	100
Learning Objectives											
LO1	To understand the concepts of ADTs										
LO2	To learn linear data structures-lists, stacks, queues										
LO3	To learn Tree structures and application of trees										
LO4	To learn graph strutures and and application of graphs										
LO5	To understand various sorting and searching										
Sl. No	**Contents**										**No. of Hours**
1.	Write a program to implement the List ADT using arrays and linked lists.										

2.	Write a programs to implement the following using a singly linked list. • Stack ADT • Queue ADT	**75**
3.	Write a program that reads an infix expression, converts the expression to postfix form and then evaluates the postfix expression (use stack ADT).	
4.	Write a program to implement priority queue ADT.	
5.	Write a program to perform the following operations: • Insert an element into a binary search tree. • Delete an element from a binary search tree. • Search for a key element in a binary search tree.	
6.	Write a program to perform the following operations • Insertion into an AVL-tree • Deletion from an AVL-tree	
7.	Write a programs for the implementation of BFS and DFS for a given graph.	
8	Write a programs for implementing the following searching methods: • Linear search • Binary search.	
9.	Write a programs for implementing the following sorting methods: • Bubble sort • Selection sort • Insertion sort • Radix sort.	
	Total	**75**

Course Outcomes		**Programmem Outcome**
CO	On completion of this course, students will	
1	Understand the concept of Dynamic memory management, data types, algorithms, Big O notation	PO1,PO4,PO5
2	Understand basic data structures such as arrays, linked lists, stacks and queues	PO1, PO4,PO6
3	Describe the hash function and concepts of collision and	PO1,PO3,PO6

	its resolution methods	
4	Solve problem involving graphs, trees and heaps	PO3,PO4
5	Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data	PO1,PO5,PO6
Text Book		
1	Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education 2014, 4th Edition.	
2	ReemaThareja, "Data Structures Using C", Oxford Universities Press 2014, 2nd Edition	
Reference Books		
1	Thomas H.Cormen,ChalesE.Leiserson,RonaldL.Rivest, Clifford Stein, "Introduction to Algorithms", McGraw Hill 2009, 3rd Edition	
2.	Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education 2003	
Web Resources		
1.	https://www.programiz.com/dsa	
2.	https://www.geeksforgeeks.org/learn-data-structures-and-algorithms-dsa-tutorial/	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	1	3	2	3
CO 3	3	3	3	3	2	3
CO 4	3	3	3	3	2	3
CO 5	3	2	3	3	3	3
Weightage of course contributed to each PSO	15	15	13	15	13	15

S-Strong-3 M-Medium-2 L-Low-1

SECOND YEAR

SEMESTER III

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
CC5	Python programming	**Core**	5	-	-	-	5	25	75	100
Learning Objectives										
LO1	To make students understand the concepts of Python programming.									

LO2	To apply the OOPs concept in PYTHON programming.	
LO3	To impart knowledge on demand and supply concepts	
LO4	To make the students learn best practices in PYTHON programming	
LO5	To know the costs and profit maximization	
UNIT	**Contents**	**No. of Hours**
I	**Basics of Python Programming:** History of Python-Features of Python-Literal-Constants-Variables - Identifiers–Keywords-Built-in Data Types-Output Statements – Input Statements-Comments – Indentation- Operators-Expressions-Type conversions. **Python Arrays:** Defining and Processing Arrays – Array methods.	**15**
II	**Control Statements:** Selection/Conditional Branching statements: if, if-else, nested if and if-elif-else statements. Iterative Statements: while loop, for loop, else suite in loop and nested loops. **Jump Statements:** break, continue and pass statements**.**	**15**
III	**Functions:** Function Definition – Function Call – Variable Scope and its Lifetime-Return Statement. **Function Arguments**: Required Arguments, Keyword Arguments, Default Arguments and Variable Length Arguments- Recursion. **Python Strings:** String operations- Immutable Strings - Built-in String Methods and Functions - String Comparison.**Modules**: import statement- The Python module – dir() function – Modules and Namespace – Defining our own modules.	**15**
IV	**Lists:** Creating a list -Access values in List-Updating values in Lists-Nested lists -Basic list operations-List Methods. Tuples: Creating, Accessing, Updating and Deleting Elements in a tuple – Nested tuples– Difference between lists and tuples. **Dictionaries:** Creating, Accessing, Updating and Deleting Elements in a Dictionary – Dictionary Functions and Methods - Difference between Lists and Dictionaries.	**15**
V	**Python File Handling:** Types of files in Python - Opening and Closing files-Reading and Writing files: write() and writelines() methods- append() method – read() and readlines() methods – with keyword – Splitting words – File methods - File Positions- Renaming and deleting files.	**15**
	TOTAL HOURS	**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Learn the basics of python, Do simple programs on python, Learn how to use an array.	PO1, PO2, PO3,

		PO4, PO5, PO6
CO2	Develop program using selection statement, Work with Looping and jump statements, Do programs on Loops and jump statements.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Concept of function, function arguments, Implementing the concept strings in various application, Significance of Modules, Work with functions, Strings and modules.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Work with List, tuples and dictionary, Write program using list, tuples and dictionary.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Usage of File handlings in python, Concept of reading and writing files, Do programs using files.	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	ReemaThareja, "Python Programming using problem solving approach", First Edition, 2017, Oxford University Press.
2	Dr. R. NageswaraRao, "Core Python Programming", First Edition, 2017, Dream tech Publishers.

Reference Books

1.	VamsiKurama, "Python Programming: A Modern Approach", Pearson Education.
2.	Mark Lutz, "Learning Python", Orielly.
3.	Adam Stewarts, "Python Programming", Online.
4.	Fabio Nelli, "Python Data Analytics", APress.
5.	Kenneth A. Lambert, "Fundamentals of Python – First Programs", CENGAGE Publication.

Web Resources

1.	https://www.programiz.com/python-programming
2.	https://www.guru99.com/python-tutorials.html
3.	https://www.w3schools.com/python/python_intro.asp
4.	https://www.geeksforgeeks.org/python-programming-language/
5.	https://en.wikipedia.org/wiki/Python_(programming_language)

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	3	3	2	3
CO 3	3	3	3	3	2	2
CO 4	3	3	3	3	2	3

CO 5	3	2	3	3	3	3
Weightage of course contributed to each PSO	15	14	15	15	13	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
CC6	**Python Programming Lab**	**Core**	-	-	5	-	5	25	75	100

Learning Objectives

LO1	Be able to design and program Python applications.
LO2	Be able to create loops and decision statements in Python.
LO3	Be able to work with functions and pass arguments in Python.
LO4	Be able to build and package Python modules for reusability.
LO5	Be able to read and write files in Python.

LAB EXERCISES	**Required Hours**
1. Program using variables, constants, I/O statements in Python. 2. Program using Operators in Python. 3. Program using Conditional Statements. 4. Program using Loops. 5. Program using Jump Statements. 6. Program using Functions. 7. Program using Recursion. 8. Program using Arrays. 9. Program using Strings. 10. Program using Modules. 11. Program using Lists. 12. Program using Tuples. 13. Program using Dictionaries. 14. Program for File Handling.	**75**

Course Outcomes

On completion of this course, students will

CO1	Demonstrate the understanding of syntax and semantics of PYTHON language
CO2	Identify the problem and solve using PYTHON programming techniques.
CO3	Identify suitable programming constructs for problem solving.
CO4	Analyze various concepts of PYTHON language to solve the problem in an efficient way.
CO5	Develop a PYTHON program for a given problem and test for its correctness.

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	1	3	2	3
CO 3	3	3	3	3	2	2
CO 4	3	3	3	3	2	3
CO 5	3	2	3	3	3	3
Weightage of course contributed to each PSO	15	15	13	15	13	14

S-Strong-3 M-Medium-2 L-Low-1

SEMESTER IV

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	Ext	Total
CC7	**Java Programming**	Core	5	-	-	-	5	5	25	75	100

Learning Objectives	
LO1	To provide fundamental knowledge of object-oriented programming
LO2	To equip the student with programming knowledge in Core Java from the basics up.
LO3	To enable the students to use AWT controls, Event Handling and Swing for GUI.
LO4	To provide fundamental knowledge of object-oriented programming.

LO5	To equip the student with programming knowledge in Core Java from the basics up.	
UNIT	**Contents**	**No. of Hours**
I	**Introduction:**ReviewofObjectOrientedconcepts - HistoryofJava - Javabuzzwords - JVMarchitecture - Datatypes - Variables - Scope and life timeofvariables - arrays - operators - controlstatements - type conversion and casting - simple java program - constructors - methods - Static block - Static Data - StaticMethodStringandStringBufferClasses.	15
II	**Inheritance**: Basic concepts - Types of inheritance - Member access rules - Usage of this and Super key word - Method Overloading - Method overriding - Abstract classes - Dynamic method dispatch - Usage of final keyword. **Packages**:Definition-AccessProtection - ImportingPackages. **Interfaces**:Definition–Implementation–Extending Interfaces. **Exception Handling**: *try – catch- throw - throws – finally* – Built-inexceptions - Creating own Exception classes.	15
III	**Multithreaded Programming**: Thread Class - Runnable interface –Synchronization–Using synchronizedmethods– Using synchronized statement-InterthreadCommunication –Deadlock. **I/O Streams:** Concepts of streams - Stream classes- Byte and Character stream - Reading console Input and Writing Console output - File Handling.	15
IV	**AWT Controls:** The AWT class hierarchy - user interface components- Labels - Button - Text Components - Check Box - Check Box Group - Choice - List Box - Panels – Scroll Pane - Menu - Scroll Bar. Working with Frame class - Colour - Fonts and layout managers. **Event Handling:** Events - Event sources - Event	15

	Listeners - Event Delegation Model (EDM) - Handling Mouse and Keyboard Events - Adapter classes - Inner classes	
V	**Swing:** Introduction to Swing - Hierarchy of swing components. Containers - Top level containers - JFrame - JWindow - JDialog - JPanel - JButton - JToggleButton - JCheckBox - JRadioButton - JLabel,JTextField - JTextArea - JList - JComboBox - JScrollPane.	15
	Total	**75**
Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the basic Object-oriented concepts.Implement the basic constructs of Core Java.	PO1, PO2, PO6
CO2	Implement inheritance, packages, interfaces and exception handling of Core Java.	PO2, PO3, PO8
CO3	Implement multi-threading and I/O Streams of Core Java	PO1, PO3, PO5
CO4	Implement AWT and Event handling.	PO2, PO6
CO5	Use Swing to create GUI.	PO1, PO3, PO6
Text Books:		
1.	Herbert Schildt, The Complete Reference, Tata McGraw Hill, New Delhi, 7th Edition, 2010	
2.	Gary Cornell, *Core Java 2 Volume I – Fundamentals,* Addison Wesley, 1999	
References :		
1.	Head First Java, O'Rielly Publications,	
2.	Y. Daniel Liang, *Introduction to Java Programming*, 7th Edition, Pearson Education India, 2010	
Web Resources		
1.	https://javabeginnerstutorial.com/core-java-tutorial	

2.	http://docs.oracle.com/javase/tutorial/
3.	https://www.coursera.org/

Mapping with Programme Outcomes:

S-Strong-3 M-Medium-2 L-Low-1

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**3**	**3**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**3**
CO3	**2**	**2**	**1**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**1**
Weightage of course contributed to each PSO	**14**	**14**	**13**	**14**	**14**	**11**

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC8	**Java Programming Lab**	Core	-	-	5	-	5	5	25	75	100

Learning Objectives	
LO1	To provide fundamental knowledge of object-oriented programming.
LO2	To equip the student with programming knowledge in Core Java from the basics up.
LO3	To enable the students to know about Event Handling .
LO4	To enable the students to use String Concepts.
LO5	To equip the student with programming knowledge in to creat GUI using AWT

	controls.
EXCERCISE	**Details**
1	Write a Java program that prompts the user for an integer and then prints out all the prime numbers up to that Integer
2	Write a Java program to multiply two given matrices.
3	Write a Java program that displays the number of characters, lines and words in a text
4	Generate random numbers between two given limits using Random class and print messages according to the range of the value generated.
5	Write a program to do String Manipulation using CharacterArray and perform the following string operations: a. String length b. Finding a character at a particular position c. Concatenating two strings
6	Write a program to perform the following string operations using String class: a. String Concatenation b. Search a substring c. To extract substring from given string
7	Write a program to perform string operations using String Buffer class: a. Length of a string b. Reverse a string c. Delete a substring from the given string
8	Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.

9	Write a threading program which uses the same method asynchronously to print the numbers 1to10 using Thread1 and to print 90 to100 using Thread2.	75
10	Write a program to demonstrate the use of following exceptions. a. Arithmetic Exception b. Number Format Exception c. ArrayIndexOutofBoundException d. NegativeArraySizeException	
11	Write a Java program that reads on file name from the user, then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes	
12	Write a program to accept a text and change its size and font. Include bold italic options. Use frames and controls.	
13	Write a Java program that handles all mouse events and shows the event name at the center of the window when a mouse event is fired. (Use adapter classes).	
14	Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero.	
15	Write a Java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green with radio buttons. On selecting a button, an appropriate message with “stop” or “ready” or “go” should appear above the buttons in a selected color. Initially there is no message shown.	
	Total	**75**

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	Understand the basic Object-oriented concepts.Implement the basic constructs of Core Java.	PO1
2	Implement inheritance, packages, interfaces and exception handling of Core Java.	PO1, PO2
3	Implement multi-threading and I/O Streams of Core Java	PO4, PO6
4	Implement AWT and Event handling.	PO4, PO5, PO6
5	Use Swing to create GUI.	PO3, PO6
Text Book		
1	Herbert Schildt, The Complete Reference, Tata McGraw Hill, New Delhi, 7th Edition, 2010.	
2.	Gary Cornell, *Core Java 2 Volume I – Fundamentals*, Addison Wesley, 1999.	
Reference Books		
1.	Head First Java, O'Rielly Publications,	
2.	Y. Daniel Liang, *Introduction to Java Programming*, 7th Edition, Pearson Education India, 2010.	
Web Resources		
1.	https://www.w3schools.com/java/	
2.	http://java.sun.com	
3.	http://www.afu.com/javafaq.html	

Mapping with Programme Outcomes:

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**3**	**3**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**2**	**2**	**3**
CO3	**2**	**2**	**1**	**3**	**3**	**3**

CO4	**3**	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**2**
Weightage of course contributed to each PSO	**14**	**14**	**13**	**14**	**14**	**12**

S-Strong M-Medium L-Low

THIRD YEAR

SEMESTER V

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
CC9	**Software Engineering**	Core	5	-	-	-	4	5	25	75	100

Learning Objectives	
LO1	Gain basic knowledge of analysis and design of systems
LO2	Ability to apply software engineering principles and techniques
LO3	Model a reliable and cost-effective software system
LO4	Ability to design an effective model of the system
LO5	Perform Testing at various levels and produce an efficient system.

UNIT	**Contents**	**No. of Hours**	**Course Objectives**
I	**Introduction**: The software engineering discipline, programs vs. software products, why study software engineering, emergence of software engineering, Notable changes in software development practices, computer systems engineering. **Software Life Cycle Models**: Why use a life cycle model, Classical waterfall model, iterative waterfall	15	

	model, prototyping model, evolutionary model, spiral model, comparison of different life cycle models.	
II	**Requirements Analysis and Specification:** Requirements gathering and analysis, Software requirements specification (SRS) **Software Design**: Good software design, cohesion and coupling, neat arrangement, software design approaches, object- oriented vs function-oriented design	15
III	**Function-Oriented Software Design:** Overview of SA/SD methodology, structured analysis, data flow diagrams (DFD's), structured design, detailed design.**User-Interface design:** Characteristics of a good interface; basic concepts; types of user interfaces; component based GUI development, a user interface methodology.	15
IV	**Coding and Testing:** Coding; code review; testing; testing in the large vs testing in the small; unit testing; black-box testing; white-box testing; debugging; program analysis tools; integration testing; system testing; some general issues associated with testing.**Software Reliability and Quality Management:** Software reliability; statistical testing; software quality; software quality management system; SEI capability maturity model; personal software process.	15
V	**Computer Aided Software Engineering:** CASE and its scope; CASE environment; CASE support in software life cycle; other characteristics of CASE tools; towards second generation CASE tool; architecture of a CASE environment. **Software Maintenance:** Characteristic of	15

	software maintenance; software reverse engineering; software maintenance process models; estimation of maintenance cost.	
	Total	**75**
Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Gain basic knowledge of analysis and design of systems	PO1
CO2	Ability to apply software engineering principles and techniques	PO1, PO2
CO3	Model a reliable and cost-effective software system	PO4, PO6
CO4	Ability to design an effective model of the system	PO4, PO5, PO6
CO5	Perform Testing at various levels and produce an efficient system.	PO3, PO6
Text Books		
1.	Rajib Mall, Fundamentals of Software Engineering, Fifth Edition, Prentice-Hall of India, 2018	
References Books		
1.	Richard Fairley, Software Engineering Concepts, Tata McGraw-Hill publishing company Ltd, Edition 1997	
2.	Roger S. Pressman, Software Engineering, Seventh Edition, McGraw-Hill.	
3.	James A. Senn, Analysis & Design of Information Systems, Second Edition, McGraw-Hill International Editions.	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	3	2	2	3
CO2	3	2	2	2	1	2
CO3	3	3	3	2	3	2
CO4	3	3	3	2	2	2
CO5	3	3	3	2	2	2
Weightage of course contribute d to each PO/PSO	15	13	14	10	10	11

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC10	Database Management System	Core	5	-	-	-	4	5	25	75	100
Learning Objectives											
LO1	To enable the students to learn the designing of data base systems, foundation on the relational model of data and normal forms.										
LO2	To understood the concepts of data base management system, design simple Database models										
LO3	To learn and understand to write queries using SQL, PL/SQL.										
LO4	To enable the students to learn the designing of data base systems, foundation on the relational model of data and normal forms.										
LO5	To understood the concepts of data base management system, design simple Database models										
UNIT	Contents							No. of Hours			

I	**Database Concepts:**Database Systems - Data vs Information - Introducing the database -File system - Problems with file system – Database systems. Data models - Importance - Basic Building Blocks - Business rules - Evolution of Data models - Degrees of Data Abstraction	15
II	**Design Concepts:** Relational database model - logical view of data-keys -Integrity rules - relational set operators - data dictionary and the system catalog - relationships -data redundancy revisited -indexes - codd's rules. Entity relationship model - ER diagram	15
III	**Normalization of Database Tables**: Database tables and Normalization – The Need for Normalization –The Normalization Process – Higher level Normal Form. **Introduction to SQL**: Data Definition Commands – Data Manipulation Commands – SELECT Queries – Additional Data Definition Commands – Additional SELECT Query Keywords – Joining Database Tables.	15
IV	**Advanced SQL**:Relational SET Operators: UNION – UNION ALL – INTERSECT - MINUS.SQL Join Operators: Cross Join – Natural Join – Join USING Clause – JOIN ON Clause – Outer Join.**Sub Queries and Correlated Queries**: WHERE – IN – HAVING – ANY and ALL – FROM. SQL Functions: Date and Time Function – Numeric Function – String Function – Conversion Function	15
V	**PL/SQL**:A Programming Language: History – Fundamentals – Block Structure – Comments – Data Types – Other Data Types – Variable Declaration –	15

	Assignment operation –Arithmetic operators.**Control Structures and Embedded SQL**: Control Structures – Nested Blocks – SQL in PL/SQL – Data Manipulation – Transaction Control statements. **PL/SQL Cursors and Exceptions**: Cursors – Implicit Cursors, Explicit Cursors and Attributes – Cursor FOR loops – SELECT…FOR UPDATE – WHERE CURRENT OF clause – Cursor with Parameters – Cursor Variables – Exceptions – Types of Exceptions.	
	Total	**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Understand the various basic concepts of Data Base System. Difference between file system and DBMS and compare various data models.	PO1
CO2	Define the integrity constraints. Understand the basic concepts of Relational Data Model, Entity-Relationship Model.	PO1, PO2
CO3	Design database schema considering normalization and relationships within database. Understand and construct database using Structured Query Language. Attain a good practical skill of managing and retrieving of data using Data Manipulation Language (DML)	PO4, PO6
CO4	Classify the different functions and various join operations and enhance the knowledge of handling multiple tables.	PO4, PO5, PO6
CO5	Learn to design Data base operations and implement using PL/SQL programs. Learn basics of PL/SQL and develop programs using Cursors, Exceptions	PO3, PO5

Text Book	
1	Coronel, Morris, Rob, "Database Systems, Design, Implementation and Management", Ninth Edition
2	Nilesh Shah, "Database Systems Using Oracle", 2nd edition, Pearson Education India, 2016

Reference Books	
1.	Abraham Silberschatz, Henry F.Korth and S.Sudarshan,"Database System Concepts", McGraw Hill International Publication ,VI Edition
2.	Shio Kumar Singh , "Database Systems ",Pearson publications ,II Edition
Web Resources	
1.	Web resources from NDL Library, E-content from open-source libraries

Mapping with Programme Outcomes:

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**1**	**2**	**1**	**2**
CO2	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**3**	**2**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**2**	**3**
CO5	**3**	**2**	**2**	**2**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**12**	**10**	**11**	**12**	**13**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC11	**Database Management System lab**	Core	-	-	5	-	4	5	25	75	100
Learning Objectives											
LO1	To enable the students to learn the designing of data base systems, foundation on the relational model of data and normal forms.										
LO2	To understood the concepts of data base management system, design simple Database models										

LO3	To learn and understand to write queries using SQL, PL/SQL.		
LO4	To enable the students to learn the designing of data base systems, foundation on the relational model of data and normal forms.		
LO5	To understood the concepts of data base management system, design simple Database models		
	List of Exercises:	**No. of Hours**	**Course Objective**
II	***I. SQL*** 1. DDLCOMMANDS 2. DMLCOMMANDS 3. TCLCOMMANDS ***II. PL/SQL*** 4. FIBONACCI SERIES 5. FACTORIAL 6. STRING REVERSE 7. SUM OF SERIES 8. TRIGGER ***III. CURSOR*** 9. STUDENT MARK ANALYSIS USING CURSOR ***IV. APPLICATION*** 10. LIBRARY MANAGEMENTSYSTEM 11. STUDENT MARK ANALYSIS		75
	Total		**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Understand the various basic concepts of Data Base System. Difference between file system and DBMS and compare various data models.	PO1

CO2	Define the integrity constraints. Understand the basic concepts of Relational Data Model, Entity-Relationship Model.	PO1, PO2
CO3	Design database schema considering normalization and relationships within database. Understand and construct database using Structured Query Language. Attain a good practical skill of managing and retrieving of data using Data Manipulation Language (DML)	PO4, PO6
CO4	Classify the different functions and various join operations and enhance the knowledge of handling multiple tables.	PO4, PO5, PO6
CO5	Learn to design Data base operations and implement using PL/SQL programs. Learn basics of PL/SQL and develop programs using Cursors, Exceptions	PO3, PO4
Text Book		
1	Coronel, Morris, Rob, "Database Systems, Design, Implementation and Management", Ninth Edition	
2	Nilesh Shah, "Database Systems Using Oracle", 2nd edition, Pearson Education India, 2016	
Reference Books		
1.	Abraham Silberschatz, Henry F.Korth and S.Sudarshan,"Database System Concepts", McGraw Hill International Publication ,VI Edition	
2.	Shio Kumar Singh , "Database Systems ",Pearson publications ,II Edition	
Web Resources		
1.	Web resources from NDL Library, E-content from open-source libraries	

Mapping with Programme Outcomes:

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**3**	**3**	**3**	**2**
CO2	**3**	**3**	**1**	**2**	**2**	**2**
CO3	**2**	**2**	**3**	**3**	**3**	**3**
CO4	**2**	**2**	**3**	**3**	**3**	**1**

CO5	**2**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributedto each PSO	**12**	**12**	**13**	**14**	**14**	**11**

S-Strong-3 M-Medium-2 L-Low-1

SEMESTER VI

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
CC13	**Computer Networks**	Core	6	-	-	-	4	6	25	75	100

Course Objective	
LO1	To learn the basic concepts of Data communication and Computer network
LO2	To learn about wireless Transmission
LO3	To learn about networking and data link layer.
LO4	To study about Network communication.
LO5	To learn the concept of Transport layer

UNIT	**Contents**	**No. of Hours**
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	18
II	Wireless Transmission - Communication Satellites – Telephone System: Structure, Local Loop, Trunks and Multiplexing and Switching. Data Link Layer: Design Issues – Error Detection and Correction.	18
III	Elementary Data Link Protocols - Sliding Window Protocols – Data Link Layer in the Internet - Medium Access Layer – Channel Allocation Problem – Multiple Access Protocols – Bluetooth.	18
IV	Network Layer - Design Issues - Routing Algorithms - Congestion Control Algorithms – IP Protocol – IP Addresses – Internet Control Protocols.	18
V	Transport Layer - Services - Connection Management - Addressing,	18

	Establishing and Releasing a Connection – Simple Transport Protocol – Internet Transporet Protocols (ITP) - Network Security: Cryptography	
	Total	**90**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	To Understand the basics of Computer Network architecture, OSI and TCP/IP reference models	PO1
CO2	To gain knowledge on Telephone systems using wireless network	PO1, PO2
CO3	To understand the concept of MAC	PO4, PO6
CO4	To analyze the characteristics of Routing and Congestion control algorithms	PO4, PO5, PO6
CO5	To understand network security and define various protocols such as FTP, HTTP, Telnet, DNS	PO3, PO4

Text Book	
1	A. S. Tanenbaum, "Computer Networks", 4th Edition, Prentice-Hall of India, 2008.
Reference Books	
1.	B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th Edition, 2017
2.	F. Halsall, "Data Communications, Computer Networks and Open Systems", Pearson Education, 2008
3.	D. Bertsekas and R. Gallagher, "Data Networks", 2nd Edition, PHI, 2008.
4.	Lamarca, "Communication Networks", Tata McGraw- Hill, 2002
Web Resources	
1.	https://en.wikipedia.org/wiki/Computer_network
2.	https://citationsy.com/styles/computer-networks

Mapping with Programme Outcomes:

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	**3**	**3**	**2**	**3**	**2**	**3**
CO2	**3**	**2**	**2**	**2**	**2**	**2**

CO3	**3**	**2**	**3**	**3**	**2**	**3**
CO4	**3**	**2**	**2**	**2**	**2**	**2**
CO5	**3**	**2**	**2**	**2**	**2**	**3**
Weightage of course contributed to each PSO	**15**	**11**	**11**	**12**	**10**	**13**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
CC14	**.Net Programming**	Core	6	-	-	-	4	6	25	75	100

Course Objective	
C1	To identify and understand the goals and objectives of the .NET framework and ASP.NET with C# language.
C2	To develop ASP.NET Web application using standardcontrols.
C3	To implement file handling operations.
C4	To handles SQL Server Database using ADO.NET.
C5	Understand the Grid view control and XML classes.

UNIT	**Contents**	**No. of Hours**
I	Overview of .NET framework: Common Language Runtime (CLR), Framework Class Library- C# Fundamentals: Primitive types and Variables – Operators - Conditional statements -Looping statements – Creating and using Objects – Arrays – Stringoperations.	18
II	Introduction to ASP.NET - IDE-Languages supported Components -Working with Web Forms – Web form standard controls: Properties and its events – HTML controls -List Controls: Properties and its events.	18

III	Rich Controls: Properties and its events – validation controls: Properties and its events– File Stream classes - File Modes – File Share – Reading and Writing to files – Creating, Moving, Copying and Deletingfiles – File uploading.	18
IV	ADO.NET Overview – Database Connections – Commands – Data Reader - Data Adapter - Data Sets - Data Controlsand its Properties – DataBinding	18
V	Grid View control: Deleting, editing, Sorting and Paging. XML classes – Web form to manipulate XML files - Website Security - Authentication - Authorization – Creating aWeb application.	18
	Total	**90**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
1	Develop working knowledge of C# programming constructs and the .NET Framework	PO1, PO2, PO6
2	To develop a software to solve real-world problems using ASP.NET	PO2, PO3, PO5
3	To Work On Various Controls Files	PO1, PO3, PO6
4	To create a web application using MicrosoftADO.NET.	PO2, PO6
5	To develop web applications using XML	PO1, PO3, PO6

Text Book

1	SvetlinNakov,VeselinKolev& Co, Fundamentals of Computer Programming with C#,Faber publication,2019.
2	Mathew, Mac Donald, The Complete Reference ASP.NET, Tata McGraw-Hill,2015.

Reference Books

1.	Herbert Schildt, The Complete Reference C#.NET, TataMcGraw-Hill,2017.
2.	Kogent Learning Solutions, C# 2012 Programming Covers .NET 4.5 Black Book,

	Dreamtechpres,2013.
3.	Anne Boehm, Joel Murach, Murach's C# 2015, Mike Murach& Associates Inc.2016.
4.	DenielleOtey, Michael Otey, ADO.NET: The Complete reference, McGrawHill,2008.
5.	Matthew MacDonald, Beginning ASP.NET 4 in C# 2010,APRESS,2010.
Web Resources	
1.	https://www.geeksforgeeks.org/introduction-to-net-framework/
2.	https://www.javatpoint.com/net-framework

Mapping with Programme Outcomes:

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**3**	**3**	**3**	**2**	**3**
CO2	**3**	**2**	**2**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**2**	**3**	**3**
CO4	**2**	**2**	**1**	**3**	**3**	**2**
CO5	**3**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**14**	**13**	**12**	**14**	**14**	**14**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC15	**.Net Programming LAB**	Core	-	-	6	-	4	6	25	75	100
Course Objective											
LO1	To develop ASP.NET Web application using standardcontrols.										
LO2	To create rich database applications usingADO.NET.										
LO3	To implement file handling operations.										
LO4	To implement XML classes.										

LO5	To utilize ASP.NET security features for authenticating the website	
Sl. No	**Programs**	**No. of Hours**
1.	Create an exposure of Web applications and tools	90
2.	Implement the Html Controls	
3.	Implement the Server Controls	
4.	Web application using Web controls.	
5.	Web application using List controls.	
6.	Web Page design using Rich control. Validate user input using Validation controls. Working with Fileconcepts.	
7.	Web application using Data Controls.	
8.	Data binding with Web controls	
9.	Data binding with Data Controls.	
10.	Database application to perform insert, update and delete operations.	
11.	Database application using Data Controls to perform insert, delete, edit, paging and sorting operation.	
12.	Implement the Xml classes.	
13.	Implement Authentication – Authorization.	
14.	Ticket reservation using ASP.NET controls.	
15.	Online examination using ASP.NET controls	
	Total	**90**
Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	To create web applications and implement various controls	PO1, PO2, PO4
CO2	Create web pages in Rich control.	PO3, PO5
CO3	Develop knowledge about file handling operations	PO1, PO4, PO5

CO4	An ability to design XML classes	PO2, PO4, PO6
CO5	To develop a software to solve real-world problems using ASP.NET	PO1,PO3, PO5, PO6
Text Book		
1	SvetlinNakov, VeselinKolev& Co, Fundamentals of Computer Programming with C#, Faber publication,2019.	
2	Mathew, Mac Donald, The Complete Reference ASP.NET, Tata McGraw-Hill,2015.	
Reference Books		
1.	Herbert Schildt, The Complete Reference C#.NET, TataMcGraw-Hill,2017.	
2.	Kogent Learning Solutions, C# 2012 Programming Covers .NET 4.5 Black Book, Dreamtech pres,2013.	
3.	Anne Boehm, Joel Murach, Murach's C# 2015, Mike Murach& Associates Inc.2016.	
4.	DenielleOtey, Michael Otey, ADO.NET: The Complete reference, McGrawHill,2008.	
5.	Matthew MacDonald, Beginning ASP.NET 4 in C# 2010, APRESS,2010.	
Web Resources		
1.	https://www.geeksforgeeks.org/introduction-to-net-framework/	
2.	https://www.javatpoint.com/net-framework	

Mapping with Programme Outcomes:

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**1**	**2**	**1**	**2**
CO2	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**3**	**2**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**2**	**3**
CO5	**3**	**2**	**2**	**2**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**12**	**10**	**11**	**12**	**13**

S-Strong-3 M-Medium-2 L-Low-1

Annexure I

Suggested topics in Core component

1. Programming in C
2. Programming in C Lab
3. Object oriented Programming using C++
4. Object oriented Programming using C++ Lab
5. Mobile Application Development
6. Mobile Application Development Lab
7. Data Analytics using R
8. Data Analytics using RLab
9. Machine Learning
10. Machine Learning Lab
11. Data Mining and Warehousing
12. Software Metrics
13. Network Security

Suggested topics in Core component

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC	**PROGRAMMING IN C**	Core	5	-	-	-	4	5	25	75	100
Learning Objective											
LO1	To familiarize the students with the Programming basics and the fundamentals of C, Datatypes in C, Mathematical and logical operations.										
LO2	To understand the concept using if statements and loops										
LO3	This unit covers the concept of Arrays and Functions										
LO4	This unit covers the concept of Structurs and unions and Preprocessors										
LO5	To understand the concept of implementing pointers.										
UNIT	**Contents**								**No. of Hours**		
I	**Overview of C**: Importance of C, sample C program, C program structure, executing C program. Constants, Variables, and Data Types: Character set, C tokens, keywords and identifiers, constants, variables, data types, declaration of variables, Assigning values to variables---								15		

	Assignment statement, declaring a variable as constant, as volatile. **Operators and Expression**: Arithmetic, Relational, logical, assignment, increment, decrement, conditional, bitwise and special operators, arithmetic expressions, operator precedence, type conversions, mathematical functions **Managing Input and Output Operators**: Reading and writing a character, formatted input, formatted output.	
II	**Decision Making and Branching**: Decision making with If, simple IF, IF ELSE, nested IF ELSE , ELSE IF ladder, switch, GOTO statement. **Decision Making and Looping**: While, Do-While, For, Jumps in loops.	15
III	**Arrays**: Declaration and accessing of one & two-dimensional arrays, initializing two-dimensional arrays, multidimensional arrays. **Functions**: The form of C functions, Return values and types, calling a function, categories of functions, Nested functions, Recursion, functions with arrays, call by value, call by reference, storage classes-character arrays and string functions.	15
IV	**Structures and Unions**: Defining, giving values to members, initialization and comparison of structure variables, arrays of structure, arrays within structures, structures within structures, structures and functions, unions. **Preprocessors**: Macro substitution, file inclusion.	15
V	**Pointers:** definition, declaring and initializing pointers, accessing a variable through address and through pointer, pointer expressions, pointer increments and scale factor, pointers and arrays, pointers and functions, pointers and structures.	15
	Total	**75**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	Remember the program structure of C with its syntax and semantics	PO1,PO3,PO5
CO2	Understand the programming principles in C (data types, operators, branching and looping, arrays,	PO2,PO3,PO6

	functions, structures, pointers and files)	
CO3	Apply the programming principles learnt in real-time problems	PO3,PO4,PO5
CO4	Analyze the various methods of solving a problem and choose the best method	PO4,PO5,PO6
CO5	Code, debug and test the programs with appropriate test cases	PO5,PO6
Text Book		
1	E. Balagurusamy, Programming in ANSI C, Fifth Edition, Tata McGraw-Hill, 2010.	
Reference Books		
1.	Byron Gottfried, Schaum's Outline Programming with C, Fourth Edition, Tata McGraw-Hill, 2018.	
2.	Kernighan and Ritchie, The C Programming Language, Second Edition, Prentice Hall, 1998	
3.	YashavantKanetkar, Let Us C, Eighteenth Edition, BPB Publications,2021	
Web Resources		
1.	https://codeforwin.org/	
2.	https://www.geeksforgeeks.org/c-programming-language/	
3.	http://en.cppreference.com/w/c	
4.	http://learn-c.org/	
5.	https://www.cprogramming.com/	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	3	2	3	3

CO 3	2	3	2	3	3	2
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	3	2
Weight age of course contributed to each PSO	14	15	14	14	15	13

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
CC	**PROGRAMMING IN C LAB**	Core	-	-	4	-	4	4	25	75	100

Course Objective			
LO1	To familiarize the students with the Programming basics and the fundamentals of C, Datatypes in C, Mathematical and logical operations.		
LO2	To understand the concept using if statements and loops		
LO3	This unit covers the concept of Arrays and Functions		
LO4	This unit covers the concept of Structurs and unions and Preprocessors		
LO5	To understand the concept of implementing pointers and files		
UNIT	**List of Excercises**	**No. of Hours**	**Course Objectives**
I	**Unit I : Variables, Data types, Constants and Operators** 1.Evaluation of expression ex: ((x+y) ^2 * (x+z))/w 2.Temperature conversion problem (Fahrenheit to Celsius) 3.Program to convert days to months and days (Ex: 364 days = 12 months and 4 days) 4.Solution of quadratic equation 5.Salesman salary (Given: Basic Salary, Bonus for every item sold, commission on the total monthly sales)	12	
II	**Unit II: Decision making Statements**	12	

	6.Maximum of three numbers 7.Calculate Square root of five numbers (using gototatement) 8.Pay-Bill Calculation for different levels of employee (Switch statement) 9. Fibonacci series 10.Floyds Triangle 11.Pascal's Triangle	
III	**Unit III: Arrays, Functions and Strings** 12.Prime numbers in an array 13.Sorting data (Ascending and Descending) 14.Matrix Addition and Subtraction 15.Matrix Multiplication 16.Function with no arguments and no return values 17.Function that convert lower case letters to upper case 18. Factorial using recursion. 19.Perform String Operations using Switch Case.	12
IV	**Unit IV : Structures and Macros** 20.Structure that describes a Hotel (name, address, grade, avg room rent, number of rooms) Perform some operations (list of hotels of a given grade etc.) 21. Using Pointers in Structures. 22.Cricket team details using Union. 23.Write a macro that calculates the max and min of two numbers 24.Nested macro to calculate Cube of a number.	12

V	**Unit V : Pointers and Files** 25.Evaluation of Pointer expressions 26.Function to exchange two pointer values 27.Creation, insertion and deletion in a linked list 28.Program to read a file and print the data. 29.Program to receive a file name and a line of text as command line arguments and write the text to the file 30. Program to copy the content of one file to another file.	12
	Total	**60**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
1	Remember the program structure of C with its syntax and semantics	PO1,PO3,PO5
2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)	PO2,PO3,PO6
3	Apply the programming principles learnt in real-time problems	PO3,PO4
4	Analyze the various methods of solving a problem and choose the best method	PO4,PO5,PO6
5	Code, debug and test the programs with appropriate test cases	PO4,PO6

Text Book	
1	E. Balagurusamy, Programming in ANSI C, Fifth Edition, Tata McGraw-Hill, 2010.

Reference Books	
1.	Byron Gottfried, Schaum's Outline Programming with C, Fourth Edition, Tata McGraw-Hill, 2018.
2.	Kernighan and Ritchie, The C Programming Language, Second Edition, Prentice Hall, 1998

3.	YashavantKanetkar, Let Us C, Eighteenth Edition, BPB Publications,2021
Web Resources	
1.	https://codeforwin.org/
2.	https://www.geeksforgeeks.org/c-programming-language/
3.	http://en.cppreference.com/w/c
4.	http://learn-c.org/
5.	https://www.cprogramming.com/

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	2	3	3	3	3	3
CO 3	3	3	2	3	3	2
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	3	3
Weight age of course contributed to each PSO	14	15	14	15	15	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC	**OBJECT ORIENTED PROGRAMMING USING C++**	Core	5	-	-	-	4	5	25	75	100
Learning Objective											
LO1	Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects										

LO2	Understand dynamic memory management techniques using pointers, constructors, destructors, etc	
LO3	Describe the concept of function overloading, operator overloading, virtual functions and polymorphism	
LO4	Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming	
LO5	Demonstrate the use of various OOPs concepts with the help of programs	
UNIT	**Contents**	**No. of Hours**
I	Introduction to C++ - key concepts of Object-Oriented Programming – Advantages – ObjectOriented Languages – I/O in C++ - C++ Declarations. Control Structures : - Decision Makingand Statements : If ..else, jump, goto, break, continue, Switch case statements - Loops in C++ :for, while, do - functions in C++ - inline functions – Function Overloading.	15
II	Classes and Objects: Declaring Objects – Defining Member Functions – Static Member variablesand functions – array of objects –friend functions – Overloading member functions – Bit fieldsand classes – Constructor and destructor with static members.	15
III	Operator Overloading: Overloading unary, binary operators – Overloading Friend functions –type conversion – Inheritance: Types of Inheritance – Single, Multilevel, Multiple, Hierarchal,Hybrid, Multi path inheritance – Virtual base Classes – Abstract Classes.	15
IV	Pointers – Declaration – Pointer to Class , Object – this pointer – Pointers to derived classes andBase classes – Arrays – Characteristics – array of classes – Memory models – new and deleteoperators – dynamic object – Binding, Polymorphism and Virtual Functions.	15
V	Files – File stream classes – file modes – Sequential Read / Write operations – Binary and ASCIIFiles – Random Access Operation – Templates – Exception Handling - String – Declaring andInitializing string objects – String Attributes – Miscellaneous functions.	15
	Total	**75**

Course Outcomes		**Programme Outcome**
CO	Upon completion of the course the students would be able to:	
1	Remember the program structure of C with its syntax and semantics	PO1,PO6

2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)	PO2
3	Apply the programming principles learnt in real-time problems	PO4 ,PO5
4	Analyze the various methods of solving a problem and choose the best method	PO6
5	Code, debug and test the programs with appropriate test cases	PO3,PO6
Text Book		
1	E. Balagurusamy, "Object-Oriented Programming with C++", TMH 2013, 7th Edition.	
Reference Books		
1.	Ashok N Kamthane, "Object-Oriented Programming with ANSI and Turbo C++", Pearson Education 2003.	
2.	Maria Litvin& Gray Litvin, "C++ for you", Vikas publication 2002.	
Web Resources		
1.	https://alison.com/course/introduction-to-c-plus-plus-programming	

Mapping with Programme Outcomes:

CO/PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO 1	3	3	3	3	3	3
CO 2	3	3	3	2	3	3
CO 3	3	2	2	2	3	2
CO 4	3	3	3	3	2	3
CO 5	3	2	3	2	3	3
Weight age of course contributed to each PSO	15	13	14	12	14	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC	**OBJECT ORIENTED PROGRAMMING USING C++LAB**	Core	-	-	4	-	4	4	25	75	100

Course Objective	
C1	Describe the procedural and object oriented paradigm with concepts of streams, classes, functions, data and objects
C2	Understand dynamic memory management techniques using pointers, constructors, destructors, etc
C3	Describe the concept of function overloading, operator overloading, virtual functions and polymorphism
C4	Classify inheritance with the understanding of early and late binding, usage of exception handling, generic programming
C5	Demonstrate the use of various OOPs concepts with the help of programs

S.No	**List of Excercises**	**No. of Hours**
1	Write a C++ program to demonstrate function overloading, Default Arguments and Inlinefunction.	60
2	Write a C++ program to demonstrate Class and Objects	
3	Write a C++ program to demonstrate the concept of Passing Objects to Functions	
4	Write a C++ program to demonstrate the Friend Functions.	
5	Write a C++ program to demonstrate the concept of Passing Objects to Functions	
6	Write a C++ program to demonstrate Constructor and Destructor	
7	Write a C++ program to demonstrate Unary Operator Overloading	

8	Write a C++ program to demonstrate Binary Operator Overloading	
9	Write a C++ program to demonstrate: • Single Inheritance • Multilevel Inheritance • Multiple Inheritance • Hierarchical Inheritance • Hybrid Inheritance	
10	Write a C++ program to demonstrate Virtual Functions.	
11	Write a C++ program to manipulate a Text File.	
12	Write a C++ program to perform Sequential I/O Operations on a file.	
13	Write a C++ program to find the Biggest Number using Command Line Arguments	
14	Write a C++ program to demonstrate Class Template	
15	Write a C++ program to demonstrate Function Template.	
16	Write a C++ program to demonstrate Exception Handling.	

Course Outcomes		**Programme Outcome**
CO	Upon completion of the course the students would be able to:	
1	Remember the program structure of C with its syntax and semantics	PO4,PO5
2	Understand the programming principles in C (data types, operators, branching and looping, arrays, functions, structures, pointers and files)	PO6
3	Apply the programming principles learnt in real-time problems	PO4 ,PO5
4	Analyze the various methods of solving a problem and choose the best method	PO6
5	Code, debug and test the programs with appropriate test cases	PO4,PO5

Text Book	
1	E. Balagurusamy, “Object-Oriented Programming with C++”, TMH 2013, 7th Edition.

Reference Books

1.	Ashok N Kamthane, “Object-Oriented Programming with ANSI and Turbo C++”, Pearson Education 2003.
2.	Maria Litvin& Gray Litvin, “C++ for you”, Vikas publication 2002.
Web Resources	
1.	https://alison.com/course/introduction-to-c-plus-plus-programming

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	2	3	3	2	3
CO 3	3	3	3	3	3	3
CO 4	3	2	2	3	3	3
CO 5	3	2	3	3	3	2
Weightage of course contributed to each PSO	15	12	14	15	14	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC	**MOBILE APPLICATION DEVELOPMENT**	**Core**	**5**	**-**	**-**	**-**	**4**	**5**	**25**	**75**	**100**

Course objectives	
LO1	To provide the students with the basics of Android Programming
LO2	To gain knowledge on Software Development tools for Mobile Applications
LO3	Development of software on mobile platform for Real Time use

Unit	Contents	No. of Hours

I	IntroductiontoAndroidOperatingSystem–ConfigurationofAndroidEnvironment-CreatetheFirstAndroid Application.Layout: Vertical, Vertical Scroll, horizontal, horizontal Scroll, Table Layout arrangement. **Designing User Interface:** Label Text - TextView – Password Text Box - Button –ImageButton– CheckBox– Image - RadioButton – Slider – Autocomplete text View.	**15**
II	User Interface: Spinner–Switch – Side Bar-ListView - List Picker -Image Picker - Notifier-Time andDatePicker - Web Viewer	**15**
III	Media: Camcorder - Camera – Player – Speech Recognizer – Text to Speech – Video Player - Canvas	**15**
IV	Maps: Maps - Sensor: Location Sensor – Barcode Scanner Social components: Contact Picker – Email Picker – Phone Number Picker – Phone Call - Social: Texting	**15**
V	Storage: Cloud DB – Tiny DB – Experimental – Fire DB	**15**
TOTAL		**75**

CO	**Course Outcomes**
CO1	Charttherequirementsneededfordevelopingandroidapplication
CO2	Identify the results by executing the application in emulator or in android device
CO3	Applyproperinterfacesetup,styles&themes,storingandmanagement
CO4	Analyzetheproblemandaddnecessaryuserinterfacecomponents,graphicsandmultimediacomponentsintotheapplication.
CO5	Evaluate theresultsbyimplementing the conceptbehindtheproblemwithpropercode.

Textbooks

1	Karen Lang and Selim Tezel, (2022), Become an App Inventor The official guide from MIT App Inventor, Miteen Press, Walker Books Limited.

Reference Books

1	Wei – Meng Lee, (2012), Beginning Android 4 Application Development, Wiley India Edition.
2	Deital, Android for Programmers-An App-Driven Approach,Second Edition.

	NOTE: Latest Edition of Textbooks May be Used
Web Resources	
	http://ai2.appinventor.mit.edu/reference/
	http://appinventor.mit.edu/explore/paint-pot-extended-camera

MAPPING TABLE						
CO/PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**2**	**3**	**2**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**3**	**3**
CO5	**2**	**3**	**3**	**3**	**3**	**3**
Weightageofcoursecontributedtoeach PSO	**14**	**13**	**14**	**14**	**14**	**13**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
CC	**MOBILE APPLICATION DEVELOPMENT LAB**	**Core**	-	-	4	-	4	25	75	100

Learning Objectives:

LO1. To explain user defined functions and the concepts of class.
LO2. To demonstrate the creation cookies and sessions
LO3. To facilitate the creation of Database and validate the user inputs

Lab Exercises	Required Hours
1. Develop an application for Simple Counter. 2. Develop an application to display your personal details using GUI Components. 3. Develop a Simple Calculator that uses radio buttons and text view. 4. Develop an application that uses Intent and Activity. 5. Develop an application that uses Dialog Boxes. 6. Develop an application to display a Splash Screen. 7. Develop an application that uses Layout Managers. 8. Develop an application that uses different types of Menus. 9. Develop an application that uses to send messages from one mobile to another mobile. 10. Develop an application that uses to send E-mail. Develop an application that plays Audio and Video. 11. Develop an application that uses Local File Storage. 12. Develop an application for Simple Animation. 13. Develop an application for Login Page using Sqlite. 14. Develop an application for Student Marksheet processing using Sqlite.	**60**

Course Outcomes	
CO	On completion of this course, students will able to
CO1	Understand the concepts of counter and dialogs.
CO2	Concepts of Layout Managers. Perform sending email on audio and video To enable the applications of audio and video.
CO3	To apply Local File Storage and Development of files.
CO4	To determine the concepts of Simple Animation To apply searching pages.
CO5	Usage of Student mark sheet- preparation in MAD. Concepts of processing Sqlite are implemented.

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	2
CO 2	3	3	3	2	3	3
CO 3	3	3	3	2	3	3

CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	3	3
Weightage of course contributed to each PSO	15	15	15	13	15	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
CC	**Data analytics using R**	Core	5	-	-	-	4	5	25	75	100

Course Objective	
C1	To understand the problem solving approaches
C2	To learn the basic programming constructs in R Programming
C3	To learn the basic programming constructs in R Programming
C4	To use R Programming data structures - lists, tuples, and dictionaries.
C5	To do input/output with files in R Programming.

UNIT	**Contents**	**No. of Hours**
I	**Data Explosion and Big Data Analytics**: An Overview: Introduction, Evolution of Database Technology and Big Data, Elements of Big Data, Big Data System Components, Big Data Analytics – Data Analytics. Types of Big Data Analytics, Applications of Big Data Technology, Challenges and Skills required with Big Data Technology.	15
II	**Analytical Theory:** Introduction about Classification Algorithms, Regression Techniques, Domain Specific Analytic Techniques: In Database Analytics, Text Analytics. **Real – Time Analysis:** Introduction: Real-time System, Types of Real-time System, Characteristics of Real-time Systems, Real-time Processing Systems for Big Data: Introduction, Data Integration and Analytics,	15

	Big Data Engine-Hadoop, Real-time System Architecture, Real-time Data Analytics.	
III	**Big Data: Hardware, Technology Foundations**: Introduction, Big Data Stack, Virtualization and Big Data. **Understanding NoSQL and Hadoop Ecosystem**: Introduction, NoSQL: CouchDB, MongoDB, Hadoop Ecosystem – HDFS, HBase, Yarn.	15
IV	**High Dimensional Data: A Big Data Perspective:** Introduction – What is Dimensionality? Dimensionality Reduction: Approaches for Dimensionality Reduction, Dimensionality Reduction Techniques. **User Interface and Visualization:** Desirable Properties, Visualization Techniques. **R Programming Basics:** Introduction, Data Types, Data Structures and Operators – Basic Data Types in R, R Operators, Vectors, List, Factor, Arrays and Matrix, Data Frame, R Programming Structure – Control Statements of R: if, if-else, if-else ladder, Switch-Case, Return, Loops and Loop Control Statements.	15
V	Interfacing R - Interfacing R to other languages – Parallel R–Basic Statistic s– Linear Model– Generalized Linear models–Non-linear Models– Time Series and Auto-Correlation– Clustering.	15
	Total	**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
1	Work with big data tools and its analysis techniques.	PO1
2	Analyze data by utilizing clustering and classification algorithms.	PO1, PO3
3	Learn and apply different mining algorithms and recommendation systems for large volumes of data.	PO2, PO6

4	Perform analytics on data streams.	PO4, PO5, PO6
5	Learn NoSQL databases and management.	PO5, PO6
Text Book		
1	**1.** Big Data Analytics – Concepts, Techniques, Tools and Technologies – First Edition, Dr.M.Thangaraj,Dr. S. Suguna, G. Sudha, PHI Learning Private Limited, Delhi,2022. Unit I : Chapter 1 Unit II : Chapter 2.2.2, 2.2.4, 2.3.2, 2.3.2 Chapter 3 (3.1.1, 3.1.2, 3.2, 3.3.1 – 3.3.4, 3.4) Unit III : Chapter 4 (4.1 – 4.3) Chapter 5 (5.1, 5.2, 5.3.1 - 5.3.3) Unit IV : Chapter 6.1, 6.3 Chapter 7.3 Chapter 8 (8.1 – 8.3) Unit V : Chapter 8 (8.4 – 8.7)	
2	Norman Matloff,"The Art of R Programming- A Tour of Statistical Software Design", 2011	
Reference Books		
1.	1. Garrett Grolemund, Hadley Wickham,"Hands-On Programming with R: Write Your Own Functions and Simulations" , 1st Edition, 2014	
2.	Venables ,W.N.,andRipley,"S programming", Springer, 2000.	
Web Resources		
1.	https://www.simplilearn.com	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**2**	**3**	**2**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**3**	**3**

CO5	**2**	**3**	**3**	**3**	**3**	**3**
Weightageofcoursecontributedtoeach PSO	**14**	**13**	**14**	**14**	**14**	**13**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
SEC8	**Data analytics using R Lab**	**SEC**	-	-	4	-	4	4	25	75	100

Course Objective	
C1	To understand the problem solving approaches
C2	To learn the basic programming constructs in R Programming
C3	To practice various computing strategies for R Programming -based solutions to real world problems
C4	To use R Programming data structures - lists, tuples, and dictionaries.
C5	To do input/output with files in R Programming.

Sl. No	**Contents**	
1.	Program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.	
2.	Program, to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.	
3.	Write a program to find list of even numbers from 1 to n using R-Loops.	
4.	Create a function to print squares of numbers in sequence.	**60**
5.	Write a program to join columns and rows in a data frame using cbind()	

	and rbind() in R.	
6.	Implement different String Manipulation functions in R.	
7.	Implement different data structures in R (Vectors, Lists, Data Frames)	
8	Write a program to read a csv file and analyze the data in the file in R.	
9	Create pie chart and bar chart using R.	
10	10. Create a data set and do statistical analysis on the data using R.	
11	Program to find factorial of the given number using recursive function	
12	Write a R program to count the number of even and odd numbers from array of N numbers.	
	Total	**60**

Course Outcomes		**Programe Outcome**
CO	On completion of this course, students will	
1	Acquire programming skills in core R Programming	PO1,PO4,PO5
2	Acquire Object-oriented programming skills in R Programming.	PO1, PO4,PO6
3	Develop the skill of designing graphical-user interfaces (GUI) in R Programming	PO1,PO3,PO6
4	Acquire R Programming skills to move into specific branches	PO3,PO4
5		PO1,PO5,PO6

Text Book	
1	Roger D. Peng," R Programming for Data Science ", 2012
2	Norman Matloff,"The Art of R Programming- A Tour of Statistical Software Design", 2011
Reference Books	
1	Garrett Grolemund, Hadley Wickham,"Hands-On Programming with R: Write Your Own Functions and Simulations" , 1st Edition, 2014
2.	Venables ,W.N.,andRipley,"S programming", Springer, 2000.

Web Resources	
1.	https://www.simplilearn.com

Subject Code	Subject Name	Category	L	T	P	S	Credits	Instruction hour	Marks		
									CIA	External	Total
CC	**MACHINE LEARNING**	**Core**	5	-	-	-	4	5	25	75	100

Learning Objectives	
LO1	To Learn about Machine Intelligence and Machine Learning applications
LO2	To implement and apply machine learning algorithms to real-world applications
LO3	To identify and apply the appropriate machine learning technique to classification, pattern recognition, optimization and decision problems
LO4	To create instant based learning
LO5	To apply advanced learning

UNIT	**Contents**	**No. Of. Hours**
I	**Introduction Machine Learning** - Difference between AI, Machine Learning and Big data. Supervised and unsupervised learning, parametric vs non-parametric models, parametric models for classification and regression- Linear Regression, Logistic Regression, Naïve Bayes classifier, simple non-parametric classifier-K-nearest neighbour, support vector machines	**15**
II	**Neural networks and genetic algorithms** Neural Network Representation – Problems – Perceptrons – Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms – Hypothesis Space Search – Genetic Programming – Models of Evaluation and Learning.	**15**
III	**Bayesian and computational learning** Bayes Theorem – Concept Learning – Maximum Likelihood – Minimum Description Length Principle – Bayes Optimal Classifier – Gibbs Algorithm – Naïve Bayes Classifier – Bayesian Belief Network – EM Algorithm – Probability Learning – Sample Complexity – Finite and Infinite Hypothesis Spaces – Mistake Bound Model.	**15**
IV	**Instant based learning** K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.	**15**
V	**Advanced learning** Recommendation systems – opinion mining, sentiment analysis. Learning Sets of Rules – Sequential Covering Algorithm – Learning Rule Set – First Order Rules – Sets of First Order Rules – Induction on Inverted Deduction – Inverting Resolution – Analytical Learning – Perfect Domain Theories – Explanation Base Learning – FOCL Algorithm – Reinforcement Learning – Task – Q-	**15**

	Learning – Temporal Difference Learning.	
	TOTAL HOURS	**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Appreciate the importance of visualization in the data analytics solution	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Apply structured thinking to unstructured problems	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Understand a very broad collection of machine learning algorithms and problems	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Learn algorithmic topics of machine learning and mathematically deep enough to introduce the required theor	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Develop an appreciation for what is involved in learning from data.	PO1, PO2, PO3, PO4, PO5, PO6

1	Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2	Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning" 2015, MIT Press

Reference Books

1.		EthemAlpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
2		Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

Mapping with Programme Outcomes:

CO/PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO 1	3	3	3	3	3	3
CO 2	3	3	3	3	2	3
CO 3	3	3	3	3	3	3

CO 4	3	3	2	3	3	3
CO 5	3	3	3	3	3	2
Weightage of course contributed to each PSO	15	15	14	15	14	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Instruction Hours**	**Credits**	**Marks**		
									CIA	**External**	**Total**
CC	MACHINE LEARNING LAB	**Core**	-	-	4	-	4	4	25	75	100

Learning Objectives:

To apply the concepts of Machine Learning to solve real-world problems and to implement basic algorithms in clustering & classification applied to text & numeric data

LAB EXERCISES	Required Hours
1. Solving Regression & Classification using Decision Trees 2. Root Node Attribute Selection for Decision Trees using Information Gain 3. Bayesian Inference in Gene Expression Analysis 4. Pattern Recognition Application using Bayesian Inference 5. Bagging in Classification 6. Bagging, Boosting applications using Regression Trees 7. Data & Text Classification using Neural Networks 8. Using Weka tool for SVM classification for chosen domain application 9. Data & Text Clustering using K-means algorithm 10. Data & Text Clustering using Gaussian Mixture Models	**60**

Course Outcomes

CO	On completion of this course, students will
CO1	Effectively use the various machine learning tools
CO2	Understand and implement the procedures for machine learning algorithms
CO3	Design Python programs for various machine learning algorithms
CO4	Apply appropriate datasets to the Machine Learning algorithms
CO5	Analyze the graphical outcomes of learning algorithms with specific datasets

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	2
CO 2	3	3	3	2	3	3
CO 3	3	3	3	3	3	3
CO 4	2	3	3	3	3	3
CO 5	3	3	3	3	3	3
Weightage of course contributed to each PSO	14	15	15	14	15	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
CC	**Data mining and warehousing**	Core	5	-	-	-	4	5	25	75	100

Learning Objectives	
LO1	To provide the knowledge on Data Mining and Warehousing concepts and techniques
LO2	To study the basic concepts of Data Mining, Architecture and Comparison.
LO3	To study a set of Mining Association Rules, Data Warehouses.
LO4	To study about Classification and Prediction, Classifier Accuracy
LO5	To study the basic concepts of cluster analysis, Cluster Methods

UNIT	**Contents**	**No. of Hours**	**Course Objectives**

I	Introduction: Data mining – Functionalities – Classification – Introduction to Data Warehousing – Data Preprocessing: Preprocessing the Data – Data cleaning – Data Integration and Transformation – Data Reduction	15
II	Data Mining, Primitives, Languages and System Architecture: Data Mining – Primitives – Data Mining Query Language, Architecture of Data mining Systems. Concept Description, Characterization and Comparison: Concept Description, Data Generalization and Summarization, Analytical Characterization, Mining Class Comparison – Statistical Measures.	15
III	Mining Association Rules: Basic Concepts – Single Dimensional Boolean Association Rules From Transaction Databases, Multilevel Association Rules from transaction databases – Multi dimension Association Rules from Relational Database and Data Warehouses.	15
IV	Classification and Prediction: Introduction – Issues – Decision Tree Induction – Bayesian Classification – Classification of Back Propagation. Classification based on Concepts from Association Rule Mining – Other Methods. Prediction – Introduction – Classifier Accuracy	15
V	Cluster Analysis: Introduction – Types of Data in Cluster Analysis, Petitioning Methods – Hierarchical Methods-Density Based Methods – GRID Based Method – Model based Clustering Method	15
	Total	**75**

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	To understand the basic concepts and the functionality of the various data mining and data warehousing component	PO1, PO3, PO6, PO8
CO2	To know the concepts of Data mining system architectures	PO1,PO2,PO3,PO6
CO3	To analyze the principles of association rules	PO3, PO5

CO4	To get analytical idea on Classification and prediction methods	PO1, PO2, PO3, PO5
CO5	To Gain knowledge on Cluster analysis and its methods.	PO2, PO4, PO6
Text Books (Latest Editions)		
1.	Han and M. Kamber, "Data Mining Concepts and Techniques", 2001, Harcourt India Pvt. Ltd, New Delhi.	
References Books (Latest editions)		
1.	K.P. Soman, ShyamDiwakar, V. Ajay "Insight into Data Mining Theory and Practice ",Prentice Hall of India Pvt. Ltd, New Delhi	
2.	Parteek Bhatia, 'Data Mining and Data Warehousing: Principles and Practical Techniques', Cambridge University Press, 2019	
Web Resources		
1.	https://www.topcoder.com/thrive/articles/data-warehousing-and-data-mining#:~:text=Data%20warehousing%20is%20a%20method,compiled%20in%20the%20data%20warehouse.	
2.	https://www.javatpoint.com/data-mining-cluster-vs-data-warehousing	
3.	https://www.tutorialspoint.com/Data-Warehousing-and-Data-Mining	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**2**	**3**	**2**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**3**	**3**
CO5	**2**	**3**	**3**	**3**	**3**	**3**
Weightageofcoursecontributedtoeach PSO	**14**	**13**	**14**	**14**	**14**	**13**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC	**SOFTWARE METRICS**	**Core**	**-**	**5**	**-**	**-**	**4**	**5**	**25**	**75**	**100**

Learning Objectives	
LO1	Gain a solid understanding of what software metrics are and their significance
LO2	Learn how to identify and select appropriate software metrics based on project goals
LO3	Acquire knowledge and skills in collecting and measuring software metrics
LO4	Learn how to analyze and interpret software metrics data to extract valuable insights
LO5	Gain the ability to evaluate software quality using appropriate metrics

Unit	Contents	No. of Hours
I	**Fundamentals of Measurement: Need for** Measurement: Measurement in Software Engineering, Scope of Software Metrics, **The Basics of measurement**: The representational theory of measurement, Measurement and models, Measurement scales and scale types, meaningfulness in measurement	**15**
II	**A Goal-Based Framework For Software Measurement:** Classifying software measures, Determining what to Measure, Applying the framework, Software measurement validation, Performing SoftwareMeasurementValidation **Empirical investigation**: Principles of Empirical Studies, Planning Experiments, Planning case studies as quasi-experiments, Relevant and Meaningful Studies	**15**
III	**Software Metrics Data Collection:** Defining good data, Data collection for incident reports, How to collect data, Reliability of data collection Procedures **Analyzing software measurement data:** Statistical distributions and hypothesis testing, Classical data analysis techniques, Examples of simple analysis techniques	**15**
IV	**Measuring internal product attributes: Size** Properties of Software Size, Code size, Design size, Requirements analysis and Specification size, Functional size measures and estimators, Applications of size measures **Measuring internal product attributes: Structure:** Aspects of Structural Measures, Control flow structure of program units, Design-levelAttributes, Object-oriented	**15**

	Structural attributes and measures	
V	**Measuring External Product Attributes:** Modelling software quality, Measuring aspects of quality, Usability Measures, Maintainability measures,SecurityMeasures **Software Reliability: Measurement and Prediction:** Basics of reliability theory, The software reliability problem, Parametric reliability growth models, Predictive accuracy	**15**
TOTAL		**75**

CO	**Course Outcomes**
CO1	Understand various fundamentals of measurement and software metrics
CO2	Identify frame work and analysis techniques for software measurement
CO3	Apply internal and external attributes of software product for effort estimation
CO4	Use appropriate analytical techniques to interpret software metrics data and derive meaningful insights
CO5	Recommend reliability models for predicting software quality

Textbooks

1	Software Metrics A Rigorous and Practical Approach, Norman Fenton, James Bieman , Third Edition, 2014

Reference Books

1	Software metrics, Norman E, Fenton and Shari Lawrence Pfleeger, International Thomson Computer Press, 1997
2	Metric and models in software quality engineering, Stephen H.Kan, Second edition, 2002, Addison Wesley Professional
3	Practical Software Metrics for Project Management and Process Improvement, Robert B.Grady, 1992, Prentice Hall.

NOTE: Latest Edition of Textbooks May be Used

Web Resources

1.			https://lansa.com/blog/general/what-are-software-metrics-how-can-i-measure-these-metrics/
2.			https://stackify.com/track-software-metrics/

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	3	3	3	3
CO2	3	3	2	3	2	2
CO3	3	2	3	3	3	2
CO4	3	2	3	2	3	3
CO5	2	3	3	3	3	3
Weightageofcoursecontributedtoeach PSO	14	13	14	14	14	13

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
CC	Network Security	Core	5	-	-	-	4	5	25	75	100

Course Objectives	
CO1	To familiarize on the model of network security, Encryption techniques
CO2	To understand the concept of Number Theory , theorems
CO3	To understand the design concept of cryptography and authentication
CO4	To develop experiments on algorithm used for security
CO5	To understand about virus and threats, firewalls, and implementation of Cryptography

UNIT	Contents	No. of Hours
I	Model of network security – Security attacks, services and attacks – OSI security architecture – Classical encryption techniques – SDES – Block cipher PrinciplesDES – Strength of DES – Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – RC4 - Differential and	15

	linear cryptanalysis – Placement of encryption function – traffic confidentiality.	
II	Number Theory – Prime number – Modular arithmetic – Euclid's algorithm - Fermet's and Euler's theorem – Primality – Chinese remainder theorem – Discrete logarithm – Public key cryptography and RSA – Key distribution – Key management – Diffie Hellman key exchange – Elliptic curve cryptography	15
III	Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA - HMAC – CMAC - Digital signature and authentication protocols – DSS.	15
IV	Authentication applications – Kerberos – X.509 Authentication services - E- mail security – IP security - Web security	15
V	Intruder – Intrusion detection system – Virus and related threats – Countermeasures – Firewalls design principles – Trusted systems – Practical implementation of cryptography and security	15
	Total	**75**

Course Outcomes

Course Outcomes	On completion of this course, students will;	
CO1	Analyze and design classical encryption techniques and block ciphers.	PO1, PO3, PO6
CO2	Understand and analyze public-key cryptography, RSA and other public-key cryptosystems such as Diffie-Hellman Key Exchange, ElGamal Cryptosystem, etc	PO1,PO2,PO3,PO5
CO3	Understand key management and distribution schemes and design User Authentication	PO4, PO5
CO4	Analyze and design hash and MAC algorithms, and digital signatures.	PO1, PO2, PO3, PO6
CO5	Know about Intruders and Intruder Detection mechanisms, Types of Malicious software,	P02, PO6

Reference Text :	
1.	William Stallings, "Cryptography & Network Security", Pearson Education, Fourth Edition 2010.
References	
1.	CharlieKaufman,RadiaPerlman,MikeSpeciner,"NetworkSecurity,Privatecommunication inpublicworld",PHISecondEdition,2002
2.	Bruce Schneier, Neils Ferguson, "Practical Cryptography", Wiley Dreamtech India Pvt Ltd, First Edition, 2003.
3.	DouglasRSimson"Cryptography– Theoryandpractice",CRCPress,FirstEdition,1995
Web Resources	
1.	https://www.javatpoint.com/computer-network-security
2.	https://www.tutorialspoint.com/information_security_cyber_law/network_security.htm
3.	https://www.geeksforgeeks.org/network-security/

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**3**	**3**	**3**	**3**	**3**
CO2	**3**	**3**	**2**	**3**	**2**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**3**	**3**
CO5	**2**	**2**	**2**	**2**	**3**	**3**
Weightageofcoursecontributedtoeach PSO	**14**	**12**	**13**	**13**	**14**	**13**

S-Strong-3 M-Medium-2 L-Low-1

Annexure I

Suggested topics in Elective Course

Generic Specific

1. Discrete Mathematics – I
2. Discrete Mathematics-II
3. Statistical Methods and its Application-I
4. Statistical Methods and its Application-II
5. Digital Logic Fundamentals
6. Numerical Methods
7. Optimization Techniques
8. Nano Technology
9. Introduction to Linear Algebra
10. Graph Theory and its Application
11. Resource Management Techniques and more

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-GS	Discrete Mathematics – I	**Elect**	4	-	-		3	25	75	100
Learning Objectives										
LO1	To understand the mathematical concepts like set theory, logics, number theory, combinatory and relations.									
LO2	To Explain the Relations concepts and their properties									
LO3	To know the Applications of recurrence relations									
LO4	To understand the Graphs and Graphs models									
LO5	To explain the Matrices concepts									
UNIT	**Contents**									**No. Of. Hours**
I	***SET THEORY*** Introduction- set and Its Element – Set Description (Roster, Set									**12**

	Builder and cardinal number method) Types of Sets- Set Operations and Laws of set Theory. Partition of sets. Minsets- Countable and un Countable set. Algebra of sets andDuality	
II	***MATHEMATICAL LOGIC*** Basic Logic and Proof, logical operations – Logic Propositional equivalence, Predicates and Quantities, Tautology-Contradiction- Methods of proofs(Direct and Indirect)- Function- Definition- Notation- Types of Function- Composition of Functions-	**12**
III	***NUMBER THEORY*** The Integers and Division, Integers and Algorithms,(Multiplication, Addition and Division-Sequences and Summations, Recursive algorithms, Program correctness	**12**
IV	***COMBINATORICS*:** The basics of counting, the pigeonhole principle, Permutations and Combinations, Binomial coefficients, Generalized permutations and combinations	**12**
V	***RELATIONS*** Relations – Relations and their properties, Representing Relations, Closures of relations, Equivalence relations, Partial orderings- Recurrence Relations Binary Relations.	**12**

Total hours		**60**
Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	To understand the mathematical concepts like set theory, logics, number theory, combinatory and relations.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	To understand different mathematical logics and functions	PO1, PO2, PO3, PO4, PO5, PO6
CO3	To Understanding the different form of number theory	PO1, PO2, PO3, PO4, PO5, PO6

CO4	To gain knowledge on set theory	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Able to understand Relations and its applications	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Discrete Mathematics and its applications, Seventh Edition, Kenneth.H.Rosen, McGrawHill Publishing Company, 2012.	
2	Discrete Mathematics, M.Venkataraman, N.Sridharan and N.Chandrasekaran, The National Publishing Company, 2009. Unit I : Textbook 1 Chapter 1: Sections: 1.1, 1.2, 1.3, 1.4, 1.6 Unit II : Textbook 1 Chapter 9: Sections: 9.1, 9.3, 9.4, 9.5, 9.6 Unit III : Textbook 1 Chapter 6: Sections: 6.1, 6.2, 6.3 Chapter 8: Sections: 8.1, 8.2, 8.3 (Pages: 527 -529 only) (Exclude algorithms and relations, on page 507 and its related problems) Unit IV : Textbook 1 Chapter 10: Sections: 10.1, 10.2, 10.3, 10.4, 10.6) Unit V : Textbook 2 Chapter 6 :Sections :6.1 to 6.5, and 6.7)	
3.	J.K Sharma “DISCRETE MATHEMATICS” 3 rd Edition Macmillan Reprint2011	
Reference Books		
1.	Modern Algebra - S.Arumugam and A. Thangapandi Isaac, Scitechpublications 2005.	
2.	Invitation to Graph Theory-S.Arumugam and S.Ramachandran, Scitech Publications,2005, Chennai.	
3.	Discrete Mathematical Structures with applications to Computer Science - Tremblay and Manohar, McGraw Hill,1997.	
Web Resources		
1.	Web resources from NDL Library, E-content from open-source libraries	

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-GS	Discrete Mathematics-II	**Elect**	4	-	-		3	25	75	100

Learning Objectives	
LO1	To introduce the Data Models
LO2	To explain the Logic & Proofs
LO3	To understanding the Relational Structures on Sets
LO4	To know the Counting &Combinatorics
LO5	To explain the Algebraic Structures

UNIT	Contents	No. Of. Hours
I	**Sets and Sequences: Data Models.** Finite Sets, Power Set, Cardinality of finite sets, Cartesian Product, Properties of Sets, Vector Implementations of Sets.	**12**
II	**Describing Sets : Logic & Proofs** Introduction to Logic. Propositional Logic, Truth tables, Deduction, Resolution, Predicates and Quantifiers, Mathematical Proofs. Infinite sets, well-ordering. Countable and Uncountable sets, Cantor's diagonalization. Mathematical Induction - weak and strong induction.	**12**
III	**Relational Structures on Sets : Relations & Graphs** Relations, Equivalence Relations. Functions, Bijections. Binary relations and Graphs. Trees (Basics). Posets and Lattices, Hasse Diagrams. Boolean Algebra.	**12**
IV	**Sizes of Sets : Counting &Combinatorics** Counting, Sum and product rule, Principle of Inclusion Exclusion. Pigeon Hole Principle, Counting by Bijections. Double Counting. Linear Recurrence relations - methods of solutions. Generating Functions. Permutations and counting.	**12**
V	**Structured Sets : Algebraic Structures** Structured sets with respect to binary operations. Groups, Semigroups, Monoids. Rings, and Fields. Vector Spaces, Basis.	**12**
Total hours		**60**

Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO1	Understanding the concepts of Sets and Sequences	PO1, PO2, PO3, PO4, PO5, PO6
CO2	To know the concepts of Logic & Proofs	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Understanding the Relations & Graphs	PO1, PO2, PO3, PO4, PO5, PO6
CO4	To explain he Sum and product rule	PO1, PO2, PO3, PO4, PO5, PO6
CO5	To understating the concepts of Algebraic Structures	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Discrete Mathematics and its Applications - Kenneth H. Rosen 7th Edition -Tata McGraw Hill Publishers - 2007	
Reference Books		
1.	Elements of Discrete Mathematics, C. L Liu, McGraw-Hill Inc, 1985. Applied Combinatorics, Alan Tucker, 2007.	
2.	Concrete Mathematics, Ronald Graham, Donald Knuth, and Oren Patashnik, 2nd Edition - Pearson Education Publishers - 1996.	
3.	Combinatorics: Topics, Techniques, Algorithms by Peter J. Cameron, Cambridge University Press, 1994 (reprinted 1996).	
4.	Topics in Algebra, I.N. Herstein, Wiley, 1975.	
Web Resources		
1.	Web resources from NDL Library, E-content from open-source libraries	

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-GS	Statistical Methods and its Application-I	Elect	4	-	-		3	25	75	100

Learning Objectives	
LO1	To make understand the fundamentals of Statistics.
LO2	Define the principal concepts about probability.
LO3	To explain the Coefficient of Variation
LO4	To understand the concept of Conditional Probability
LO5	Explain the concept of a random variable and the probability distributions.

UNIT	Contents	No. Of. Hours
I	Introduction to statistics – primary and secondary data – classification, tabulation and Diagrammatic Representation of statistical data – Bar-charts, Pie-diagrams' – Graphical Representation of data – Histograms, Frequency polygon, Ogives.	12
II	Measures of dispersion – characteristics – coefficient of dispersion - Coefficient of variation – Moments – skewness and kurtosis – Pearson's coefficient of skewness - Bowley's coefficient of Skewness – Coefficient of skewnessbased upon moments.	12
III	Simple correlation – Karl Pearson's coefficient of correlation – correlation coefficient for A bivariate frequency distribution – Rank correlation – Regression – lines of regression – Properties of regression coefficient.	12
IV	Events and sets – sample space – concept of probability – addition and multiplications Theorem on probability – conditional probability and independence of evens – Baye's Theorem – concept of random variable – Mathematical Expectation.	12
V	Concept of sampling distributions – standard error – Tests of significance basedont, Chi-squareandFdistributionswithrespect to mean,variance.	12

Total hours		60
Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Summarize the concepts of statistical methods	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Analyse the different Statistical measures of data	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Derive the marginal and conditional distributions of random variables, translate realworld problems into probability models	PO1, PO2, PO3, PO4, PO5, PO6
CO4	To understanding the concepts of Probability of an event	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Understand basic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Statistical Methods, S.P.Gupta, Sultan Chand and sons Publications,4th Edition 2011	
Reference Books		
1.	Statistics, Dr. S.Arumugam and A.ThangapandiIssac, New Gamma Publication house, 2002.	
2.	KishorS. Trivedi - Probability and statistics with reliability queuing and Computer Science Applications - Prentice Hall of India (P) Ltd., New Delhi -1997	
3.	Discrete Mathematics - Seymour Lipschutz, Marc Lars Lipson Schaum‘s Outlines- by, 3rd Edition., Tata McGraw Hill, Education Pvt. Ltd., New Delhi. 5th Reprint, 2012	
Web Resources		
1.	Web resources from NDL Library, E-content from open-source libraries	

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-GS	Statistical Methods and its Application-II	Elect	4	-	-		3	25	75	100

Learning Objectives	
LO1	To introduce the concepts of statistics
LO2	To know the concepts of Bowley's coefficient of Skewness – Coefficient of skewness based upon moments
LO3	To explain the concepts of simple correlation
LO4	To understanding the concept of Mathematical Expectation
LO5	To know the standard error

UNIT	Contents	No. Of. Hours
I	Introduction to statistics – primary and secondary data – classification, tabulation and Diagrammatic Representation of statistical data – Bar-charts, Pie diagrams' – Graphical Representation of data – Histograms, Frequency polygon, Ogives.	12
II	Measures of dispersion – characteristics – coefficient of dispersion - Coefficient of variation-Moments – skewness and kurtosis – Pearson's coefficient of skewness - Bowley's coefficient of Skewness – Coefficient of skewness based upon moments.	12
III	Simple correlation – Karl Pearson's coefficient of correlation – correlation coefficient for A bivariate frequency distribution – Rank correlation – Regression lines of regression – Properties of regression coefficient	12
IV	Events and sets – sample space – concept of probability – addition and multiplications Theorem on probability – conditional probability and independence of evens – Baye's Theorem – concept of random variable – Mathematical Expectation.	12
V	Concept of sampling distributions – standard error- Tests of significance based on t, Chi- square and F distributions with respect to mean, variance.	12

Total hours		60
Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	summarize the concepts of statistics	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Analyzing the concepts -Bowley‘s coefficient of Skewness – Coefficient of skewness based upon moments	PO1, PO2, PO3, PO4, PO5, PO6
CO3	To understanding the concepts of simple correlation	PO1, PO2, PO3, PO4, PO5, PO6
CO4	To understanding the concept of Mathematical Expectation	PO1, PO2, PO3, PO4, PO5, PO6
CO5	To know the test of significance	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Statistical Methods, S.P.Gupta, Sultan Chand and sons Publications,4th Edition 2011	
Reference Books		
1.	Statistics, Dr. S.Arumugam and A.ThangapandiIssac, New Gamma Publication house, 2002.	
2.	KishorS. Trivedi - Probability and statistics with reliability queuing and Computer Science Applications - Prentice Hall of India (P) Ltd., New Delhi -1997	
3.	Discrete Mathematics - Seymour Lipschutz, Marc Lars Lipson Schaum‘s Outlines- by, 3rd Edition., Tata McGraw Hill, Education Pvt. Ltd., New Delhi. 5th Reprint, 2012	
Web Resources		
1.	Web resources from NDL Library, E-content from open-source libraries	

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-GS	Digital Logic Fundamentals	**Elect**	4	-	-		3	25	75	100

Learning Objectives	
LO1	ItaimstotrainthestudenttothebasicconceptsofDigitalLogicFundamentals
LO2	To impart the in-depth knowledge of logic gates, Booleanalgebra,combinationalcircuitsandsequentialcircuits.
LO3	To explain the concept of Combinational Logic and counters
LO4	To introduce the concepts of Flip-Flops, Registers
LO5	To explain the Asynchronous and Synchronous Counters

UNIT	**Contents**	**No. Of. Hours**
I	NumberSystemsandCodes:NumberSystem–BaseConversion – BinaryCodes – Code Conversion. Digital Logic: Logic Gates – Truth Tables – UniversalGates.	**12**
II	Boolean Algebra: Laws and Theorems – SOP, POS Methods – Simplification ofBooleanFunctions– UsingTheorems,K-Map,Prime–ImplicantMethod–Binary Arithmetic: Binary Addition – Subtraction – Various Representations ofBinaryNumbers– ArithmeticBuildingBlocks–Adder–Subtractor.	**12**
III	Combinational Logic: Multiplexers – Demultiplexers – Decoders – Encoders –CodeConverters– ParityGeneratorsandCheckers.	**12**
IV	SequentialLogic:RS,JK,D,andTFlip-Flops–Master-Slave Flip-Flops.Registers:ShiftRegisters–TypesofShiftRegisters.	**12**
V	Counters: Asynchronous and Synchronous Counters - Ripple, Mod, Up-DownCounters– Ring Counters. Memory: Basic Terms and Ideas –Types of ROMs –TypesofRAMs.	**12**
Total hours		**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Identify the logic gates and their functionality.	PO1, PO2, PO3, PO4, PO5, PO6

CO2	Perform number conversions from one system to another system	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Understand the functions of combinational circuits	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Perform number conversions	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Perform Counter design and learn its operations	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	V.RajaramanandT.Radhakrishnan,*Digital Computer Design*, Prentice HallofIndia,2001
2	D.P.LeachandA.P.Malvino,*DigitalPrinciplesandApplications*–TMH–FifthEdition–2002
3	M.MorisMano,*DigitalLogicandComputerDesign*,PHI,2001
4	T.C.Bartee,*DigitalComputerFundamentals*,6thEdition,TataMcGrawHill,1991

Web Resources

1.	Web resources from NDL Library, E-content from open-source libraries

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-GS	Numerical Methods	**Elect**	4	-	-		3	25	75	100

Learning Objectives

LO1	To introduce the various topics in Numerical methods.
LO2	To make understand the fundamentals of algebraic equations.
LO3	To apply interpolation and approximation on examples.
LO4	To solve problems using numerical differentiation and integration
LO5	To solve linear systems, numerical solution of ordinary differential equations.

UNIT	Contents	No. Of. Hours
I	FUNDAMENTALS OF ALGEBRAIC EQUATION: Solution of	**12**

	algebraic and transcendental equations-Bisection method – Fixed point iteration method – Newton Raphson method –linear system of equations – Gauss elimination method – Gauss Jordan method .	
II	ITERATIVE, INTERPOLATION AND APPROXIMATION: Iterative methods - Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices. Interpolation with unequal intervals – Lagrange's interpolation – Newton's divided difference interpolation	**12**
III	INTERPOLATION WITH EQUAL INTERVAL: Difference operators and relations. -Interpolation with equal intervals – Newton's forward and backward difference formulae.	**12**
IV	NUMERICAL DIFFERENTIATION AND INTEGRATION: Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal, Simpson's 1/3 rule	**12**
V	INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS: Single step methods – Taylor's series method – Euler's method – Modified Euler's method - RungeKutta method for solving(first, second , Third and 4th) order equations – Multi step methods	**12**
Total hours		**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Know how to solve various problems on numerical methods	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Use approximation to solve problems	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Differentiation and integration concept are applied	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Apply , direct methods for solving linear systems	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Numerical solution of ordinary differential equations	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks	
1	Numerical Methods, Second Edition, S.Arumugam, A.ThangapandiIssac, A.Somasundaram, SCITECH publications, 2009.
Reference Books	
1.	Mathews J.H. Numerical Method for Maths, Science and Engineering; PHI, New Delhi, 2001
2.	Iqbal H. Khan & Q. Hassan Numerical Methods for Engineers and Scientist - Galgotia Publications (P) Ltd., New Delhi – 1997
3.	M.K. Jain, S.R.K. Iyengar&R.K.Jain - Numerical Methods for Scientific and Engineering Computation - New Age International(P) Ltd., New Delhi – 1996.
Web Resources	
1.	Web resources from NDL Library, E-content from open-source libraries

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-GS	Optimization Techniques	**Elect**	4	-	-		3	25	75	100

Learning Objectives		
LO1	To introduce the concepts of Linear Programming	
LO2	Insights into the Simplex method	
LO3	To explain the Transportation Problem	
LO4	To understanding the concepts of Assignment Problem	
LO5	To know the Scheduling Techniques	
UNIT	**Contents**	**No. Of. Hours**
I	Linear Programming :Linear Programming Problem –Assumptions of Linear Programming Problem – Three Stages of Linear Programming Problem – Limitations of Linear Programming – Formulating a	**12**

	Problem as Linear Programming Model – Illustrative examples of LP Model Formulation -General Linear Programming Problem - Canonical and Standard forms of LPP- Terminology for the solution of LPP- Solving Linear Programming Problems: Graphical Solution method.	
II	Insights into the Simplex method – The computational procedure – Simplex Algorithm – Use of Artificial variables – Two-Phase Method – Big-M method – Degeneracy and Unboundedness in Linear Programming.	**12**
III	Transportation Problem: General Structure of a Transportation Problem –Existence of solution and degeneracy in Transportation Problem - Standard transportation table -Solution of a Transportation Problem – Methods for finding Initial Basic feasible solution -Optimality TestStepping Stone method - MODI method - Unbalanced Transportation Problem.	**12**
IV	Assignment Problem: Model formulation of an Assignment Problem – Assumptions in Assignment Problem - Methods of solving an Assignment Problem – The Hungarian Assignment algorithm – Special cases in Assignment Problems - Maximization cases in Assignment Problems – Prohibited Assignments.	**12**
V	Scheduling Techniques: Why networks? - Basic components of Network – Logical Sequencing - Rules of Network Construction –Network Scheduling - Critical Path Analysis-Critical Path Calculations – Procedure for determining Critical Path.	**12**
Total hours		**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	summarize various algorithms and rules used in solving OR problems.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	solve all problems of Linear Programming, Transportation, Assignment and Network scheduling.	PO1, PO2, PO3, PO4, PO5, PO6

CO3	analyze various problems for infeasibility, degeneracy, unboundedness and alternate solutions.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	find the best suitable method for obtaining optimal solution to Linear Programming, Transportation, Assignment problems.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	formulate the real world decision making problems into mathematical models.	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	KantiSwarup, P.K.Gupta and Manmohan(2022) , "Operations Research", Sultan Chand & Sons, Twentieth Revised Edition.

Reference Books

1.	J..K.Sharma(2017), "Operations Research Theory and Applications", Lakshmi Publications, Sixth Edition.
2.	G.Srinivasan (2017), "Operations Research", PHI Learning Private Limited, Third Edition.

Web Resources

1.	https://nptel.ac.in/courses/111107128
2	https://nptel.ac.in/courses/110106062

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-GS	Nano Technology	Elect	4	-	-		3	25	75	100

Learning Objectives

LO1	To introduce the concepts of nanoscience and nanotechnology
LO2	Define the nano system
LO3	To explain the importance of Nanotechnology
LO4	To explain the concepts of Nanostructured materials
LO5	To know the advanced concepts of nano technology

UNIT	Contents	No. Of. Hours
I	Background to nanoscience and nanotechnology - scientific revolutions - nanosizedeffectssurface to volume ratio- – atomic	**12**

	structure – molecules & phases – energy at the nanoscale molecular and atomic size -quantum effects- types of nanotechnology and nano machines	
II	Definition of a nano system - classification of nanocrystals - dimensionality and size dependent phenomena; Quantum dots, Nanowires and Nanotubes, 2D films;	**12**
III	Nano &mesopores – top down and bottom up- Misnomers and misconception of Nanotechnology importance of the nanoscale materials and their devices -size dependent variation in mechanical, physical and chemical, magnetic, electronic transport, reactivity etc.,	**12**
IV	Nanostructured materials-metal-semiconductor-ceramics and composites- size dependent properties - uniqueness in these properties compared to bulk and microscopic solids– nanomaterials and nanostructures in nature- super hydrophobicity, self-cleaning - antifogging.	**12**
V	Recent special nanomaterials - Carbon based nanomaterials – CNT- graphene-core-shell structures- Micro and Mesopores Materials- Organic-Inorganic Hybrids- ZnO- Silicon -- DNA- RNA- Nanoproducts	**12**
Total hours		**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Understanding the concepts of nanoscience and nanotechnology	PO1, PO2, PO3, PO4, PO5, PO6
CO2	To explain the classification of nanocrystals	PO1, PO2, PO3, PO4, PO5, PO6
CO3	To understanding the importance of Nanotechnology	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Explain the nanomaterials and nanostructures in nature	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Design processing conditions to functional nanomaterials	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks	
1	Introduction to Nanoscience and Nanotechnology, Gabor .L et al,
Reference Books	
1.	"Nanostructures &Nanomaterials: Synthesis, Properties &Applications" G. Cao, Imperial College Press, 2004.
2.	Nanomaterials, Nanotechnologies and Design: An introduction for engineers andArchitects, Micheal F. Ashby, P.J. Ferreria, D.L. Schodek,
3	Fundamentals of Nanotechnology, Hornyak, G. Louis, Tibbals, H. F., Dutta, Joydeep,CRC Press, 2009
4	Nanomaterials: An introduction to synthesis, properties and application, Dieter Vollath,WILE-VCH, 2008
Web Resources	
1.	Web resources from NDL Library, E-content from open-source libraries

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-GS	Introduction to Linear Algebra	**Elect**	4	-	-		3	25	75	100

Learning Objectives		
LO1	Introduce students to the theory of systems of linear equations and to mathematical proof	
LO2	To explain the concepts Matrix of a linear transformation.	
LO3	To understanding the Inner product Spaces	
LO4	To explain the Matrices	
LO5	To understanding the Bilinear forms	
UNIT	**Contents**	**No. Of. Hours**

I	Vector spaces: Definitions and Examples – Subspaces – Linear Transformations - Span of a set.	**12**
II	Linear independence – Basis and dimensions – Rank and Nullity – Matrix of a linear transformation.	**12**
III	Inner product Spaces: Definition and examples – Orthogonality – Orthogonal Complement.	**12**
IV	Matrices – Elementary transformations – Rank of a matrix – Simultaneous linear equations – Characteristic equations and Cayley Hamilton theorem – Eigen values and eigen vectors.	**12**
V	Bilinear forms – Quadratic forms.	**12**
Total hours		**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	The concepts of linear algebra are crucial for understanding the theory behind machine learning, especially for deep learning.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Prove statements of an algebraic nature concerning linear transformations	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Calculate eigenvalues and their corresponding eigenspaces	PO1, PO2, PO3, PO4, PO5, PO6
CO4	DetermineRank of a matrix	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Understand **algebraic** and geometric representations	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	Dr. S. Arumugam and Prof. A. Thangapandi Isaac, Modern Algebra, SciTech Publication, India Private Ltd., January 2018. Unit I: Chapter 5 – Sections 1, 2, 3 and 4 Unit II: Chapter 5 – Sections 5, 6, 7 and 8 Unit III: Chapter 6 – Sections 1, 2 and 3 Unit IV: Chapter 7 – Sections 4, 5, 6, 7 and 8

	Unit V: Chapter 8 – Sections 1 and 2.

Reference Books

1.	I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd, 2006.
2.	A. R. Vasishtha, Modern Algebra, Krishna Publication, January 2015

Web Resources

1.	Web resources from NDL Library, E-content from open-source libraries

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-GS	Graph Theory and its Application	**Elect**	4	-	-		3	25	75	100

Learning Objectives

LO1	Definition of Graph, sub graph their representations, degree and algebraic operations.
LO2	Connected graphs, weighted graphs and shortest paths
LO3	Trees: Characterizations, spanning tree, minimum spanning trees
LO4	Eulerian and Hamiltonian graphs: Characterization, Necessary and sufficient conditions
LO5	Special classes of graphs: Bipartite graphs, line graphs, chordal graphs

UNIT	Contents	No. Of. Hours
I	**INTRODUCTION**: Graph-mathematical definition- Introduction – sub graphs –Walks, paths, Circuits connectedness- Components- Euler Graphs- Hamiltonian paths and circuits-Trees- properties of Trees- Distance and centers in Tree- Rooted and Binary Trees	**12**
II	**CONNECTIVITY AND PLANARITY:** Introduction to circuits - cut set- properties of cut set- All cut sets –connectivity and separability – Network Flows - 1-Isomorphism - 2-Isomorphism- Combinatorial and Geometric graphs- Planar Graphs – Different representation of planar	**12**

	graph.	
III	**COLORING AND DIRECTED GRAPH:** Basics of Colouring&Chromatic number – Chromatic partitioning – Graph Colouring – four colour Problem Chromatic polynomial - Matching – Covering - Directed graphs - Types of Directed Graphs – Diagraphs and binary relations – Directed paths- Euler Graph.	**12**
IV	**MATRIX REPRESENTATION IN GRAPH:** Matrix representation of graphs, Sub graphs& Quotient Graphs, Transitive Closure digraph, Euler's Path & Circuit (only definitions and examples), spanning Trees of Connected Relations, Prim's Algorithm to construct Spanning Trees, Weighted Graphs, Minimal, Spanning Trees by Prim's Algorithm &Kruskal's Algorithm.	**12**
V	**APPLICATIONS OF GRAPH:** Traveling Sales Person Problem with Directed and Un directed Graph, - Graph with n vertices and k colours- Shortest path from one to many Cities with directed graph- Shortest Paths with Un directed Graphs-Connected Components.	**12**
Total hours		**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	To Introduce the fundamental concepts in graph theory Graphs, subgraphs, walks, Euler graphs, Hamiltonian Paths Tree Properties , Hamiltonian paths and circuits	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Understanding the concepts of Circuits, Cut set and its Properties, Network Flows, Isomorphism and Combinatorial and Planar Graphs.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Applying the concept of Colouring with Chromatic Number, Directed Graphs, Matching , Covering Pattern and Euler Graphs	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Analysing the Various Concepts of Representation of Graphs, Euler Paths Circuit, Kruskals and Prims Algorithms, Connected Components.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Implementation of an application using All Types of Graphs and evaluate the Applications with travelling sales person Problem, K	PO1, PO2, PO3, PO4,

	colour Problem with n vertices in a Graph and Shortest Path finding Problem using Directed and Undirected Graphs	PO5, PO6
Textbooks		
1	NarsinghDeo , " Graph Theory with Application to Engineering and Computer Science" Prentice Hall of India 2010(Reprint)	
2	Rosen H "Discrete Mathematics and Its Application " McGraw Hill , 2007	
Reference Books		
1.	Discrete Maths for Computer Scientists & Mathematicians by Mott, Kandel, Baker	
2.	Clark J and Holton DA " First look at Graph Theory" AlliedPublishers 1995	
3.	Discrete Maths for Computer Scientists & Mathematicians by Mott, Kandel, Baker	
Web Resources		
1.	Web resources from NDL Library, E-content from open-source libraries	

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
EC-GS	Resource Management Techniques	**Elect**	4	-	-		3	25	75	100
Learning Objectives										
LO1	To introduce the concepts of OR									
LO2	To explain the Linear Programming Problem									
LO3	To illustrate the Simplex Method									
LO4	To know the Duality Theorems									
LO5	To understanding the Methods for finding IBFS for the Transportation Problems									
UNIT	**Contents**									**No. Of. Hours**
I	Development of OR: Definition of OR – Modeling - Characteristics and Phases - Tools, Techniques & Methods - scope of OR.									**12**

II	Linear Programming Problem: Formulation - Slack & surplus variables - Graphical solution of LPP.	**12**
III	Simplex Method: Computational Procedure - Big-M method - Concept of duality in LPP - Definition of primal dual problems - General rules for converting any primal into its dual.	**12**
IV	Duality Theorems: (without proof) Primal dual correspondence - Duality and Simplex method - Mathematical formulation of assignment problem - Method for solving assignment problem.	**12**
V	Mathematical formulation of Transportation Problem: Methods for finding IBFS for the Transportation Problems.	**12**
Total hours		**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	To understanding the concepts of Development of OR	PO1, PO2, PO3, PO4, PO5, PO6
CO2	develop linear programming (LP) models for shortest path, maximum flow, minimal spanning tree, critical path, minimum cost flow, and transshipment problems	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Solve the problems of Simplex Method	PO1, PO2, PO3, PO4, PO5, PO6
CO4	To study the Duality Theorems	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Finding initial basic feasible and optimal solution of the Transportation problems	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	Operations Research, S.D.Sharma, KedarNath Ram Nath& Co Unit I : Chapter-1(1.1, 1.2, 1.4,1.,1.8,1.9,1.10,1.11) Unit II : Chapter-3 (3.1, 3.2, 3.3, 3.3.1, 3.3.2, 3.3.3, 3.3.4, 3.4,3.5) Unit III : Chapter-5 (5.1, 5.2, 5.2.1, 5.3,5.4,5.5.4) Chapter- 7 (7.1,7.2,7.3,7.4) Unit IV : Chapter-7 (7.5) (Statements only); 7.6, 7.7

	Chapter 11(11.2,11.3,11.4) Unit V : Chapter-12 (12.2 to 12.8)
Reference Books	
1.	Operation Research, Nita H.Shah, Ravi M.Gor and Hardiksoni,PrenticeHall of India Pvt. Ltd., New Delhi 2008.
2.	Operation Research, R.Sivarethinamohan, Tata McGraw Hill, 2005.
3.	Operations Research – An Introduction by HamdyA.Taha. Ninth Edition, Dorling Kindersley Pvt. Ltd., Noida, India, 2012
Web Resources	
1.	Web resources from NDL Library, E-content from open-source libraries

Annexure I

Suggested Topics in Elective courses (EC1-EC8)

Discipline Specific Electives Syllabus

1. Natural Language Processing
2. Analytics for Service Industry
3. Cryptography
4. RDBMS with PL/SQL
5. Big Data Analytics
6. IOT and its Applications
7. Software Project Management
8. Image Processing
9. Human Computer Interaction
10. Fuzzy Logic
11. Artificial Intelligence
12. Robotics and its Applications
13. Computational Intelligence
14. Cloud Computing
15. Artificial Neural Network
16. Introduction to Data Science
17. Agile Project Management
18. Virtual Reality and more

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-DS	NATURAL LANGUAGE PROCESSING	Elect	4	-	-		3	25	75	100

Learning Objectives		
LO1	To understand approaches to syntax and semantics in NLP.	
LO2	To learn natural language processing and to learn how to apply basic algorithms in this field.	
LO3	To understand approaches to discourse, generation, dialogue and summarization within NLP.	
LO4	Toget acquainted with the algorithmic description of the main language levels: morphology, syntax, semantics, pragmatics etc.	
LO5	To understand current methods for statistical approaches to machine translation.	
UNIT	**Contents**	**No. Of. Hours**
I	**Introduction :** Natural Language Processing tasks in syntax, semantics, and pragmatics – Issue- Applications – The role of machine learning – Probability Basics –Information theory – Collocations -N-gram Language Models – Estimating parameters and smoothing – Evaluating language models.	**12**
II	**Word level and Syntactic Analysis:**Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging.Syntactic Analysis: Context-free Grammar-Constituency-Parsing-Probabilistic Parsing.	**12**
III	**Semantic analysis and Discourse Processing:** Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion-Reference Resolution-Discourse Coherence and Structure.	**12**
IV	**Natural Language Generation:** Architecture of NLG Systems-Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation. Characteristics of Indian Languages- Machine Translation Approaches-Translation involving	**12**

	Indian Languages.	
V	**Information retrieval and lexical resources:** Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: WorldNet-Frame NetStemmers- POS Tagger- Research Corpora SSAS.	**12**
Total hours		**60**
Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Describe the fundamental concepts and techniques of natural language processing. Explain the advantages and disadvantages of different NLP technologies and their applicability in different business situations.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Distinguish among the various techniques, taking into account the assumptions, strengths, and weaknesses of each Use NLP technologies to explore and gain a broad understanding oftext data.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions. Use NLP methods to analyse sentiment of a text document.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Analyze large volume text data generated from a range of real-world applications. Use NLP methods to perform topic modelling.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Develop robotic process automation to manage business processes and to increase and monitor their efficiency and effectiveness. Determine the framework in which artificial intelligence and the Internet of things may function, including interactions with people, enterprise functions, and environments.	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks		
1	Daniel Jurafsky, James H. Martin, “Speech & language processing”, Pearson publications.	
2	Allen, James. Natural language understanding. Pearson, 1995.	
Reference Books		
1.	Pierre M. Nugues, “An Introduction to Language Processing with Perl and Prolog”,Springer	
Web Resources		
1.	https://en.wikipedia.org/wiki/Natural_language_processing	
2.	https://www.techtarget.com/searchenterpriseai/definition/natural-language-processing-NLP	

Mapping with Programme Outcomes:

CO/PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO 1	3	3	3	3	3	3
CO 2	2	3	3	3	2	3
CO 3	3	3	3	3	3	3
CO 4	3	2	3	3	2	3
CO 5	3	3	3	3	3	3
WeightageofcoursecontributedtoeachPSO	14	14	15	15	13	15

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-DS	ANALYTICSFOR SERVICE INDUSTRY	Elect	4	-	-	-	3	25	75	100

Learning Objectives	
LO1	Recognize challenges in dealing with data sets in service industry.
LO2	Identify and apply appropriate algorithms for analyzing the healthcare, Human resource, hospitality and tourism data.
LO3	Make choices for a model for new machine learning tasks.
LO4	To identify employees with high attrition risk.
LO5	To Prioritizing various talent management initiatives for your organization.

UNIT	Contents	No. Of. Hours
I	**Healthcare Analytics :** Introduction to Healthcare Data Analytics- Electronic Health Records– Components of EHR- Coding Systems- Benefits of EHR- Barrier to Adopting HER Challenges-Phenotyping Algorithms. Biomedical Image Analysis and Signal Analysis- Genomic Data Analysis for Personalized Medicine. Review of Clinical Prediction Models.	**12**
II	**Healthcare Analytics Applications :** Applications and Practical Systems for Healthcare– Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer- Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.	**12**
III	**HR Analytics:** Evolution of HR Analytics, HR information systems and data sources, HR Metric and HR Analytics, Evolution of HR Analytics; HR Metrics and HR Analytics; Intuition versus analytical thinking; HRMS/HRIS and data sources; Analytics frameworks like LAMP, HCM:21(r) Model.	**12**
IV	**PerformanceAnalysis:** Predicting employee performance,Training requirements, evaluating training and development, Optimizing selection and promotion decisions.	**12**
V	**Tourism and Hospitality Analytics:** Guest Analytics – Loyalty Analytics – Customer Satisfaction – Dynamic Pricing – optimized disruption management – Fraud detection in payments.	**12**

	TOTAL HOURS	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Understand and critically apply the concepts and methods of business analytics	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Identify, model and solve decision problems in different settings.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Create viable solutions to decision making problems.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Instill a sense of ethical decision-making and a commitment to the long-run welfare of both organizations and the communities they serve.	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks	
1	Chandan K. Reddy and Charu C Aggarwal, "Healthcare data analytics", Taylor & Francis, 2015.
2	Edwards Martin R, Edwards Kirsten (2016),"Predictive HR Analytics: Mastering the HR Metric", Kogan Page Publishers, ISBN-0749473924
3	Fitz-enzJac (2010), "The new HR analytics: predicting the economic value of your company's human capital investments", AMACOM, ISBN-13: 978-0-8144-1643-3
4	RajendraSahu, Manoj Dash and Anil Kumar. Applying Predictive Analytics Within the Service Sector.

Reference Books	
1.	Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016
2.	Fitz-enzJac, Mattox II John (2014), "Predictive Analytics for Human Resources", Wiley, ISBN- 1118940709.

Web Resources	
1.	https://www.ukessays.com/essays/marketing/contemporary-issues-in-marketing-marketing-essay.php
2.	https://yourbusiness.azcentral.com/examples-contemporary-issues-marketing-field-26524.html

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	2	3	3	3	3	3
CO 3	3	3	2	3	3	2
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	3	3
WeightageofcoursecontributedtoeachPSO	14	15	14	15	15	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-DS	**CRYPTOGRAPHY**	**Elect**	4	-	-	-	3	25	75	100

Learning Objectives		
LO1	To understand the fundamentals of Cryptography	
LO2	To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.	
LO3	To understand the various key distribution and management schemes.	
LO4	To understand how to deploy encryption techniques to secure data in transit across data networks	
LO5	To design security applications in the field of Information technology	
UNIT	**Contents**	**No. Of. Hours**
I	**Introduction:** The OSI security Architecture – Security Attacks – Security Mechanisms – Security Services – A model for network Security.	**12**
II	**Classical Encryption Techniques:** Symmetric cipher model – **Substitution Techniques:** Caesar Cipher – Monoalphabetic cipher – Play fair cipher – Poly Alphabetic Cipher – Transposition techniques – Stenography	**12**
III	**Block Cipher and DES:** Block Cipher Principles – DES – The Strength of DES –**RSA:** The RSA algorithm.	**12**

IV	**Network Security Practices**: IP Security overview - IP Security architecture – Authentication Header. **Web Security**: SecureSocketLayerand Transport Layer Security – Secure Electronic Transaction.	**12**
V	Intruders – Malicious software – Firewalls.	**12**
	TOTAL HOURS	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Analyze the vulnerabilities in any computing system and hence be able to design a security solution.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Apply the different cryptographic operations of symmetric cryptographic algorithms	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Apply the different cryptographic operations of public key cryptography	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Apply the various Authentication schemes to simulate different applications.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Understand various Security practices and System security standards	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks	
1	**William Stallings,** "Cryptography and Network Security Principles andPractices".
Reference Books	
1.	**Behrouz A. Foruzan,** "Cryptography and Network Security", Tata McGraw-Hill, 2007.
2	**AtulKahate**, "*Cryptography and Network Security*", Second Edition, 2003,TMH.
3	**M.V. Arun Kumar**, "*Network Security*", 2011, First Edition,USP.
	Web Resources
1	https://www.tutorialspoint.com/cryptography/
2	https://gpgtools.tenderapp.com/kb/how-to/introduction-to-cryptography

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	2	3	2
CO 2	3	2	3	2	3	3
CO 3	3	3	3	2	3	3
CO 4	2	3	3	3	2	3
CO 5	3	2	3	3	3	3
WeightageofcoursecontributedtoeachPSO	14	13	15	12	14	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Relational Database Management System with PL/SQL**	Elective	4	-	-	-	3	4	25	75	100

Course Objective	
LO1	To understand the basic DBMS models and architecture
LO2	To learn how to query and normalize the database.
LO3	To study the data base design, transaction Processing and Management and Security Issues.
LO4	To understanding the concepts of Functional Dependencies
LO5	To understanding the concepts of PL/SQL.

UNIT	Contents	No. of Hours	Course Objective
I	Introduction to Databases: Introduction –	12	

	Characteristics of the Database Approach – Actors on the Scene – Workers behind the scene – Advantages of using DBMS Approach. Overview of database and Architectures: Data Models, Schemas, and Instances – Three-schema Architecture and Data Independence – Database languages & Interfaces – Database System Environment– Centralized & Client Server Architecture for DBMS - Classification of DBMS.	
II	Basic Relational Model: Relational Model Concepts – Relational Model Constraints and Relational Database Schemas – Update Operations, Tractions, Dealing with Constraint Violations – Formal Relational Languages: Unary Relational Operations: SELECT and PROJECT – Relational Algebra Operations from Set Theory – Binary Relational Operations: JOIN and DIVISION – Examples of Queries in Relational Algebra.	12
III	Conceptual Data Modeling using the ER Model: Using High-Level Conceptual Data Models for Database Design – An example DB application – Entity Types, Entity Sets, Attributes, and Keys – Relationship Types, Relationship sets, Roles, and Structural Constraints – Weak entity types – Example- Mapping a Conceptual Design into Logical Design: Relational Database Design using ER- Relational Mapping – Mapping EER Model Constructs to Relations	12

IV	Functional Dependencies and Normalization for Relational Database: Functional Dependencies – Definition of Functional Dependency – Normal Forms based on Primary Keys – Normalization of Relations – First Normal Form – Second Normal Form – Third Normal Form – BCNF- Fourth Normal Form- Fifth Normal Form.	12
V	SQL: The Relational Database Standard: Data definition, Constraints, and schema changes in SQL – Basic Queries in SQL – More complex SQL Queries – Insert, delete and update statements in SQL – Views in SQL. PL/SQL: Introduction to PL/SQL – More on PL/SQL – Error Handling in PL/SQL – Oracle‘s Named Exception Handlers – Stored Procedures and Functions – Execution of Procedures and Functions – Advantages – Procedures Vs. Functions – Syntax for Creating Procedures and Functions – Deleting a Stored Procedure or Function – Oracle Packages – Database Triggers – Types Of Triggers – Deleting a Trigger – Raise-Application Error Procedure	12
	Total	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
1	Outline the fundamental RDBMS concepts and PL/SQL	PO1
2	Apply database operations, mapping, normalization, SQL and PL/SQL	PO1, PO2
3	Analyze the requirements to implement relational database concepts	PO4, PO5

4	Evaluate the database based on various models and normalization.	PO3, PO5, PO6
5	Design and construct normalized tables and manipulate it effectively using SQL and PL/SQL database objects	PO3, PO4
Text Book		
1	RamezElmasri, Shamkant B. Navathe (2014), ―Database Systems‖, Sixth edition, Pearson Education, New Delhi.	
2	Ivan Bayross (2003 Reprint), SQL, PL/SQL-The Programming Language of Oracle, Second Revised Edition, BPB Publications, New Delhi.	
	Reference Book	
1.	Abraham Silberschatz, Henry F.Korth, S.Sudarshan, Database System Concepts, Tata McGraw Hill Publication, 4th Edition.	
Web Resources		
1.	http://srikanthtechnologies.com/books/orabook/ch1.pdf	
2.	Http://www.tmv.edu.in/pdf/Distance_education/BCA%20Books/BCA%20IV%20SEM/BC A-428%20Oracle.pdf	
3.	http://www.tutorialspoint.com/sql/sql-rdbms-concepts.htm	
4.	http://ecomputernotes.com/database-system/rdbms	
5.	http://www.mithunashok.com/2011/04/basics-of-rdbms.html	

Subject Code	Subject	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Big Data Analytics**	Elective	4	-	-	-	3	4	25	75	100

Course Objective	
C1	Understand the Big Data Platform and its Use cases, Map Reduce Jobs
C2	To identify and understand the basics of cluster and decision tree
C3	To study about the Association Rules,Recommendation System
C4	To learn about the concept of stream
C5	Understand the concepts of NoSQL Databases

UNIT	Contents	No. of Hours	Course Objective
I	**Data Explosion and Big Data Analytics**: An Overview: Introduction, Evolution of Database Technology and Big Data, Elements of Big Data, Big Data System Components, Big Data Analytics – Data Analytics. Types of Big Data Analytics, Applications of Big Data Technology, Challenges and Skills required with Big Data Technology.	12	
II	**Analytical Theory:** Introduction about Classification Algorithms, Regression Techniques, Domain Specific Analytic Techniques: In Database Analytics, Text Analytics. **Real – Time Analysis:** Introduction: Real-time System, Types of Real-time System, Characteristics of Real-time Systems, Real-time Processing Systems for Big Data: Introduction, Data Integration and Analytics, Big Data Engine-Hadoop, Real-time System Architecture, Real-time Data Analytics.	12	
III	**Big Data: Hardware, Technology Foundations**: Introduction, Big Data Stack, Virtualization and Big Data.	12	

	Understanding NoSQL and Hadoop Ecosystem: Introduction, NoSQL: CouchDB, MongoDB, Hadoop Ecosystem – HDFS, HBase, Yarn.	
IV	**High Dimensional Data: A Big Data Perspective:** Introduction – What is Dimensionality? Dimensionality Reduction: Approaches for Dimensionality Reduction, Dimensionality Reduction Techniques. **User Interface and Visualization:** Desirable Properties, Visualization Techniques. **R Programming Basics:** Introduction, Data Types, Data Structures and Operators – Basic Data Types in R, R Operators, Vectors, List, Factor, Arrays and Matrix, Data Frame, R Programming Structure – Control Statements of R: if, if-else, if-else ladder, Switch-Case, Return, Loops and Loop Control Statements.	12
V	Interfacing R - Interfacing R to other languages – Parallel R–Basic Statistic s– Linear Model– Generalized Linear models–Non-linear Models– Time Series and Auto-Correlation– Clustering.	12
	Total	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
1	Work with big data tools and its analysis techniques.	PO1
2	Analyze data by utilizing clustering and classification algorithms.	PO1, PO2
3	Learn and apply different mining algorithms and recommendation systems for large volumes of data.	PO4, PO5
4	Perform analytics on data streams.	PO3, PO5, PO6
5	Learn NoSQL databases and management.	PO3, PO4

Text Book

1 **1.** Big Data Analytics – Concepts, Techniques, Tools and Technologies – First Edition, Dr.M.Thangaraj,Dr. S. Suguna, G. Sudha, PHI Learning Private

	Limited, Delhi,2022. **Unit I : Chapter 1** **Unit II : Chapter 2.2.2, 2.2.4, 2.3.2, 2.3.2** **Chapter 3 (3.1.1, 3.1.2, 3.2, 3.3.1 – 3.3.4, 3.4)** **Unit III : Chapter 4 (4.1 – 4.3)** **Chapter 5 (5.1, 5.2, 5.3.1 - 5.3.3)** **Unit IV : Chapter 6.1, 6.3** **Chapter 7.3** **Chapter 8 (8.1 – 8.3)** **Unit V : Chapter 8 (8.4 – 8.7)**
Reference Books	
1.	David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", Morgan Kaufmann/El sevier Publishers, 2013
2.	EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015.
Web Resources	
1.	https://www.simplilearn.com
2.	https://www.sas.com/en_us/insights/analytics/big-data-analytics.html

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	3	3	3
CO2	3	3	2	3	3	3
CO3	3	3	3	3	3	2
CO4	3	3	2	3	3	3
CO5	3	3	2	3	3	2
Weightage ofcoursecontributedtoeachPSO	15	14	11	15	15	13

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Internet of Things and its applications**	Elective	4	-	-	-	3	4	25	75	100
Course Objective											
C1	Use of Devices, Gateways and Data Management in IoT.										
C2	Design IoT applications in different domain and be able to analyze their performance										
C3	Implement basic IoT applications on embedded platform										
C4	To gain knowledge on Industry Internet of Things										
C5	To Learn about the privacy and Security issues in IoT										
UNIT	**Details**							**No. of Hours**			
I	IoT& Web Technology, The Internet of Things 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			
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			
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,							12			

	Functional View, Information View, Deployment and Operational View, Other Relevant architectural views	
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 GasIndustry, Opinions on IoT Application and Value for Industry, Home Management	12
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
	Total	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
1	Work with big data tools and its analysis techniques.	PO1
2	Analyze data by utilizing clustering and classification algorithms.	PO1, PO2
3	Learn and apply different mining algorithms and recommendation systems for large volumes of data.	PO4, PO6
4	Perform analytics on data streams.	PO4, PO5, PO6
5	Learn NoSQL databases and management.	PO3, PO5

Text Book

1	Vijay Madisetti and ArshdeepBahga, "Internet of Things: (A Hands-on Approach)", Universities Press (INDIA) Private Limited 2014, 1st Edition.

Reference Books

1.	Michael Miller, "The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World", kindle version.
2.	Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications 2013, 1st Edition,.

3	WaltenegusDargie, ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice" 4..CunoPfister, "Getting Started with the Internet of Things", O"Reilly Media 2011
Web Resources	
1.	https://www.simplilearn.com
2.	https://www.javatpoint.com
3.	https://www.w3schools.com

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	3	3	3
CO2	3	2	2	3	3	3
CO3	3	2	3	3	3	3
CO4	3	3	2	3	3	3
CO5	3	3	2	3	3	2
Weightage ofcoursecontributedtoeachPSO	15	12	11	15	15	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	SOFTWARE PROJECT MANAGEMENT	Elective	4	-	-	-	3	4	25	75	100
Learning Objectives											
LO1	To define and highlight importance of software project management.										
LO2	To formulate and define the software management metrics & strategy in managing projects										

LO3	To famialarize in Software Project planning	
LO4	Understand to apply software testing techniques in commercial environment	
Unit	**Contents**	**No. of Hours**
I	Introduction to Competencies - Product Development Techniques - Management Skills - Product Development Life Cycle - Software Development Process and models - The SEI CMM - International Organization for Standardization.	**12**
II	Managing Domain Processes - Project Selection Models - Project Portfolio Management - Financial Processes - Selecting a Project Team - Goal and Scope of the Software Project -Project Planning - Creating the Work Breakdown Structure - Approaches to Building a WBS - Project Milestones - Work Packages - Building a WBS for Software.	**12**
III	Tasks and Activities - Software Size and Reuse Estimating - The SEI CMM - Problems and Risks - Cost Estimation - Effort Measures - COCOMO: A Regression Model - COCOMO II - SLIM: A Mathematical Model - Organizational Planning - Project Roles and Skills Needed.	**12**
IV	Project Management Resource Activities - Organizational Form and Structure - Software Development Dependencies - Brainstorming - Scheduling Fundamentals - PERT and CPM - Leveling Resource Assignments - Map the Schedule to a Real Calendar - Critical Chain Scheduling.	**12**
V	Quality: Requirements – The SEI CMM - Guidelines - Challenges - Quality Function Deployment - Building the Software Quality Assurance - Plan - Software Configuration Management: Principles - Requirements - Planning and Organizing - Tools - Benefits - Legal Issues in Software - Case Study	**12**
TOTAL		**60**
CO	**Course Outcomes**	
CO1	Understand the principles and concepts of project management	
CO2	Knowledge gained to train software project managers	
CO3	Apply software project management methodologies.	
CO4	Able to create comprehensive project plans	
CO5	Evaluate and mitigate risks associated with software development process	
Textbooks		
1	Robert T. Futrell, Donald F. Shafer, Linda I. Safer, “Quality Software Project	

	Management", Pearson Education Asia 2002.
Reference Books	
1.	PankajJalote, "Software Project Management in Practice", Addison Wesley 2002.
2.	Hughes, "Software Project Management", Tata McGraw Hill 2004, 3rd Edition.
NOTE: Latest Edition of Textbooks May be Used	
Web Resources	
1.	Software Project Management e-resources from Digital libraries
2.	www.smartworld.com/notes/software-project-management

Mapping with Programme Outcomes:

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	**3**	**2**	**1**	**2**	**2**	**2**
CO2	**3**	**1**	**3**	**2**	**2**	**2**
CO3	**2**	**3**	**2**	**3**	**3**	**3**
CO4	**3**	**3**	**2**	**3**	**3**	**2**
CO5	**2**	**2**	**2**	**3**	**3**	**3**
Weightageofcoursecontributed toeachPSO	**13**	**11**	**10**	**13**	**13**	**12**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Image Processing**	Elective	4	-	-	-	3	4	25	75	100

Learning Objective	
LO1	To learn fundamentals of digital image processing.
LO2	To learn about various 2D Image transformations
LO3	To learn about various image enhancement processing methods and filters
LO4	To learn about various classification of Image segmentation techniques
LO5	To learn about various image compression techniques

UNIT	Contents	No. of Hours
I	**Digital Image Fundamentals:** Image representation - Basic relationship between pixels, Elements of DIP system -Applications of Digital Image Processing - 2D Systems - Classification of 2D Systems - Mathematical Morphology- Structuring Elements- Morphological Image Processing - 2D Convolution - 2D Convolution Through Graphical Method -2D Convolution Through Matrix Analysis	12
II	2D Image transforms: Properties of 2D-DFT - Walsh transform - Hadamard transform- Haar transform- Discrete Cosine Transform- Karhunen-Loeve Transform -Singular Value Decomposition	12
III	Image Enhancement: Spatial domain methods- Point processing- Intensity transformations - Histogram processing- Spatial filtering- smoothing filter- Sharpening filters - Frequency domain methods: low pass filtering, high pass Filtering- Homomorphic filter.	12
IV	Image segmentation: Classification of Image segmentation techniques - Region approach – Clustering techniques - Segmentation based on thresholding - Edge based segmentation - Classification of edges- Edgedetection - Hough transform- Active contour.	12
V	Image Compression: Need for compression -Redundancy- Classification of image- Compression schemes- Huffman coding- Arithmetic coding- Dictionary based compression -Transform based compression,	12

	Total	60
Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
1	Understand the fundamental concepts of digital image processing.	PO1
2	Understand various 2D Image transformations	PO1, PO2
3	Understand image enhancement processing techniques and filters	PO4, PO6
4	Understand the classification of Image segmentation techniques	PO4, PO5, PO6
5	Understand various image compression techniques	PO3, PO5
Text Book		
1	S Jayaraman, S Esakkirajan, T Veerakumar, Digital image processing ,Tata McGraw Hill, 2015	
2	Gonzalez Rafel C, Digital Image Processing, Pearson Education, 2009	
Reference Books		
1.	1. Jain Anil K , Fundamentals of digital image processing: , PHI,1988	
2.	Kenneth R Castleman , Digital image processing:, Pearson Education,2/e,2003	
3.	Pratt William K , Digital Image Processing: , John Wiley,4/e,2007	
Web Resources		
1.	https://kanchiuniv.ac.in/coursematerials/Digital%20image%20processing%20-Vijaya%20Raghavan.pdf	
2.	http://sdeuoc.ac.in/sites/default/files/sde_videos/Digital%20Image%20Processing%203rd%20ed.%20-%20R.%20Gonzalez%2C%20R.%20Woods-ilovepdf-compressed.pdf	
3.	https://dl.acm.org/doi/10.5555/559707	
4.	https://www.ijert.org/image-processing-using-web-2-0-2	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**2**	**3**	**2**	**2**
CO2	**3**	**3**	**2**	**3**	**2**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**2**	**3**	**2**	**2**
CO5	**3**	**3**	**2**	**3**	**2**	**2**
Weightage ofcoursecontributedtoeachPSO	**15**	**14**	**11**	**15**	**10**	**10**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Human Computer Interaction**	Elective	4	-	-	-	3	4	25	75	100
Learning Objectives											
LO1	To learn about the foundations of Human Computer Interaction.										
LO2	To learn the design and software process technologies.										
LO3	To learn HCI models and theories.										
LO4	To learn Mobile Ecosystem.										
LO5	To learn the various types of Web Interface Design.										
UNIT	**Contents**										**No. of Hours**
I	**FOUNDATIONS OF HCI :** • The Human: I/O channels – Memory • Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; • Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms. - Case Studies										12
II	**DESIGN & SOFTWARE PROCESS:** • Interactive Design: • Basics – process – scenarios • Navigation: screen design Iteration and prototyping. • HCI in software process: • Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design										12

III	**MODELS AND THEORIES:** • HCI Models : Cognitive models:- Socio-Organizational issues and stakeholder requirements Communication and collaboration models-Hypertext, Multimedia and WWW.	12
IV	**Mobile HCI:** • Mobile Ecosystem: Platforms, Application frameworks • Types of Mobile Applications: Widgets, Applications, Games • Mobile Information Architecture, Mobile 2.0, • Mobile Design: Elements of Mobile Design, Tools. - Case Studies	12
V	**WEB INTERFACE DESIGN:** Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies	12
	Total	**60**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	Understand thefundementals of HCI.	PO1
CO2	Understand the design and software process technologies.	PO1, PO2
CO3	Understand HCI models and theories.	PO4, PO6
CO4	Understand Mobile Ecosystem, types of Mobile Applications, mobile Architecture and design.	PO4, PO5, PO5
CO5	Understand the various types of Web Interface Design.	PO3, PO4

Text Book

1	Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, ”Human -Computer Interaction‖”, III Edition, Pearson Education, 2004 (UNIT I, II & III)
2	Brian Fling, ―”Mobile Design and Development”, I Edition, O‘Reilly Media Inc., 2009(UNIT–IV)
3	Bill Scott and Theresa Neil, ―Designing Web Interfaces‖, First Edition, O‘Reilly,

	2009. (UNIT-V)
Reference Books	
1.	Shneiderman, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, V Edition, Pearson Education.
Web Resources	
1.	https://www.interaction-design.org/literature/topics/human-computer-interaction
2.	https://link.springer.com/10.1007/978-0-387-39940-9_192
3.	https://en.wikipedia.org/wiki/Human%E2%80%93computer_interaction

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	3	2	2
CO2	3	3	2	3	2	2
CO3	3	3	3	3	2	2
CO4	3	3	2	3	2	2
CO5	3	3	2	3	3	2
Weightage ofcoursecontributedtoeachPSO	15	14	11	15	11	10

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Fuzzy Logic**	Elective	4	-	-	-	3	4	25	75	100
Course Objective											
CO1	To understand the basic concept of Fuzzy logic										
CO2	To learn the various operations on relation properties										
CO3	To study about the membership functions										
CO4	To learn about the Defuzzification and Fuzzy Rule-Based System										
CO5	To learn the concepts of Applications of Fuzzy Logic										

UNIT	Contents	No. of Hours
I	Introduction to Fuzzy Logic- Fuzzy Sets- Fuzzy Set Operations, Properties of Fuzzy Sets, Classical and Fuzzy Relations: Introduction-Cartesian Product of Relation-Classical Relations-Cardinality of Crisp Relation.	12
II	Operations on Crisp Relation-Properties of Crisp Relations-Composition Fuzzy Relations, Cardinality of Fuzzy Relations-Operations on Fuzzy Relations-Properties of Fuzzy Relations-Fuzzy Cartesian Product and Composition-Tolerance and Equivalence Relations ,Crisp Relation.	12
III	Membership Functions: Introduction, Features of Membership Function, Classification of Fuzzy Sets, Fuzzification, Membership Value Assignments, Intuition, Inference, Rank Ordering.	12
IV	Defuzzification: Introduction, Lambda Cuts for Fuzzy Sets, Lambda Cuts for Fuzzy Relations, DefuzzificationMethods, Fuzzy Rule-Based System: Introduction, Formation of Rules, Decomposition of Rules, Aggregation of Fuzzy Rules, Properties of Set of Rules.	12
V	Applications of Fuzzy Logic: Fuzzy Logic in Automotive Applications, Fuzzy Antilock Brake System-Antilock-Braking System and Vehicle Speed-Estimation Using Fuzzy Logic.	12
	Total	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	

1	Understand the basics of Fuzzy sets, operation and properties.	PO1
2	Apply Cartesian product and composition on Fuzzy relations and usethe tolerance and Equivalence relations.	PO1, PO2
3	Analyze various fuzzification methods and features of membership Functions.	PO4, PO6
4	Evaluate defuzzification methods for real time applications.	PO3, PO4, PO6
5	Design an application using Fuzzy logic and its Relations.	PO3, PO6
Text Book		
1	S. N. Sivanandam, S. Sumathi and S. N. Deepa-Introduction to Fuzzy Logic using MATLAB, Springer-Verlag Berlin Heidelberg 2007.	
Reference Books		
1.	Guanrong Chen and Trung Tat Pham- Introduction to Fuzzy Sets, Fuzzy Logic and Fuzzy Control Systems	
2.	Timothy J Ross , Fuzzy Logic with Engineering Applications	
Web Resources		
1.	https://www.javatpoint.com/fuzzy-logic	
2.	https://www.guru99.com/what-is-fuzzy-logic.html	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**2**	**3**	**2**	**2**
CO2	**3**	**3**	**2**	**3**	**2**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**2**	**3**	**2**	**2**
CO5	**3**	**3**	**2**	**2**	**3**	**2**
Weightage ofcoursecontributedtoeachPSO	**15**	**14**	**11**	**14**	**11**	**10**

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Artificial Intelligence**	Elective	4	-	-	-	3	4	25	75	100

Course Objective	
C1	To learn various concepts of AI Techniques.
C2	To learn various Search Algorithm in AI.
C3	To learn probabilistic reasoning and models in AI.
C4	To learn about Markov Decision Process.
C5	To learn various type of Reinforcement learning.

UNIT	**Contents**	**No. of Hours**
I	Introduction: Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree	12
II	Search Algorithms : Random search, Search with closed and open list, Depth first and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search	12
III	Probabilistic Reasoning : Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.	12
IV	Markov Decision process : MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.	12
V	Reinforcement Learning : Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning	12
	Total	**60**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
1	Understand the various concepts of AI Techniques.	PO1

2	Understand various Search Algorithm in AI.	PO1, PO2
3	Understand probabilistic reasoning and models in AI.	PO4, PO6
4	Understand Markov Decision Process.	PO4, PO5, PO6
5	Understand various type of Reinforcement learning Techniques.	PO3, PO4
Text Book		
1	Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach" , 3rd Edition, Prentice Hall.	
	Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill	
Reference Books		
1.	Trivedi, M.C., "A Classical Approach to Artifical Intelligence", Khanna Publishing House, Delhi.	
2.	SarojKaushik, "Artificial Intelligence", Cengage Learning India, 2011	
3.	David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010	
Web Resources		
1.	https://github.com/dair-ai/ML-Course-Notes	
2.	https://web.cs.hacettepe.edu.tr/~erkut/ain311.f21/index.html	
3.	https://www.toolify.ai/?gclid=CjwKCAjwvdajBhBEEiwAeMh1U6tlqU1LXlRFbcghLMZVwICm_4PkIRcDRE-VYq_wTDcuaQeq_bCHnhoCcm4QAvD_BwE	

Mapping with Programme Outcomes:

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	**3**	**2**	**1**	**2**	**1**	**2**
CO2	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**3**	**2**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**2**	**3**
CO5	**3**	**2**	**2**	**2**	**3**	**3**
Weightage ofcoursecontributedto eachPSO	**15**	**12**	**10**	**11**	**12**	**13**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Robotics and its Applications**	Elective	4	-	-	-	3	4	25	75	100
Learning Objectives											
LO1	To understand the robotics fundamentals										
LO2	Understand the sensors and matrix methods										
LO3	Understand the Localization: Self-localizations and mapping										
LO4	To study about the concept of Path Planning, Vision system										
LO5	To learn about the concept of robot artificial intelligence										

UNIT	Details	No. of Hours	Course Objective
I	Introduction: Introduction, brief history, components of robotics, classification, workspace, work-envelop, motion of robotic arm, end-effectors and its types, service robot and its application, Artificial Intelligence in Robotics.	12	
II	Actuators and sensors :Types of actuators, stepper-DC-servo-and brushless motors- model of a DC servo motor-types of transmissions-purpose of sensor-internal and external sensor-common sensors-encoders tachometers-strain gauge based force torque sensor-proximity and distance measuring sensors Kinematics of robots: Representation of joints and frames, frames transformation, homogeneous matrix, D-H matrix, Forward and inverse kinematics: two link planar (RR) and spherical robot (RRP). Mobile robot Kinematics: Differential wheel mobile robot	12	
III	Localization: Self-localizations and mapping - Challenges in localizations – IR based localizations – vision based localizations – Ultrasonic based localizations - GPS localization systems.	12	
IV	Path Planning: Introduction, path planning-overview-road map path planning-cell decomposition path	12	

	planning potential field path planning-obstacle avoidance-case studies Vision system: Robotic vision systems-image representation-object recognition-and categorization-depth measurement- image data compression-visual inspection-software considerations	
V	Application: Ariel robots-collision avoidance robots for agriculture-mining-exploration-underwater-civilian- and military applications-nuclear applications-space Applications-Industrial robots-artificial intelligence in robots-application of robots in material handling-continuous arc welding-spot welding-spray painting-assembly operation-cleaning-etc.	12
	Total	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Describe the different physical forms of robot architectures.	PO1
CO2	Kinematically model simple manipulator and mobile robots.	PO1, PO2
CO3	Mathematically describe a kinematic robot system	PO4, PO6
CO4	Analyze manipulation and navigation problems using knowledge of coordinate frames, kinematics, optimization, control, and uncertainty.	PO4, PO5, PO6
CO5	Program robotics algorithms related to kinematics, control, optimization, and uncertainty.	PO3, PO8

Text Book

1	RicharedD.Klafter. Thomas Achmielewski and MickaelNegin, Robotic Engineering and Integrated Approach, Prentice Hall India-Newdelhi-2001
2	SaeedB.Nikku, Introduction to robotics, analysis, control and applications, Wiley-India, 2 nd edition 2011

Reference Books

1.	Industrial robotic technology-programming and application by M.P.Groover et.al, McGrawhill2008
2.	Robotics technology and flexible automation by S.R.Deb, THH-2009

Web Resources

1.	https://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_robotics.htm
2.	https://www.geeksforgeeks.org/robotics-introduction/

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	3	3	2
CO2	3	3	2	3	3	2
CO3	3	3	3	3	3	2
CO4	3	3	2	3	3	2
CO5	3	3	2	3	3	2
Weightage ofcoursecontributedtoeachPSO	15	14	11	15	15	10

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Computational Intelligence**	Elective	4	-	-	-	3	4	25	75	100

Learning Objectives	
LO1	To identify and understand the basics of AI and its search.
LO2	To study about the Fuzzy logic systems.
LO3	Understand and apply the concepts of Neural Network and its functions.
LO4	Understand the concepts of Artifical Neural Network
LO5	To study about the Genetic Algorithm.

UNIT	Contents	No. of Hours
I	**Introduction to AI**: Problem formulation – AI Applications – Problems – State Space and Search – Production Systems – Breadth First and Depth First – Travelling Salesman Problem – Heuristic search techniques: Generate and Test – Types of Hill	12

	Climbing.	
II	**Fuzzy Logic Systems:** Notion of fuzziness – Operations on fuzzy sets – T-norms and other aggregation operators – Basics of Approximate Reasoning – Compositional Rule of Inference – Fuzzy Rule Based Systems – Schemes of Fuzzification – Inferencing – Defuzzification – Fuzzy Clustering – fuzzy rule-based classifier.	12
III	**Neural Networks:** What is Neural Network, Learning rules and various activation functions, Single layer Perceptions, Back Propagation networks, Architecture of Backpropagation (BP) Networks, Back propagation Learning, Variation of Standard Back propagation Neural Network, Introduction to Associative Memory, Adaptive Resonance theory and Self Organizing Map, Recent Applications	12
IV	**Artificial Neural Networks:** Fundamental Concepts – Basic Models of Artificial Neural Networks – Important Terminologies of ANNs – McCulloch-Pitts Neuron – Linear Separability – Hebb Network.	12
V	**Genetic Algorithm:** Introduction – Biological Background – Genetic Algorithm Vs Traditional Algorithm – Basic Terminologies in Genetic Algorithm – Simple GA – General Genetic Algorithm – Operators in Genetic Algorithm	12
	Total	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
1	Describe the fundamentals of artificial intelligence concepts and searching techniques.	PO1
2	Develop the fuzzy logic sets and membership function and defuzzification techniques.	PO1, PO2
3	Understand the concepts of Neural Network and analyze and apply the learning techniques	PO4, PO6
4	Understand the artificial neural networks and its	PO4, PO5, PO6

	applications.	
5	Understand the concept of Genetic Algorithm and Analyze the optimization problems using GAs.	PO3, PO5
Text Book		
1	S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", 2nd Edition, Wiley India Pvt. Ltd.	
2	Stuart Russell and Peter Norvig, "Artificial Intelligence - A Modern Approach", 2nd Edition, Pearson Education in Asia.	
3	S. Rajasekaran, G. A. Vijayalakshmi, "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications", PHI.	
Reference Books		
1.	F. Martin, Mcneill, and Ellen Thro, "Fuzzy Logic: A Practical approach", AP Professional, 2000. Chin Teng Lin, C. S. George Lee," Neuro-Fuzzy Systems", PHI	
2.	Chin Teng Lin, C. S. George Lee," Neuro-Fuzzy Systems", PHI.	
Web Resources		
1.	https://www.javatpoint.com/artificial-intelligence-tutorial	
2.	https://www.w3schools.com/ai/	

Mapping with Programme Outcomes:

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	1	2	1	2
CO2	3	3	2	2	3	3
CO3	3	3	2	3	3	2
CO4	3	2	3	2	2	3
CO5	3	2	2	2	3	3
Weightage ofcoursecontributedto eachPSO	15	12	10	11	12	13

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Grid Computing**	Elective	4	-	-	-	3	4	25	75	100

Course Objective	
LO1	To learn the basic construction and application of Grid computing.
LO2	To learn grid computing organization and their Role.
LO3	To learn Grid Computing Anotomy.
LO4	To learn Grid Computing road map.
LO5	To learn various type of Grid Architecture.

UNIT	**Contents**	**No. of Hours**
I	Introduction: Early Grid Activity, Current Grid Activity, Overview of Grid Business areas, Grid Applications, Grid Infrastructures.	12
II	Grid Computing organization and their Roles: Organizations Developing Grid Standards, and Best Practice Guidelines, Global Grid Forum (GCF), #Organization Developing Grid Computing Toolkits and Framework#, Organization and building and using grid based solutions to solve computing, commercial organization building and Grid Based solutions.	12
III	Grid Computing Anatomy: The Grid Problem, The conceptual of virtual organizations, # Grid Architecture # and relationship to other distributed technology.	12
IV	The Grid Computing Road Map: Autonomic computing, Business on demand and infrastructure virtualization, Service-Oriented Architecture and Grid, #Semantic Grids#.	12
V	Merging the Grid services Architecture with the Web Services Architecture: Service-Oriented Architecture, Web Service Architecture, #XML messages and Enveloping#, Service message description Mechanisms, Relationship between Web Services and Grid Services, Web services Interoperability and the role of the WS-I Organization.	12
	Total	**60**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	To understand the basic elements and concepts of Grid computing.	PO1

CO2	To understand the Grid computing toolkits and Framework.	PO1, PO2
CO3	To understand the concepts of Anotomy of Grid Computing.	PO4, PO6
CO4	To understand the concept of service oriented architecture.	PO4, PO5
CO5	To Gain knowledge on grid and web service architecture.	PO3, PO5
Text Book		
1	Joshy Joseph and Craig Fellenstein, Grid computing, Pearson / IBM Press, PTR, 2004.	
Reference Books		
1.	Ahmer Abbas and Graig computing, A Practical Guide to technology and applications, Charles River Media, 2003.	
Web Resources		
1.	https://en.wikipedia.org/wiki/Grid_computing	
2.	https://link.springer.com/chapter/10.1007/978-1-84882-409-6_4	
3.	https://www.redbooks.ibm.com/redbooks/pdfs/sg246778.pdf	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**2**	**3**	**2**	**2**
CO2	**3**	**3**	**2**	**3**	**2**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**2**	**3**	**2**	**2**
CO5	**3**	**3**	**2**	**3**	**2**	**2**
Weightage ofcoursecontributedtoeachPSO	**15**	**14**	**11**	**15**	**10**	**10**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Cloud Computing**	Elective	4	-	-	-	3	4	25	75	100

Course Objective		
LO1	Learning fundamental concepts and Technologies of Cloud Computing.	
LO2	Learning various cloud service types and their uses and pitfalls.	
LO3	To learn about Cloud Architecture and Application design.	
LO4	To know the various aspects of application design, benchmarking and security on the Cloud.	
LO5	To learn the various Case Studies in Cloud Computing.	
UNIT	**Contents**	**No. of Hours**
I	Introduction to Cloud Computing: Definition of Cloud Computing – Characteristics of Cloud Computing – Cloud Models – Cloud Service Examples – Cloud-based Services and Applications. Cloud Concepts and Technologies: Virtualization – Load balancing – Scalability and Elasticity – Deployment – Replication – Monitoring – Software Defined Networking – Network Function Virtualization – MapReduce – Identity and Access Management – Service Level Agreements – Billing.	12
II	Cloud Services Compute Services: Amazon Elastic Computer Cloud - Google Compute Engine - Windows Azure Virtual Machines Storage Services: Amazon Simple Storage Service - Google Cloud Storage - Windows Azure Storage Database Services: Amazon Relational Data Store - Amazon Dynamo DB - Google Cloud SQL - Google Cloud Data Store - Windows Azure SQL Database - Windows Azure Table Service Application Services: Application Runtimes and Frameworks - Queuing Services - Email Services - Notifiction Services - Media Services Content Delivery Services: Amazon CloudFront - Windows Azure Content Delivery Network Analytics Services: Amazon Elastic MapReduce - Google	12

	MapReduceService - Google BigQuery - Windows Azure HDInsight Deployment and Management Services: Amazon Elastic Beanstack - Amazon CloudFormation Identity and Access Management Services: Amazon Identiy and Access Management - Windows Azure Active Directory Open Source Private Cloud Software: CloudStack – Eucalyptus - OpenStack	
III	**Cloud Application Design:** Introduction – Design Consideration for Cloud Applications – Scalability – Reliability and Availability – Security – Maintenance and Upgradation – Performance – Reference Architectures for Cloud Applications – Cloud Application Design Methodologies: Service Oriented Architecture (SOA), Cloud Component Model, IaaS, PaaS and SaaS Services for Cloud Applications, Model View Controller (MVC), RESTful Web Services – Data Storage Approaches: RelationalApproach (SQL), Non-RelationalApproach (NoSQL).	12
IV	**Cloud Application Benchmarking and Tuning:** Introduction to Benchmarking – Steps in Benchmarking – WorkloadCharacteristics – Application Performance Metrics – Design Consideration for BenchmarkingMethodology – Benchmarking Tools and Types of Tests – DeploymentPrototyping. **Cloud Security:** Introduction – CSA Cloud Security Architecture – Authentication (SSO) – Authorization – Identity and Access Management – Data Security : Securing data atrest, securing data in motion – Key Management – Auditing.	12
V	**Case Studies:** Cloud Computing for Healthcare – Cloud Computing for EnergySystems - Cloud Computing for Transportation Systems - Cloud Computing for ManufacturingIndustry - Cloud Computing for Education.	12
	Total	**60**

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
CO 1	Understand the fundamental concepts and Technologies in Cloud Computing.	PO1
CO 2	Able to understand various cloud service types and their uses and pitfalls.	PO1, PO2
CO 3	Able to understand Cloud Architecture and Application design.	PO4, PO5
CO 4	Understand the various aspects of application design, benchmarking and security in the Cloud.	PO4, PO5, PO6
CO 5	Understand various Case Studies in Cloud Computing.	PO3, PO6
Text Book		
1	ArshdeepBahga, Vijay Madisetti, *Cloud Computing – A Hands On Approach*, Universities Press (India) Pvt. Ltd., 2018	
Reference Books		
1.	Anthony T Velte, Toby J Velte, Robert Elsenpeter, *Cloud Computing: A Practical Approach*, Tata McGraw-Hill, 2013.	
2.	Barrie Sosinsky, *Cloud Computing Bible*, Wiley India Pvt. Ltd., 2013.	
3.	David Crookes, *Cloud Computing in Easy Steps*, Tata McGraw Hill, 2015.	
4.	Dr. Kumar Saurabh, *Cloud Computing*, Wiley India, Second Edition 2012.	
Web Resources		
1.	https://en.wikipedia.org/wiki/Cloud_computing	
2.	https://link.springer.com/chapter/10.1007/978-3-030-34957-8_7	
3.	https://webobjects.cdw.com/webobjects/media/pdf/solutions/cloud-computing/121838-CDW-Cloud-Computing-Reference-Guide.pdf	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**2**
CO4	**3**	**3**	**2**	**3**	**3**	**2**

CO5	**3**	**3**	**2**	**3**	**3**	**2**
Weightage ofcoursecontributedtoeachPSO	**15**	**14**	**11**	**15**	**15**	**10**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
EC-DS	**Artificial Neural Networks**	Elective	4	-	-	-	3	4	25	75	100

Learning Objectives	
LO1	**Understand the basics of artificial neural networks, learning process, single layer and multi-layer perceptron networks.**
LO2	Understand the Error Correction and various learning algorithms and tasks.
LO3	Identify the various Single Layer Perception Learning Algorithm.
LO4	Identify the various Multi-Layer Perception Network.
LO5	Analyze the Deep Learning of various Neural network and its Applications.

UNIT	**Contents**	**No. of Hours**
I	Artificial Neural Model- Activation functions- Feed forward and Feedback, Convex Sets, Convex Hull and Linear Separability, Non-Linear Separable Problem - Multilayer Networks. Learning Algorithms- Error correction - Gradient Descent Rules, Perception Learning Algorithm, Perception Convergence Theorem.	12
II	Introduction, Error correction learning, Memory-based learning, Hebbian learning, Competitive learning, Boltzmann learning, credit assignment problem, Learning with and without teacher, learning tasks, Memory and Adaptation.	12

III	.Single layer Perception: Introduction, Pattern Recognition, Linear classifier, Simple perception, Perception learning algorithm, Modified Perception learning algorithm, Adaptive linear combiner, Continuous perception, Learning in continuous perception. Limitation of Perception.	12
IV	Multi-Layer Perception Networks: Introduction, MLP with 2 hidden layers, Simple layer of a MLP, Delta learning rule of the output layer, Multilayer feed forward neural network with continuous perceptions, Generalized delta learning rule, Back propagation algorithm	12
V	Deep learning- Introduction- Neuro architectures building blocks for the DL techniques, Deep Learning and Neocognitron, Deep Convolutional Neural Networks, Recurrent Neural Networks (RNN), feature extraction, Deep Belief Networks, Restricted Boltzman Machines, Training of DNN and Applications	12
	Total	**60**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	**Students will learn the basics of artificial neural networks with single layer and multi-layer perception networks.**	PO1
CO2	Learn about the Error Correction and various learning algorithms and tasks.	PO1, PO2
CO3	Learn the various Perception Learning Algorithm.	PO4, PO5
CO4	Learn about the various Multi-Layer Perception Network.	PO4, PO5, PO6
CO5	Understand the Deep Learning of various Neural network and its Applications.	PO3, PO5

Text Book	
1	Neural Networks A Classroom Approach- Satish Kumar, McGraw Hill- Second Edition.
2.	"Neural Network- A Comprehensive Foundation"- Simon Haykins, Pearson Prentice Hall, 2nd Edition, 1999.
Reference Books	

1.	Artificial Neural Networks-B. Yegnanarayana, PHI, New Delhi 1998.
Web Resources	
1.	https://www.w3schools.com/ai/ai_neural_networks.asp
2.	https://en.wikipedia.org/wiki/Artificial_neural_network
3.	https://link.springer.com/chapter/10.1007/978-3-642-21004-4_12

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**2**	**3**	**2**	**2**
CO2	**3**	**3**	**2**	**3**	**2**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**2**	**3**	**2**	**2**
CO5	**2**	**3**	**2**	**3**	**2**	**2**
Weightage ofcoursecontributedtoeach PSO	**14**	**14**	**11**	**15**	**10**	**10**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Introduction to Data Science**	Elective	4	-	-	-	3	4	25	75	100
Learning Objectives											
LO1	To learn about basics of Data Science and Big data.										
LO2	To learn about overview and building process of Data Science.										
LO3	To learn about various Algorithms in Data Science.										
LO4	To learn about Hadoop Framework.										
LO5	To learn about case study about Data Science.										
UNIT	**Contents**										**No. of Hours**
I	**Introduction:** Benefits and uses – Facts of data – Data science process –										12

	Big data ecosystem and data science	
II	**The Data science process**:Overview – research goals - retrieving data - transformation – Exploratory Data Analysis – Model building .	12
III	**Algorithms** :Machine learning algorithms – Modeling process – Types – Supervised – Unsupervised - Semi-supervised	12
IV	**Introduction to Hadoop** :Hadoop framework – Spark – replacing MapReduce– NoSQL – ACID – CAP – BASE – types	12
V	**Case Study**: Prediction of Disease - Setting research goals - Data retrieval – preparation - exploration - Disease profiling - presentation and automation	12
	Total	**60**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	Understand the basics in Data Science and Big data.	PO1
CO2	Understand overview and building process in Data Science.	PO1, PO2
CO3	Understand various Algorithms in Data Science.	PO3, PO6
CO4	Understand Hadoop Framework in Data Science.	PO4, PO5
CO5	Case study in Data Science.	PO3, PO5

Text Book

1	Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", manning publications 2016

Reference Books

1.	Roger Peng, "The Art of Data Science", lulu.com 2016.
2.	MurtazaHaider, "Getting Started with Data Science – Making Sense of Data with Analytics", IBM press, E-book.
3.	Davy Cielen, Arno D.B. Meysman, Mohamed Ali,"Introducing Data Science: Big Data, Machine Learning, and More, Using Python Tools", Dreamtech Press 2016.
4.	Annalyn Ng, Kenneth Soo, "Numsense! Data Science for the Layman: No Math Added", 2017,1st Edition.

5.	Cathy O'Neil, Rachel Schutt, "Doing Data Science Straight Talk from the Frontline", O'Reilly Media 2013.
6.	Lillian Pierson, "Data Science for Dummies", 2017 II Edition
Web Resources	
1.	https://www.w3schools.com/datascience/
2.	https://en.wikipedia.org/wiki/Data_science
3.	http://www.cmap.polytechnique.fr/~lepennec/en/post/references/refs/

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**2**	**3**	**2**	**2**
CO2	**3**	**3**	**2**	**3**	**2**	**2**
CO3	**3**	**3**	**3**	**3**	**2**	**2**
CO4	**3**	**3**	**2**	**3**	**2**	**2**
CO5	**3**	**3**	**2**	**3**	**3**	**2**
Weightage ofcoursecontributedtoeachPSO	**15**	**14**	**11**	**15**	**11**	**10**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
EC-DS	**Agile Project Management**	Elective	4	-	-	-	3	4	25	75	100
Learning Objectives											
LO1	Learning of software design, software technologies and APIs.										
LO2	Detailed demonstration about Agile development and testing techniques.										
LO3	Learning about Agile Planning and Execution.										
LO4	Understanding of Agile Management Design and Quality Check.										

LO5	Detailed examination of Agile development and testing techniques.	
UNIT	**Contents**	**No. of Hours**
I	**Introduction:Modernizing Project Management:** Project Management Needed a Makeover – Introducing Agile Project Management. **Applying the Agile Manifesto and Principles:** Understanding the Agile manifesto – Outlining the four values of the Agile manifesto – Defining the 15 Agile Principles – Adding the Platinum Principles – Changes as a result of Agile Values – The Agile litmus test. **Why Being Agile Works Better:** Evaluating Agile benefits – How Agile approaches beat historical approaches – Why people like being Agile.	12
II	**Being Agile** **Agile Approaches:** Diving under the umbrella of Agile approaches – Reviewing the Big Three: Lean, Scrum, Extreme Programming - Summary **Agile Environments in Action:** Creating the physical environment – Low-tech communicating – High-tech communicating – Choosing tools. **Agile Behaviours in Action:** Establishing Agile roles – Establishing new values – Changing team philosophy.	12
III	**Agile Planning and Execution** **Defining the Product Vision and Roadmap:** Agile planning – Defining the product vision – Creating a product roadmap – Completing the product backlog. **Planning Releases and Sprints:** Refining requirements and estimates – Release planning – Sprint planning. **Working Throughout the Day:** Planning your day – Tracking progress	12

	– Agile roles in the sprint – Creating shippable functionality – The end of the day. **Showcasing Work, Inspecting and Adapting:** The sprint review – The sprint retrospective. **Preparing for Release:** Preparing the product for deployment (the release sprint) – Preparing the operational support – Preparing the organization for product deployment - Preparing the marketplace for product deployment	
IV	**Agile Management** **Managing Scope and Procurement:** What's different about Agile scope management – Managing Agile scope – What's different about Agile procurement – Managing Agile procurement. **Managing Time and Cost:** What's different about Agile time management – Managing Agile schedules – What's different about Agile cost management – Managing Agile budgets. **Managing Team Dynamics and Communication:** What's different about Agile team dynamics – Managing Agile team dynamics – What's different about Agile communication – Managing Agile communication. **Managing Quality and Risk:** What'sdifferent about Agile quality – Managing Agile quality – What's different about Agile risk management – Managing Agile risk.	12
V	**Implementing Agile** **Building a Foundation:** Organizational and individual commitment – Choosing the right pilot team members – Creating and environment that enables Agility – Support Agility initially and over time. **Being a Change Agent:** Becoming Agile requires change – why change doesn't happen on its own – Platinum Edge's Change Roadmap – Avoiding pitfalls – Signs your changes are slipping. **Benefits, Factors for Success and Metrics:** Ten key benefits of Agile project management – Ten key factors for project success – Ten metrics	12

	for Agile Organizations.	
	Total	**60**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	Understanding of software design, software technologies and APIs using Agile Management.	PO1
CO2	Understanding of Agile development and testing techniques.	PO1, PO2
CO3	Understanding about Agile Planning and Execution using Sprint.	PO4, PO5
CO4	Understanding of Agile Management Design, scope, Procurement, managing Time and Cost and Quality Check.	PO4, PO5, PO6
CO5	Analysing of Agile development and testing techniques.	PO2, PO4

Text Book	
1	Mark C. Layton, Steven J. Ostermiller, Agile Project Management for Dummies, 2nd Edition, Wiley India Pvt. Ltd., 2018.
	Jeff Sutherland, Scrum – The Art of Doing Twice the Work in Half the Time, Penguin, 2014.
Reference Books	
1.	Mark C. Layton, David Morrow, *Scrum for Dummies*, 2nd Edition, Wiley India Pvt. Ltd., 2018.
2.	Mike Cohn, Succeeding with Agile – Software Development using Scrum, Addison-Wesley Signature Series, 2010.
3.	Alex Moore, Agile Project Management, 2020.
4.	Alex Moore, *Scrum*, 2020.
5.	Andrew Stellman and Jennifer Greene, *Learning Agile: Understanding Scrum, XP, Lean, and Kanban*, Shroff/O'Reilly, First Edition, 2014.
Web Resources	
1.	www.agilealliance.org/resources

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	2	3	2	2
CO2	3	3	2	3	2	2
CO3	3	3	3	3	2	2
CO4	3	3	2	3	2	2
CO5	3	3	2	3	3	2
Weightage ofcoursecontributedtoeachPSO	15	14	11	15	11	10

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	L	T	P	S	Credits	Inst. Hours	Marks		
								CIA	External	Total
EC-DS	Virtual Reality	4	-	-	-	3	4	25	75	100

Learning Objectives

LO1	To provide knowledge on basic principles of virtual & augmented reality
LO2	To have the ability to use its technology as a platform for real-world applications.

Unit	Contents	No. of Hours
I	Virtual Reality: The Three I's of VR – History – Early commercial VR Technology – Components of a VR System –Input Devices: Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces	12
II	Output Devices: Graphics Displays – Sound Displays – Haptic Feedback - Computer Architecture for VR: The Rendering Pipeline- PC Graphics Architecture - VR Programming: Toolkits and Scene Graphs – Traditional and Emerging Applications of VR	12
III	Augmented Reality: Introduction – Augmented Reality Concepts: Working Principle of AR –Concepts related to AR- Ingredients of an Augmented Reality Experience	12
IV	Augmented Reality Hardware– Augmented Reality Software– Software to create content for AR Application – Tools and Technologies	12
V	Augmented Reality Content: Introduction- Creating Content for Visual, Audio, and other senses – Interaction in AR - Mobile Augmented Reality: Introduction – Augmented Reality Applications Areas- Collaborative Augmented Reality	12

	Total Hours		**60**
CO	**Course Outcomes**		
CO1	Outline the basic terminologies, techniques and applications of VR and AR		
CO2	Describe different architectures and principles of VR and AR systems		
CO3	Use suitable hardware and software technologies for different varieties of virtual and augmented reality applications		
CO4	Analyze and explain the behavior of VR and AR technology relates to human perception and cognition		
CO5	Assess the importance of VR/AR content and interactions to implement for the real-world problem		
Textbooks			
1.		Grigore C. Burdea and Philippe Coiffet, "Virtual Reality Technology", Wiley Student Edition , Second Edition (Unit I: Chapter 1,2 & Unit II: Chapter 3,4,6,8 & 9)	
2.		Alan B. Craig(2013), "Understanding Augmented Reality: Concepts and Applications"(Unit III: Chapter 1, 2, Unit IV : Chapter 3, 4 & Unit V: Chapter 5,6,8)	
3.		Jon Peddie (2017), "Augmented Reality: Where We Will All Live", Springer, Ist Edition (Unit IV: Chapter 7 (Tools & Technologies)	
Reference Books			
1.		Alan Craig & William R. Sherman & Jeffrey D. Will, Morgan Kaufmann(2009), "Developing Virtual Reality Applications: Foundations of Effective Design", Elsevier(Morgan Kaufmann Publishers)	
2.		Paul Mealy (2018), "Virtual and Augmented Reality", Wiley	
3.		Bruno Arnaldi & Pascal Guitton & Guillaume Moreau(2018), "Virtual Reality and Augmented Reality: Myths and Realities", Wiley	
NOTE: Latest Edition of Textbooks May be Used			
Web Resources			
1.		http://msl.cs.uiuc.edu/vr/	
2.		http://www.britannica.com/technology/virtual-reality/Living-in -virtual-worlds	
3.		https://mobidev.biz/blog/augmented-reality-development-guide	

Mapping with Programme Outcomes:

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**2**	**3**	**3**	**2**

CO2	**3**	**3**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**2**
CO4	**3**	**3**	**2**	**3**	**3**	**2**
CO5	**3**	**3**	**2**	**3**	**3**	**2**
Weightage of course contributed to each PSO	**15**	**14**	**11**	**15**	**15**	**10**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
EC-DS	**Operating Systems**	Elective	4	-	-	-	3	4	25	75	100

Learning Objectives	
LO1	Understanding the design of the Operating System
LO2	Imparting knowledge on CPU scheduling, Process and Memory Management.
LO3	To code specialized programs for managing overall resources and operations of the computer.
LO4	Explain theJob and processor scheduling
LO5	To understand the Virtual Memory organization

UNIT	**Contents**	**No. of Hours**
I	**Introduction**: operating system, history (1990s to 2000 and beyond), distributed computing, parallel computation. **Process concepts:** definition of process, process states-Life cycle of a process, process management- process state transitions, process control block(PCB), process operations , suspend and resume, context switching, Interrupts -Interrupt processing, interrupt classes, Inter	12

	process communication-signals, message passing.	
II	**Asynchronous concurrent processes:** mutual exclusion- critical section, mutual exclusion primitives, implementing mutual exclusion primitives, Peterson's algorithm,software solutions to the mutual Exclusion Problem-, n-thread mutual exclusion- Lamports Bakery Algorithm. Semaphores – Mutual exclusion with Semaphores, thread synchronization with semaphores, counting semaphores, implementing semaphores. **Concurrent programming:** monitors, message passing	12
III	**Deadlock and indefinite postponement:** Resource concepts, four necessary conditions for deadlock, deadlock prevention, deadlock avoidance and Dijkstra's Banker's algorithm, deadlock detection, deadlock recovery	12
IV	**Job and processor scheduling:** scheduling levels, scheduling objectives, scheduling criteria, preemptive vs non-preemptive scheduling, interval timer or interrupting clock, priorities, scheduling algorithms- FIFO scheduling, RR scheduling, quantum size, SJF scheduling, SRT scheduling, HRN scheduling, multilevel feedback queues, Fair share scheduling	12
V	**Real Memory organization and Management::** Memory organization, Memory management, Memory hierarchy, Memory management strategies, contiguous vs non-contiguous memory allocation, single user contiguous memory allocation, fixed partition multiprogramming, variable partition multiprogramming, Memory swapping **Virtual Memory organization:** virtual memory basic concepts, multilevel storage organization, block mapping, paging basic concepts, segmentation, paging/segmentation systems.	12

	Virtual Memory Management: Demand Paging, Page replacement strategies	
	Total	**60**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	Define the fundamentals of OS and identify the concepts relevant to process , process life cycle, Scheduling Algorithms, Deadlock and Memory management	PO1
CO2	know the critical analysis of process involving various algorithms, an exposure to threads and semaphores	PO1, PO2
CO3	Have a complete study about Deadlock and its impact over OS. Knowledge of handling Deadlock with respective algorithms and measures to retrieve from deadlock.	PO4, PO5
CO4	Have complete knowledge of Scheduling Algorithms and its types.	PO4, PO5, PO6
CO5	understand memory organization and management	PO2, PO4

Text Book	
1	H.M. Deitel, Operating Systems, Third Edition, Pearson Education Asia, 2011
Reference Books	
1.	William Stallings, Operating System: Internals and Design Principles, Seventh Edition, Prentice-Hall of India, 2012.
2.	A. Silberschatz, and P.B. Galvin., Operating Systems Concepts, Nineth Edition, John Wiley &Sons(ASIA) Pte Ltd.,2012

Web Resources	
1.	Web resources from NDL Library, E-content from open-source libraries

Mapping with Programme Outcomes:

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**2**	**3**	**3**	**2**
CO2	**3**	**3**	**2**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**2**
CO4	**3**	**3**	**2**	**3**	**3**	**2**
CO5	**3**	**3**	**2**	**3**	**3**	**2**
Weightage of course contributed to each PSO	**15**	**14**	**11**	**15**	**15**	**10**

S-Strong-3 M-Medium-2 L-Low-1

Annexure II

Suggested topics in Skill Enhancement (SEC1-SEC8) Courses

1. Fundamentals of Information Technology
2. Introduction to HTML
3. Web Designing
4. PHP Programming
5. Software Testing
6. Understanding Internet
7. Office Automation
8. Quantitative Aptitude
9. Multimedia Systems
10. Advanced Excel
11. Biometrics
12. Cyber Forensics
13. Pattern Recognition
14. Enterprise Resource Planning
15. Simulation and Modelling
16. Organization Behavior and more

Subject Code	Subject Name	Category	L	T	P	S	Inst. hours	Credits	Marks		
									CIA	External	Total
SEC	**Fundamentals of Information Technology**	Skill Enha. Course (SEC)	2	-	-	-	2	2	25	75	100

Learning Objectives		
LO1		Understand basic concepts and terminology of information technology.
LO2		Have a basic understanding of personal computers and their operation
LO3		Be able to identify data storage and its usage
LO4		Get great knowledge of software and its functionalities
LO5		Understand about operating system and their uses

UNIT		**Contents**	**No. Of. Hours**
I		**Introduction to Computers:** Introduction, Definition, .Characteristics of computer, Evolution of Computer, Block Diagram Of a computer, Generations of Computer, Classification Of Computers, Applications of Computer, Capabilities and limitations of computer	**6**
II		**Basic Computer Organization:** Role of I/O devices in a computer system. Input Units: Keyboard, Terminals and its types. Pointing Devices, Scanners and its types, Voice Recognition Systems, Vision Input System, Touch Screen, Output Units: Monitors and its types. Printers: Impact Printers and its types. Non Impact Printers and its types, Plotters, types of plotters, Sound cards, Speakers.	**6**
III		**Storage Fundamentals:** Primary Vs Secondary Storage, Data storage & retrieval methods. Primary Storage: RAM ROM, PROM, EPROM, EEPROM. Secondary Storage: Magnetic Tapes, Magnetic Disks. Cartridge tape, hard disks, Floppy disks Optical Disks, Compact Disks, Zip Drive, Flash Drives	**6**
IV		**Software:** Software and its needs, Types of S/W. System Software: Operating System, Utility Programs Programming Language: Machine Language, Assembly Language, High Level Language their advantages & disadvantages. Application S/W and its types: Word Processing, Spread Sheets Presentation, Graphics, DBMS s/w	**6**
V		**Operating System:** Functions, Measuring System Performance, Assemblers, Compilers and Interpreters.Batch Processing, Multiprogramming, Multi Tasking, Multiprocessing, Time Sharing, DOS, Windows, Unix/Linux.	**6**

	TOTAL HOURS	**30**
	Course Outcomes	**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Learn the basics of computer, Construct the structure of the required things in computer, learn how to use it.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Develop organizational structure using for the devices present currently under input or output unit.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Concept of storing data in computer using two header namely RAM and ROM with different types of ROM with advancement in storage basis.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Work with different software, Write program in the software and applications of software.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Usage of Operating system in information technology which really acts as a interpreter between software and hardware.	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1		Anoop Mathew, S. KavithaMurugeshan (2009), " Fundamental of Information Technology", Majestic Books.
2		Alexis Leon, Mathews Leon," Fundamental of Information Technology", 2nd Edition.
3		S. K Bansal, "Fundamental of Information Technology".

Reference Books

1.		BhardwajSushilPuneet Kumar, "Fundamental of Information Technology"
2.		GG WILKINSON, "Fundamentals of Information Technology", Wiley-Blackwell
3.		A Ravichandran , "Fundamentals of Information Technology", Khanna Book Publishing

Web Resources

1.		https://testbook.com/learn/computer-fundamentals
2.		https://www.tutorialsmate.com/2020/04/computer-fundamentals-tutorial.html
3.		https://www.javatpoint.com/computer-fundamentals-tutorial
4.		https://www.tutorialspoint.com/computer_fundamentals/index.htm
5.		https://www.nios.ac.in/media/documents/sec229new/Lesson1.pdf

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	3	3	3	3
CO 3	3	3	3	3	3	3
CO 4	3	3	3	3	2	3
CO 5	3	3	2	3	3	2
Weightage of course contributed to each PSO	15	15	14	15	14	14

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
SEC	**INTRODUCTION TO HTML**	Skill Enha. Course (SEC)	2	-	-		2	25	75	100

Learning Objectives	
LO1	Insert a graphic within a web page.
LO2	Create a link within a web page.
LO3	Create a table within a web page.
LO4	Insert heading levels within a web page.
LO5	Insert ordered and unordered lists within a web page. Create a web page.

UNIT	Contents	No. Of. Hours
I	Introduction :WebBasics: WhatisInternet–Webbrowsers–WhatisWebpage – HTMLBasics:Understandingtags.	**6**
II	TagsforDocumentstructure(HTML,Head,BodyTag).Blockleveltextelements:Headingsparagraph(<p> tag)–Fontstyleelements:(bold,italic,font,small,strong,strike,bigtags)	**6**
III	Lists:Typesoflists:Ordered,Unordered– NestingLists–Othertags:Marquee,HR,BR-UsingImages –CreatingHyperlinks.	**6**

IV	Tables:CreatingbasicTable,Tableelements,Caption–Tableandcellalignment–Rowspan,Colspan–Cellpadding.	**6**
V	Frames:Frameset–TargetedLinks–Noframe–Forms:Input, Textarea,Select,Option.	**6**
	TOTAL HOURS	**30**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO 1	Knows the basic concept in HTML Concept of resources in HTML	PO1, PO2, PO3, PO4, PO5, PO6
CO 2	Knows Design concept. Concept of Meta Data Understand the concept of save the files.	PO1, PO2, PO3, PO4, PO5, PO6
CO 3	Understand the page formatting. Concept of list	PO1, PO2, PO3, PO4, PO5, PO6
CO 4	Creating Links. Know the concept of creating link to email address	PO1, PO2, PO3, PO4, PO5, PO6
CO 5	Concept of adding images Understand the table creation.	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks	
1	"Mastering HTML5 and CSS3 Made Easy", TeachUComp Inc., 2014.
2	**Thomas Michaud, "Foundations of Web Design: Introduction to HTML & CSS"**
Web Resources	
1.	https://www.teachucomp.com/samples/html/5/manuals/Mastering-HTML5-CSS3.pdf
2.	https://www.w3schools.com/html/default.asp

Mapping with Programme Outcomes:

CO/PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO 1	3	3	3	3	3	3
CO 2	3	3	2	3	3	3
CO 3	2	3	3	3	3	3
CO 4	3	3	3	3	3	3
CO 5	3	3	3	2	3	3
Weightage of course	14	15	14	14	15	15

contributed to each PSO						

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst.**	**Marks**		
									CIA	**External**	**Total**
SEC	**WEB DESIGNING**	Skill Enha. Course (SEC)	-	-	2	-	2	2	25	75	100

Learning Objectives	
LO1	Understand the basics of HTML and its components
LO2	To study about the Graphics in HTML
LO3	Understand and apply the concepts of XML and DHTML
LO4	Understand the concept of JavaScript
LO5	To identify and understand the goals and objectives of the Ajax

UNIT	**Details**	**No. of Hours**
I	**(Related programs to below concepts)** HTML: HTML-Introduction-tag basics- page structure-adding comments working with texts, paragraphs and line break. Emphasizing test- heading and horizontal rules-list-font size, face and color-alignment links-tables-frames.	30
II	Forms & Images Using Html: Graphics: Introduction-How to work efficiently with images in web pages, image maps, GIF animation, adding multimedia, data collection with html forms textbox, password, list box, combo box, text area, tools for building web page front page.	
III	XML & DHTML: Cascading style sheet (CSS)-what is CSS-Why we use CSS-adding CSS to your web pages-Grouping styles-extensible markup language	

	(XML).	
IV	Dynamic HTML: Document object model (DCOM)-Accessing HTML & CSS through DCOM Dynamic content styles & positioning-Event bubbling-data binding. JavaScript: Client-side scripting, What is JavaScript, How to develop JavaScript, simple JavaScript, variables, functions, conditions, loops and repetition,	
V	Advance script, JavaScript and objects, JavaScript own objects, the DOM and web browser environments, forms and validations.	
	Total	**30**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	Develop working knowledge of HTML	PO1, PO3, PO6, PO8
CO2	Ability to Develop and publish Web pages using Hypertext Markup Language (HTML).	PO1,PO2,PO3,PO6
CO3	Ability to optimize page styles and layout with Cascading Style Sheets (CSS).	PO3, PO5
CO4	Ability to develop a java script	PO1, PO2, PO3, PO7
CO5	An ability to develop web application using Ajax.	P02, PO6, PO7

Text Book	
1	Pankaj Sharma, “Web Technology”, SkKataria& Sons Bangalore 2011.
2	Mike Mcgrath, “Java Script”, Dream Tech Press 2006, 1st Edition.
3	Achyut S Godbole&AtulKahate, “Web Technologies”, 2002, 2nd Edition.
Reference Books	
1.	Laura Lemay, RafeColburn , Jennifer Kyrnin, “Mastering HTML, CSS &Javascript Web Publishing”, 2016.
2.	DT Editorial Services (Author), “HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery)”, Paperback 2016, 2nd Edition.
Web Resources	
1.	NPTEL & MOOC courses titled Web Design and Development.
2.	https://www.geeksforgeeks.org

Mapping with Programme Outcomes:

MAPPING TABLE						
CO/ PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	**3**	**2**	**1**	**2**	**1**	**2**
CO2	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**3**	**2**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**2**	**3**
CO5	**3**	**2**	**2**	**2**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**12**	**10**	**11**	**12**	**13**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
SEC	**PHP PROGRAMMING**	Skill Enha. Course (SEC)	-	-	2	-	2	2	25	75	100
Learn ing Objectives											
LO1	To provide the necessary knowledge on basics of PHP.										
LO2	To design and develop dynamic, database-driven web applications using PHP version.										
LO3	To get an experience on various web application development techniques.										
LO4	To learn the necessary concepts for working with the files using PHP.										
LO5	To get a knowledge on OOPS with PHP.										
UNIT	**Contents**									**No. of Hours**	
I	**(Related programs to below concepts)** Introduction to PHP -Basic Knowledge of websites -Introduction of Dynamic Website -Introduction to PHP -Scope of PHP -XAMPP and WAMP Installation									30	
II	PHP Programming Basics -Syntax of PHP -Embedding PHP in										

	HTML -Embedding HTML in PHP. Introduction to PHP Variable -Understanding Data Types -Using Operators -Using Conditional Statements -If(), else if() and else if condition Statement.	
III	Switch() Statements -Using the while() Loop -Using the for() Loop PHP Functions. PHP Functions -Creating an Array -Modifying Array Elements -Processing Arrays with Loops - Grouping Form Selections with Arrays -Using Array Functions.	
IV	PHP Advanced Concepts -Reading and Writing Files -Reading Data from a File.	
V	Managing Sessions and Using Session Variables -Destroying a Session -Storing Data in Cookies -Setting Cookies.	
	Total	**30**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Write PHP scripts to handle HTML forms	PO1,PO4,PO6
CO2	Write regular expressions including modifiers, operators, and metacharacters.	PO2,PO5,PO7.
CO3	Create PHP Program using the concept of array.	PO3,PO4,PO5.
CO4	Create PHP programs that use various PHP library functions	PO2,PO3,PO5
CO5	Manipulate files and directories.	PO3,PO5,PO6.

Text Book	
1	Head First PHP & MySQL: A Brain-Friendly Guide- 2009-Lynn mighley and Michael Morrison.
2	The Joy of PHP: A Beginner's Guide to Programming Interactive Web Applications with PHP and MySQL- Alan Forbes

Reference Books	
1.	PHP: The Complete Reference-Steven Holzner.
2.	DT Editorial Services (Author), "*HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery)*", Paperback 2016, 2nd Edition.

Web Resources	
1.	Opensource digital libraries: PHP Programming
2.	https://www.w3schools.com/php/default.asp

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	2	1	2	1	2
CO2	3	3	2	2	3	3
CO3	3	3	2	3	3	2
CO4	3	2	3	2	2	3
CO5	3	2	2	2	3	3
Weightage of course contributed to each PSO	15	12	10	11	12	13

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC	**SoftwareTesting**	Skill Enha. Course (SEC)	2	-	-	-	2	2	25	75	100

Learning Objectives	
LO1	To study fundamental concepts in software testing
LO2	To discuss various software testing issues and solutions in software unit test, integration and system testing.
LO3	To study the basic concept of Data flow testing and Domain testing.
LO4	To Acquire knowledge on path products and path expressions.
LO5	To learn about Logic based testing and decision tables

UNIT	Contents	No. of Hours

I	Introduction: Purpose–Productivity and Quality in Software–TestingVsDebugging–Model for Testing–Bugs–Types of Bugs – Testing and Design Style.	6
II	Flow / Graphs and Path Testing – Achievable paths – Path instrumentation Application Transaction FlowTesting Techniques.	6
III	Data Flow Testing Strategies - Domain Testing:Domains and Paths – Domains and Interface Testing.	6
IV	Linguistic –Metrics – Structural Metric – Path Products and Path Expressions.SyntaxTesting–Formats–Test Cases	6
V	Logic Based Testing–Decision Tables–Transition Testing–States, State Graph, StateTesting.	6
	Total	**30**

Course Outcomes		**Program Outcomes**
CO	On completion of this course, students will	
CO1	Students learn to apply software testing knowledge and engineering methods	PO1
CO2	Have an ability to identify the needs of software test automation, and define and develop a test tool to support test automation.	PO1, PO2
CO3	Have an ability understand and identify various software testing problems, and solve these problems by designing and selecting software test models, criteria, strategies, and methods.	PO4, PO6
CO4	Have basic understanding and knowledge of contemporary issues in software testing, such as component-based software testing problems	PO4, PO5, PO6
CO5	Have an ability to use software testing methods and modern software testing tools for their testing projects.	PO3, PO8

Text Book

1	B.Beizer,"SoftwareTestingTechniques",IIEdn.,DreamTechIndia,NewDelhi, 2003.
2	K.V.K.Prasad,"SoftwareTestingTools",DreamTech.India,NewDelhi,2005

Reference Books

1.	I.Burnstein,2003,"PracticalSoftwareTesting",SpringerInternationalEdn.
2.	E. Kit, 1995, "Software Testing in the Real World: Improving the Process", PearsonEducation,Delhi.
3.	R. Rajani,andP.P.Oak,2004,"SoftwareTesting",TataMcgrawHill,New Delhi.
Web Resources	
1.	https://www.javatpoint.com/software-testing-tutorial
2.	https://www.guru99.com/software-testing.html

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**3**	**2**	**1**	**2**	**1**	**2**
CO2	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**3**	**2**	**3**	**3**	**2**
CO4	**3**	**2**	**3**	**2**	**2**	**3**
CO5	**3**	**2**	**2**	**2**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**12**	**10**	**11**	**12**	**13**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
SEC	**UNDERSTANDING INTERNET**	Skill Enha. Course (SEC)	2	-	-		2	25	75	100

Learning Objectives	
LO1	Knowledge of Internet medium
LO2	Internet as a mass medium
LO3	Features of Internet Technology,
LO4	Internetassourceof infotainment
LO5	Studyofinternet audiences andabout cyber crime

UNIT	Contents	No. Of. Hours
I	Theemergenceofinternetasamassmedium–theworldof‘worldwideweb’.	**6**
II	Featuresofinternetasatechnology.	**6**
III	Internetasasourceofinfotainment – classificationbasedoncontentandstyle.	**6**
IV	Demographic and psychographic descriptions of internet ‘audiences’ – effect of internet onthevalues and life-styles.	**6**
V	Presentissuessuchascybercrimeandfuturepossibilities.	**6**
	TOTAL HOURS	**30**

Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO1	Knows the basic concept in internet Concept of mass medium and world wide web	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Knows the concept of internet as a technology.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Understand the concept of infotainment and classification based on content and style	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Can be able to know about Demographic and psychographic description of internet	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Understand the concept of cyber crime and future possibilities	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1. 01. Barnouw, E and Krishnaswamy S [1990] Indian Film. New York, OUP.
2. Kumar, Keval [1999] Mass Communication in India. Mumbai, Jaico.
3. Srivastava, K M [1992] Media Issues. Sterling Publishers Pvt Ltd.

Reference Book

1. Acharya, R N [1987] Television in India. Manas Publications, New Delhi.

2	Barnouw, E [1974] Documentary – A History of Nonfiction. Oxford, OUP
3	Luthra, H R [1986] Indian Broadcasting. Ministry of I& B, New Delhi.
4	Vasudev, Aruna [1986] The New Indian Cinema. Macmillan India, New Delhi.
Web Resources	
1.	https://www.teachucomp.com/samples/html/5/manuals/Mastering-HTML5-CSS3.pdf
2.	https://www.w3schools.com/html/default.asp

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	3	3	3	3	3
CO 2	3	3	2	3	3	3
CO 3	2	3	3	3	3	3
CO 4	3	3	3	3	3	3
CO 5	3	3	3	2	3	3
Weightage of course contributed to each PSO	14	15	14	14	15	15

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC	**OFFICE AUTOMATION**	Skill Enha. Course (SEC)	**2**	-	-	-	2	2	25	75	100
Learning Objectives											
LO1	Understand the basics of computer systems and its components.										
LO2	Understand and apply the basic concepts of a word processing package.										
LO3	Understand and apply the basic concepts of electronic spreadsheet software.										

LO4	Understand and apply the basic concepts of database management system.	
LO5	Understand and create a presentation using PowerPoint tool.	
UNIT	**Contents**	**No. of Hours**
I	**Introductory concepts:** Memory unit– CPU-Input Devices: Key board, Mouse and Scanner.Outputdevices:Monitor,Printer.IntroductiontoOperatingsystems&itsfeatures:DOS– UNIX–Windows. IntroductiontoProgrammingLanguages.	6
II	**Word Processing:** Open, Save and close word document; Editing text – tools, formatting, bullets;SpellChecker - Document formatting – Paragraph alignment, indentation, headers and footers,numbering;printing–Preview,options,merge.	6
III	**Spreadsheets:**Excel– opening,enteringtextanddata,formatting,navigating;Formulas– entering,handlingand copying;Charts–creating,formatting and printing,analysistables,preparationoffinancialstatements,introductiontodataanalytics.	6
IV	**Database Concepts:** The concept of data base management system; Data field, records, and files,Sorting and indexing data; Searching records. Designing queries, and reports; Linking of datafiles; Understanding Programming environment in DBMS; Developing menu drive applicationsinquerylanguage(MS–Access).	6
V	**Power point:** Introduction to Power point - Features – Understanding slide typecasting &viewingslides – creating slide shows. Applying special object – including objects & pictures – Slidetransition–Animationeffects,audioinclusion,timers.	6
	Total	**30**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Possess the knowledge on the basics of computers	PO1,PO2,PO3,PO6,PO8

	and its components	
CO2	Gain knowledge on Creating Documents, spreadsheet and presentation.	PO1,PO2,PO3,PO6
CO3	Learn the concepts of Database and implement the Query in Database.	PO3,PO5,PO7
CO4	Demonstrate the understanding of different automation tools.	PO3,PO4,PO5,PO7
CO5	Utilize the automation tools for documentation, calculation and presentation purpose.	PO4,PO6,PO7,PO8
Text Book		
1	PeterNorton,"IntroductiontoComputers"–TataMcGraw-Hill.	
Reference Books		
1.	Jennifer Ackerman Kettel, Guy Hat-Davis, Curt Simmons, "Microsoft 2003", Tata McGrawHill.	
Web Resources		
1.	https://www.udemy.com/course/office-automation-certificate-course/	
2.	https://www.javatpoint.com/automation-tools	

Mapping with Programme Outcomes:

MAPPING TABLE						
CO/ PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	**3**	**2**	**2**	**3**	**3**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**14**	**14**	**15**	**15**	**15**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC	**Quantitative Aptitude**	Skill Enha. Course (SEC)	2	-	-	-	2	2	25	75	100

Learning Objectives	
LO1	To understand the basic concepts of numbers
LO2	Understand and apply the concept of percentage, profit & loss
LO3	To study the basic concepts of time and work, interests
LO4	To learn the concepts of permutation, probability, discounts
LO5	To study about the concepts of data representation, graphs

UNIT	**Contents**	**No. of Hours**
I	Numbers-HCF and LCM of numbers-Decimal fractions-Simplification-Square root and cube roots - Average-problems on Numbers.	6
II	Problems on Ages - Surds and Indices - percentage - profits and loss - ratio and proportion-partnership-Chain rule.	6
III	Time and work - pipes and cisterns - Time and Distance - problems on trains -Boats and streams - simple interest - compound interest - Logarithms - Area-Volume and surface area -races and Games of skill.	6
IV	Permutation and combination-probability-True Discount-Bankers Discount – Height and Distances-Odd man out & Series.	6
V	Calendar - Clocks - stocks and shares - Data representation - Tabulation – Bar Graphs- Pie charts-Line graphs.	6
	Total	**60**

Course Outcomes		**Programme Outcome**
CO	On completion of this course, students will	
CO1	understand the concepts, application and the problems of	PO1

	numbers	
CO2	To have basic knowledge and understanding about percentage, profit & loss related processings	PO1, PO2
CO3	To understand the concepts of time and work	PO4, PO6
CO4	Speaks about the concepts of probability, discount	PO4, PO5
CO5	Understanding the concept of problem solving involved in stocks & shares, graphs	PO3, PO6
Text Book		
1	"QuantitativeAptitude",R.S.AGGARWAL.,S.Chand&CompanyLtd.,	
Reference Books		
1.		
Web Resources		
1.	https://www.javatpoint.com/aptitude/quantitative	
2.	https://www.toppr.com/guides/quantitative-aptitude/	

Mapping with Programme Outcomes:

MAPPING TABLE						
CO/ PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	**3**	**2**	**1**	**2**	**2**	**2**
CO2	**2**	**3**	**1**	**3**	**2**	**2**
CO3	**1**	**3**	**1**	**1**	**3**	**1**
CO4	**1**	**2**	**1**	**1**	**3**	**1**
CO5	**1**	**2**	**1**	**1**	**3**	**3**
Weightage of course contributed to each PSO	**8**	**12**	**5**	**8**	**13**	**9**

S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC	**Multimedia Systems**	Skill Enha. Course (SEC)	2	-	-	-	2	2	25	75	100

Learning Objectives	
LO1	Understand the definition of Multimedia
LO2	To study about the Image File Formats, SoundsAudio File Formats
LO3	Understand the concepts of Animation and Digital Video Containers
LO4	To study about the Stage of Multimedia Project
LO5	Understand the concept of Ownership of Content Created for Project Acquiring Talent

UNIT	Contents	No. of Hours	Course Objective
I	Multimedia Definition-Use Of Multimedia-Delivering Multimedia- Text: About Fonts and Faces - Using Text in Multimedia.	6	
II	Computers and Text Font Editing and Design Tools-Hypermedia and Hypertext. Images: Plan Approach - Organize Tools - Configure Computer Workspace -Making Still Images - Color - Image File Formats.	6	
III	Sound: The Power of Sound -DigitalAudio-MidiAudio-Midivs.DigitalAudio-MultimediaSystemSoundsAudio File Formats - Vaughan's Law of Multimedia Minimums - Adding Sound to Multimedia Project	6	
IV	Animation: The Power of Motion-Principles of Animation-Animation by Computer - Making Animations that Work.	6	
V	Video: Using Video - Working with Video and Displays-Digital Video Containers-Obtaining Video Clips -Shooting and Editing Video	6	
	Total	**30**	

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	understand the concepts, importance, application and the process of developing multimedia	PO1

CO2	to have basic knowledge and understanding about image related processings	PO1, PO2
CO3	To understand the framework of frames and bit images to animations	PO4, PO6
CO4	Speaks about the multimedia projects and stages of requirement in phases of project.	PO4, PO5, PO6
CO5	Understanding the concept of cost involved in multimedia planning, designing, and producing	PO3, PO6
Text Book		
1	TayVaughan,"Multimedia:MakingItWork",8thEdition,Osborne/McGraw-Hill,2001.	
Reference Books		
1.	RalfSteinmetz&KlaraNahrstedt"MultimediaComputing,Communication&Applications",PearsonEducation,2012.	
Web Resources		
1.	https://www.geeksforgeeks.org/multimedia-systems-with-features-or-characteristics/	

Mapping with Programme Outcomes:

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	**2**	**2**	**3**	**3**	**3**	**2**
CO2	**2**	**3**	**2**	**3**	**2**	**1**
CO3	**1**	**2**	**3**	**3**	**3**	**2**
CO4	**3**	**2**	**2**	**2**	**1**	**2**
CO5	**2**	**3**	**1**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**10**	**12**	**11**	**14**	**12**	**10**

Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC	**Advanced Excel**	Skill Enha. Course (SEC)	-	-	2	-	2	2	25	75	100

Learning Objectives	
LO1	Handle large amounts of data
LO2	Aggregate numeric data and summarize into categories and subcategories
LO3	Filtering, sorting, and grouping data or subsets of data
LO4	Create pivot tables to consolidate data from multiple files
LO5	Presenting data in the form of charts and graphs

UNIT	Contents	No. of Hours
I	**(Related programs to below concepts)** Basics of Excel- Customizing common options- Absolute and relative cells- Protecting and un-protecting worksheets and cells- Working with Functions - Writing conditional expressions - logical functions - lookup and reference functions- VlookUP with Exact Match, Approximate Match- Nested VlookUP with Exact Match- VlookUP with Tables, Dynamic Ranges- Nested VlookUP with Exact Match- Using VLookUP to consolidate Data from Multiple Sheets	30
II	Data Validations - Specifying a valid range of values - Specifying a list of valid values- Specifying custom validations based on formula - Working with Templates Designing the structure of a template- templates for standardization of worksheets - Sorting and Filtering Data - Sorting tables- multiple-level sorting- custom sorting- Filtering data for selected view - advanced filter options- Working with Reports Creating subtotals- Multiple-level subtotal.	
III	Creating Pivot tables Formatting and customizing Pivot	

	tables- advanced options of Pivot tables- Pivot charts- Consolidating data from multiple sheets and files using Pivot tables- external data sources- data consolidation feature to consolidate data- Show Value As % of Row, % of Column, Running Total, Compare with Specific Field- Viewing Subtotal under Pivot- Creating Slicers.	
IV	More Functions Date and time functions- Text functions- Database functions- Power Functions - Formatting Using auto formatting option for worksheets- Using conditional formatting option for rows, columns and cells- What If Analysis - Goal Seek- Data Tables- Scenario Manager.	
V	Charts - Formatting Charts- 3D Graphs- Bar and Line Chart together- Secondary Axis in Graphs- Sharing Charts with PowerPoint / MS Word, Dynamically- New Features Of Excel Sparklines, Inline Charts, data Charts- Overview of all the new features.	
	Total	**30**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Work with big data tools and its analysis techniques.	PO1
CO2	Analyze data by utilizing clustering and classification algorithms.	PO1, PO2
CO3	Learn and apply different mining algorithms and recommendation systems for large volumes of data.	PO4, PO6
CO4	Perform analytics on data streams.	PO4, PO5, PO6
CO5	Learn No-SQL databases and management.	PO3, PO8

Text Book	
1	**Excel 2019 All**
2	**Microsoft Excel 2019 Pivot Table Data Crunching**
Reference Books	
1	Excel 2019 All-in-One for Dummies, Greg Harvey, 1st edition

Web Resources	
1.	https://www.simplilearn.com
2	https://www.javatpoint.com
3	https://www.w3schools.com

Mapping with Programme Outcomes:

CO/ PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO1	3	3	2	3	3	3
CO2	3	2	2	3	3	3
CO3	3	3	2	3	3	3
CO4	3	2	2	3	3	3
CO5	3	2	2	3	3	3
Weightage of course contributed to each PSO	15	12	10	15	15	15

Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC	**Biometrics**	Specific Elective	2	-	-	-	2	2	25	75	100
Learning Objectives											
LO1	Identify the various biometric technologies.										

LO2	Design of biometric recognition.	
LO3	Develop simple applications for privacy	
LO4	Understand the need of biometric in the society	
LO5	Understand the scope of biometric techniques	
UNIT	**contents**	**No. of Hours**
I	**Introduction**: What is Biometrics, History, Types of biometric Traits, General architecture of biometric systems, Basic working of biometric matching, Biometric system error and performance measures, Design of biometric system, Applications of biometrics, Biometrics versus traditional authentication methods. **Face Biometrics:** Introduction, Background of Face Recognition, Design of Face Recognition System, Neural Network for Face Recognition, Face Detection in Video Sequences, Challenges in Face Biometrics, .7 Face Recognition Methods, Advantages and Disadvantages.	6
II	**Retina and Iris Biometrics:** Introduction, Performance of Biometrics, Design of Retina Biometrics, Design of Iris Recognition System, Iris Segmentation Method , Determination of Iris Region, Determination of Iris Region, Applications of Iris Biometrics, Advantages and Disadvantages **Vein and Fingerprint Biometrics:** Introduction, Biometrics Using Vein Pattern of Palm, Fingerprint Biometrics, Fingerprint Recognition System, Minutiae Extraction, Fingerprint Indexing, Experimental Results, Advantages and Disadvantages.	6
III	**Privacy Enhancement Using Biometrics:** Introduction, Privacy Concerns Associated with Biometric Deployments, Identity and Privacy, Privacy Concerns, Biometrics with Privacy Enhancement, Comparison of Various Biometrics in Terms of Privacy, Soft Biometrics. **Multimodal Biometrics:** Introduction to Multimodal Biometrics , Basic Architecture of Multimodal Biometrics, Multimodal Biometrics Using Face and Ear, Characteristics and Advantages of Multimodal Biometrics, Characteristics and Advantages of Multimodal Biometrics.	6
IV	**Watermarking Techniques:** Introduction, Data Hiding Methods, Basic Framework of Watermarking,	6

	Classification of Watermarking, Applications of Watermarking, Attacks on Watermarks, Performance Evaluation, Characteristics of Watermarks, General Watermarking Process, Image Watermarking Techniques, Watermarking Algorithm, Experimental Results, Effect of Attacks on Watermarking Techniques, Attacks on Spatial Domain Watermarking.	
V	**Scope and Future:** Scope and Future Market of Biometrics, Biometric Technologies, Applications of Biometrics, Biometrics and Information Technology Infrastructure, Role of Biometrics in Enterprise Security, Role of Biometrics in Border Security, Smart Card Technology and Biometrics, Radio Frequency Identification (RFID) Biometrics, DNA Biometrics, Comparative Study of Various Biometric Techniques. **Biometric Standards:** Introduction, Standard Development Organizations, Application Programming Interface (API), Information Security and Biometric Standards, Biometric Template Interoperability.	6
	Total	**30**
Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	To understand the basic concepts and the functionality of the Biometrics, Face Biometrics, Types, Architecture and Applications.	PO1, PO3, PO6, PO8
CO2	To know the concepts Retina and Iris Biometrics and Vein and Fingerprint Biometrics.	PO1,PO2,PO3,PO6
CO3	To analyse the Privacy Enhancement and Multimodal Biometrics.	PO3, PO5
CO4	To get analyticalidea on Watrmarking Techniques	PO1, PO2, PO3, PO7
CO5	To Gain knowledge on Future scope of Biometrics,and Study of various Biometric Techniques.	PO2, PO6, PO7
Recommended Text		
1.	Biometrics: Concepts and Applications by G.R Sinha and SandeepB.Patil , Wiley, 2013	
References Books		

1.	Guide to Biometrics by Ruud M. Bolle , SharathPankanti, Nalinik.Ratha, Andrew W.Senior, Jonathan H. Connell , Springer 2009
2.	Introduction to Biometrics by Anil k. Jain, Arun A. Ross, KarthikNandakumar
3.	Hand book of Biometrics by Anil K. Jain, Patrick Flynn, ArunA.Ross.
Web Resources	
1.	https://www.tutorialspoint.com/biometrics/index.htm
2.	https://www.javatpoint.com/biometrics-tutorial
3.	https://www.thalesgroup.com/en/markets/digital-identity-and-security/government/inspired/biometrics

Mapping with Programme Outcomes:

MAPPING TABLE						
CO/ PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	**3**	**1**	**2**	**2**	**2**	**2**
CO2	**2**	**3**	**2**	**3**	**3**	**1**
CO3	**2**	**2**	**2**	**3**	**3**	**2**
CO4	**3**	**2**	**1**	**3**	**3**	**2**
CO5	**3**	**3**	**2**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**13**	**11**	**9**	**14**	**14**	**10**

Strong-3M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC	**Cyber Forensics**	Skill Enha. Course (SEC)	2	-	-	-	2	2	25	75	100

Learning Objectives	
LO1	Understand the definition of computer forensics fundamentals.
LO2	To study about the Types of Computer Forensics Evidence
LO3	Understand and apply the concepts of Duplication and Preservation of Digital Evidence
LO4	Understand the concepts of Electronic Evidence and Identification of Data
LO5	To study about the Digital Detective, Network Forensics Scenario, Damaging Computer Evidence.

UNIT	Contents	No. of Hours
I	**Overview of Computer Forensics Technology:** Computer Forensics Fundamentals: What is Computer Forensics Use of ComputerForensics in Law Enforcement, Computer Forensics Assistance to HumanResources/Employment Proceedings, Computer Forensics Services, Benefits of professionalForensics Methodology, Steps taken by Computer Forensics Specialists. Types of Computer.Forensics Technology: Types of Business Computer Forensic, Technology–Types ofMilitary Computer Forensic Technology–Types of Law Enforcement–Computer Forensic. Technology–Types of Business Computer Forensic Technology.	6
II	**Computer Forensics Evidence and capture:** Data Recovery: Data Recovery Defined, Data Back–up and Recovery, The Role of Back –up in Data Recovery, The Data –Recovery Solution. Evidence Collection and Data Seizure: Collection Options, Obstacles, Types of Evidence, The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collections, Artefacts, Collection Steps, Controlling Contamination: The chain of custody.	6

III	**Duplication and Preservation of Digital Evidence:** Processing steps, Legal Aspects of collecting and Preserving Computerforensic Evidence. Computer image Verification and Authentication: Special needs of Evidential Authentication, Practical Consideration, Practical Implementation.	6
IV	**Computer Forensics Analysis:** Discovery of Electronic Evidence: ElectronicDocument Discovery: A Powerful New Litigation Tool. Identification of Data: Time Travel, Forensic Identification and Analysis of Technical Surveillance Devices.	6
V	**Reconstructing Past Events:** How to Become a Digital Detective, Useable File Formats,Unusable File Formats, Converting Files.Networks: Network Forensics Scenario, a technical approach, Destruction Of E–Mail, Damaging Computer Evidence, DocumentingThe Intrusion on Destruction of Data, System Testing.	6
	Total	**30**
Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Understand the definition of computer forensics fundamentals.	PO1
CO2	Evaluate the different types of computer forensics technology.	PO1, PO2
CO3	Analyze various computer forensics systems.	PO4, PO6
CO4	Apply the methods for data recovery, evidence collection and data seizure.	PO4, PO5, PO6
CO5	Gain your knowledge of duplication and preservation of digital evidence.	PO3, PO8
Text Book		
1	John R. Vacca, "Computer Forensics: Computer Crime Investigation", 3/E ,Firewall Media, New Delhi, 2002.	
Reference Books		
1.	Nelson, Phillips Enfinger, Steuart,"Computer Forensics and Investigations" Enfinger, Steuart,	

	CENGAGE Learning, 2004.
2.	Anthony Sammes and Brian Jenkinson,"Forensic Computing: A Practitioner's Guide", Second Edition, Springer–Verlag London Limited, 2007.
3.	.Robert M.Slade," Software Forensics Collecting Evidence from the Scene of a Digital Crime", TMH 2005.
Web Resources	
1.	https://www.vskills.in
2.	https://www.hackingarticles.in/best-of-computer-forensics-tutorials/

Mapping with Programme Outcomes:

MAPPING TABLE						
CO/ PSO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**	**PSO 6**
CO1	**3**	**1**	**2**	**2**	**2**	**2**
CO2	**2**	**3**	**2**	**3**	**3**	**1**
CO3	**3**	**2**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**1**	**3**	**3**	**2**
CO5	**3**	**3**	**2**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**14**	**12**	**9**	**14**	**14**	**10**

Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC	**Pattern Recognition**	Skill Enha. Course (SEC)	2	-	-	-	2	2	75	25	100

Learning Objectives	
LO1	To learn the fundamentals of Pattern Recognition techniques
LO2	To learn the various Statistical Pattern recognition techniques
LO3	To learn the linear discriminant functions and unsupervised learning and clustering
LO4	To learn the various Syntactical Pattern recognition techniques
LO5	To learn the Neural Pattern recognition techniques

UNIT	Contents	No. of Hours	Course Objective
I	**PATTERN RECOGNITION OVERVIEW**: Pattern recognition, Classification and Description-Patterns and feature Extraction with Examples-Training and Learning in PR systems-Pattern recognition Approaches	6	CO1
II	**STATISTICAL PATTERN RECOGNITION**: Introduction to statistical Pattern Recognition-supervised Learning using Parametric and Non-Parametric Approaches.	6	CO2
III	**LINEAR DISCRIMINANT FUNCTIONS AND UNSUPERVISED LEARNING AND CLUSTERING**: Introduction-Discrete and binary Classification Problems-Techniques to directly Obtain linear Classifiers - Formulation of Unsupervised Learning Problems-Clustering for unsupervised learning and classification	6	CO3
IV	**SYNTACTIC PATTERN RECOGNITION**: Overview of Syntactic Pattern Recognition-Syntactic recognition via parsing and other grammars–Graphical Approaches to syntactic pattern recognition-Learning via grammatical inference.	6	CO4
V	**NEURAL PATTERN RECOGNITION**: Introduction to Neural Networks-Feed-forward Networks and training by Back Propagation-Content Addressable Memory Approaches and Unsupervised Learning in Neural PR	6	CO5
	Total		

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	understand the concepts, importance, application and the process of developing Pattern recognition over view	PO1
CO2	to have basic knowledge and understanding about	PO1, PO2

	parametric and non-parametric related concepts.	
CO3	To understand the framework of frames and bit images to animations	PO4, PO6
CO4	Speaks about the multimedia projects and stages of requirement in phases of project.	PO4, PO5, PO6
CO5	Understanding the concept of cost involved in multimedia planning, designing, and producing	PO3, PO8
Text Book		
1	Robert Schalkoff, "Pattern Recognition: Statistical Structural and Neural Approaches", John wiley& sons.	
2	Duda R.O., P.E.Hart& D.G Stork, " Pattern Classification", 2nd Edition, J.Wiley.	
3	Duda R.O.& Hart P.E., "Pattern Classification and Scene Analysis", J.wiley.	
4	Bishop C.M., "Neural Networks for Pattern Recognition", Oxford University Press.	
Reference Books		
1.	1. Earl Gose, Richard johnsonbaugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India, Pvt Ltd, New Delhi.	
Web Resources		
1.	https://www.geeksforgeeks.org/pattern-recognition-introduction/	
2.	https://www.mygreatlearning.com/blog/pattern-recognition-machine-learning/	

Mapping with Programme Outcomes:

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	**3**	**3**	**2**	**2**	**2**	**2**
CO2	**3**	**3**	**2**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**2**
CO5	**3**	**3**	**2**	**2**	**2**	**2**
Weightage of course contributed to each PSO	**15**	**15**	**12**	**12**	**13**	**10**

Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC	**Enterprise Resource Planning**	Skill Enha. Course (SEC)	2	-	-	-	2	2	25	75	100

Learning Objectives	
LO1	To understand the basic concepts, Evolution and Benefits of ERP.
LO2	To know the need and Role of ERP in logical and Physical Integration.
LO3	Identify the important business functions provided by typical business software such as enterprise resource planning and customer relationship management
LO4	To train the students to develop the basic understanding of how ERP enriches the business organizations in achieving a multidimensional growth
LO5	To aim at preparing the students technological competitive and make them ready to self-upgrade with the higher technical skills

UNIT	Details	No. of Hours
I	ERP Introduction, Benefits, Origin, Evolution and Structure: Conceptual Model of ERP, the Evolution of ERP, the Structure of ERP, Components and needs of ERP, ERP Vendors; Benefits & Limitations of ERP Packages.	6
II	Need to focus on Enterprise Integration/ERP; Information mapping; Role of common shared Enterprise database; System Integration, Logical vs. Physical System Integration, Benefits & limitations of System Integration, ERP's Role in Logical and Physical Integration. Business Process Reengineering, Data ware Housing, Data Mining, Online Analytic Processing (OLAP), Product Life Cycle Management (PLM), LAP, Supply chain Management.	6
III	ERP Marketplace and Marketplace Dynamics: Market Overview, Marketplace Dynamics, the Changing ERP Market. ERP- Functional Modules: Introduction, Functional Modules of ERP Software, Integration of ERP, Supply chain and Customer Relationship Applications. Cloud and Open Source, Quality Management, Material Management, Financial Module, CRM and Case Study.	6
IV	ERP Implementation Basics, , ERP implementation Strategy, ERP Implementation Life Cycle ,Pre-Implementation task,Role of SDLC/SSAD, Object Oriented Architecture, Consultants, Vendors and Employees.	6

V	ERP & E-Commerce, Future Directives- in ERP, ERP and Internet, Critical success and failure factors, Integrating ERP into or-ganizational culture. Using ERP tool: either SAP or ORACLE format to case study.	6
	Total	**30**
Course Outcomes		
Course Outcomes	On completion of this course, students will;	
CO1	Understand the basic concepts of ERP.	PO1, PO2, PO6
CO2	Identify different technologies used in ERP	PO2, PO3, PO4
CO3	Understand and apply the concepts of ERP Manufacturing Perspective and ERP Modules	PO1, PO3, PO6
CO4	Discuss the benefits of ERP	PO2, PO6
CO5	Apply different tools used in ERP	PO1, PO3, PO5
Reference Text :		
1.	Enterprise Resource Planning – Alexis Leon, Tata McGraw Hill.	
References :		
1.	Enterprise Resource Planning – Diversified by Alexis Leon, TMH.	
2.	Enterprise Resource Planning – Ravi Shankar & S. Jaiswal , Galgotia	
Web Resources		
1.	1. https://www.tutorialspoint.com/management_concepts/enterprise_resource_planning.htm	
2.	1. https://www.saponlinetutorials.com/what-is-erp-systems-enterprise-resource-planning/	
3.	1. https://www.guru99.com/erp-full-form.html	
4.	2. https://www.oracle.com/in/erp/what-is-erp/	

Mapping with Programme Outcomes:

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**3**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**2**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**3**	**3**	**2**

CO5	**3**	**3**	**3**	**2**	**2**	**3**
Weightage of course contributed to each PSO	**15**	**15**	**14**	**12**	**13**	**11**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
SEC	**Simulation and Modeling**	Skill Enha. Course (SEC)	2	-	-	-	2	2	25	75	100

Learning Objectives		
LO1	Generates computer simulation technologies and techniques, lays the groundwork for students to comprehend computer simulation requirements, and implements and tests a variety of simulation and data analysis libraries and programmes. This course focuses on what is required to create simulation software environments rather than just simulations using pre-existing packages	
LO2	Discuss the concepts of modelling layers of critical infrastructure networks in society.	
LO3	Create tools for viewing and controlling simulations and their results.	
LO4	Understand the concept of Entity modelling, Path planning	
LO5	To learn about the Algorithms and Modelling.	
UNIT	**Details**	**No. of Hours**
I	Introduction To Modeling & Simulation – What is Modeling and Simulation – Complexity Types – Model Types – Simulation Types – M&S Terms and Definitions Input Data Analysis – Simulation Input Modeling – Input Data Collection - Data Collection Problems - – Input Modeling Strategy - Histograms -Probability Distributions - Selecting a Probability Distribution.	6
II	Random Variate Generation – Random Numbers – Random Number Generators – General principles –	6

	Inverse Transform Method –Acceptance Rejection Method –Composition Method –Relocate and Rescale Method - Specific distributions-Output Data Analysis – Introduction -Types of Simulation With Respect to Output Analysis - Stochastic Process and Sample Path - Sampling and Systematic Errors - Mean, Standard Deviation and Confidence Interval - Analysis of Finite-Horizon Simulations - Single Run - Independent Replications - Sequential Estimation – Analysis of Steady-State Simulations - Removal of Initialization Bias (Warm-up Interval) - Replication-Deletion Approach - Batch-Means Method .	
III	Comparing Systems via Simulation – Introduction – Comparison Problems - Comparing Two Systems - Screening Problems - Selecting the Best - Comparison with a Standard - Comparison with a Fixed Performance Discrete Event Simulations – Introduction - Next-Event Time Advance - Arithmetic and Logical Relationships - Discrete-Event Modeling Approaches – Event-Scheduling Approach – Process Interaction Approach.	6
IV	Entity Modeling – Entity Body Modeling – Entity Body Visualization – Entity Body Animation – Entity Interaction Modeling – Building Modeling Distributed Simulation – High Level Architecture (HLA) – Federation Development and Execution Process (FEDEP) – SISO RPR FOM Behavior Modeling – General AI Algorithms - Decision Trees - Neural Networks - Finite State Machines - Logic Programming - Production Systems – Path Planning - Off-Line Path Planning - Incremental Path Planning - Real-Time Path Planning – Script Programming -Script Parsing - Script Execution.	6
V	Optimization Algorithms – Genetic Algorithms – Simulated Annealing Examples: Sensor Systems Modeling – Human Eye Modeling – Optical Sensor	6

	Modeling – Radar Modeling.	
	Total	**30**
Course Outcomes		
Course Outcomes	On completion of this course, students will;	**Programme Outcomes**
CO1	Introduction To Modeling & Simulation, Input Data Analysis and Modeling.	PO1
CO2	Random Variate and Number Generation. Analysis of Simulations and methods.	PO1, PO2
CO3	Comparing Systems via Simulation	PO4, PO6
CO4	Entity Body Modeling, Visualization, Animation.	PO4, PO5, PO6
CO5	Algorithms and Sensor Modeling.	PO3, PO5
Text Books		
1.	Jerry Banks, "Handbook of Simulation: Principles, Methodology, Advances, Applications, and Practice", John Wiley & Sons, Inc., 1998.	
2.	George S. Fishman, "Discrete-Event Simulation: Modeling, Programming and Analysis", Springer-Verlag New York, Inc., 2001.	
References Books		
1.	Andrew F. Seila, Vlatko Ceric, PanduTadikamalla, "Applied Simulation Modeling", Thomson Learning Inc., 2003.	
Web Resources		
1.	https://www.tutorialspoint.com/modelling_and_simulation/index.htm	
2.	https://www.javatpoint.com/verilog-simulation-basics	

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	**3**	**2**	**2**	**3**	**3**	**2**
CO 2	**3**	**3**	**2**	**3**	**3**	**2**
CO 3	**3**	**3**	**3**	**3**	**3**	**2**
CO 4	**3**	**3**	**2**	**3**	**3**	**2**
CO 5	**3**	**3**	**2**	**3**	**3**	**2**
	15	**14**	**11**	**15**	**15**	**10**

Strong-3M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	O	Credits	Inst. Hours	Marks		
									CIA	External	Total
SEC	**Organizational Behaviour**	Skill Enha. Course (SEC)	2	-	-	-	2	2	25	75	100

Learning Objectives	
LO1	To have extensive knowledge onOB and the scope of OB.
LO2	To create awareness of Individual Benaviour.
LO3	To enhance the understanding of Group Behaviour
LO4	To know the basics of Organisaitonal Culture and Organisational Structure
LO5	To understand Organisational Change, Conflict and Power

UNIT	**Contents**	**No. of Hours**
I	**INTRODUCTION** : Concept of Organizational Behavior (OB): Nature, Scope and Role of OB: Disciplines that contribute to OB; Opportunities for OB (Globalization, Indian workforce diversity, customer service, innovation and change, networked organizations, work-life balance, people skills, positive work environment, ethics)	6
II	**INDIVIDUAL BEHAVIOUR:** 1. Learning, attitude and Job satisfaction: Concept of learning, conditioning, shaping and reinforcement. Concept of attitude, components, behavior and attitude. Job satisfaction: causation; impact of satisfied employees on workplace. 2. Motivation : Concept; Theories (Hierarchy of needs, X and Y, Two factor, McClelland, Goal setting, Self-efficacy, Equity theory); Job characteristics model; Redesigning jobs, 3. Personality and Values : Concept of personality; Myers-Briggs Type Indicator (MBTI); Big Five model. Relevance of values; Linking personality and values to the workplace (person-job fit, person-organization fit) 4. Perception, Decision Making : Perception and Judgements; Factors; Linking perception to individual decision making:	6
III	**GROUP BEHAVIOUR** : 1. Groups and Work Teams : Concept : Five Stage model of group development; Group norms, cohesiveness ; Group think and shift ; Teams; types of teams; Creating team players from individuals and team based work(TBW) 2. Leadership : Concept; Trait theories; Behavioral theories (Ohio and Michigan studies); Contingency theories (Fiedler, Hersey and Blanchard, Path-Goal);	6
IV	ORGANISATIONAL CULTURE AND STRUCTURE : Concept	6

	of culture; Impact (functions and liability); Creating and sustaining culture: Concept of structure, Prevalent organizational designs: New design options	
V	ORGANISATIONAL CHANGE, CONFLICT AND POWER: Forces of change; Planned change; Resistance; Approaches (Lewin's model, Organisational development);. Concept of conflict, Conflict process; Types, Functional/ Dysfunctional. Introduction to power and politics.	6
		30

Course Outcomes

Course Outcomes	On Completion of the course the students will	**Program Outcomes**
CO1	To define OrganisationalBehaviour, Understand the opportunity through OB.	PO1, PO2, PO6
CO2	To apply self-awareness, motivation, leadership and learning theories at workplace.	PO2,PO4. PO5, PO6
CO3	To analyze the complexities and solutions of group behaviour.	PO1, PO2, PO4, PO5, PO6
CO4	To impact and bring positive change in the culture of the organisaiton.	PO2, PO3, PO4 PO5,
CO5	To create a congenial climate in the organization.	PO1, PO2, PO5 PO6,

Text Books

1.	NeharikaVohra Stephen P. Robbins, Timothy A. Judge , *Organizational Behaviour*, Pearson Education, 18th Edition, 2022.
2.	Fred Luthans, *Organizational Behaviour*, Tata McGraw Hill, 2017.
3.	Ray French, Charlotte Rayner, Gary Rees & Sally Rumbles, *Organizational Behaviour*, John Wiley & Sons, 2011
4.	Louis Bevoc, Allison Shearsett, Rachael Collinson, *Organizational Behaviour Reference*, Nutri Niche System LLC (28 April 2017)
5.	Dr. Christopher P. Neck, Jeffery D. Houghton and Emma L. Murray, *Organizational Behaviour: A Skill-Building Approach*, SAGE Publications, Inc; 2nd edition (29 November 2018).

References Books

1.	Uma Sekaran, Organizational Behaviour Text & cases, 2nd edition, Tata McGraw Hill Publishing CO. Ltd
2.	GangadharRao, Narayana, V.S.P Rao, Organizational Behaviour 1987, Reprint 2000, Konark Publishers Pvt. Ltd, 1st edition
3.	S.S. Khanka, Organizational Behaviour, S. Chand & Co, New Delhi.
4.	J. Jayasankar, Organizational Behaviour, Margham Publications, Chennai, 2017.