APPENDIX – BC

MADURAIKAMARAJUNIVERSITY

(University with Potential for Excellence)

B.Sc. Computer Science (Artificial Intelligence)

CHOICE BASED CREDIT SYSTEM REVISEDSYLLABUS

(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 Science and other streams.

2. **Eligibility for Admission:**

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

3. **Duration of the Course:**

The students shall undergo the prescribed course of study for a period of not less than 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 the prescribed course of study and passing all the prescribed external examinations.
- 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 (Artificial Intelligence)

Artificial Intelligence or AI, is a branch of computer science that deals with building smart machines that are capable of performing complex tasks that normally require human interference and intelligence. It combines Data Science with real-life data to leverage machines and computers to imitate the decision-making and problem-solving capabilities that the human mind has.Many human mental activities such as writing computer programs, doing mathematics, engaging in common sense reasoning, understanding language, and even driving an automobile are said to demand "intelligence." Most of the work on building such kinds of systems has taken place in the field called "Artificial Intelligence (AI)." This work has had an experimental and designing direction to a great extent. Drawing from a loosely structured but growing body of computational techniques, AI systems are developed, undergo experimentation, and are improved. This interaction has created and refined a few general AI standards of wide pertinence.

The course is enabled to include several interdisciplinary areas like: Machine Learning, Deep Learning, Natural Language Processing, Robotics, Artificial Intelligence in Business and Society and The Future of Artificial Intelligence, operating systems, databases, business intelligence, big data, probability and statistics, data optimization, statistical simulation and data analysis, management decision analysis, decision models and predictive analysis. Artificial Intelligence has gained paramount importance in the computer science domain. The need for scientists who understand data in all its aspects will continue to grow strongly.Students graduating from the program will have significantly more depth and breadth in the broad area of Data Science and receive all the information they need to work with various kinds of data and statistical data. The program is designed so that students have in-depth knowledge of the many approaches, aptitudes, methodologies, and instruments needed to deal with corporate data. Students receive instruction in the abilities needed to find the needed solutions and assist in making significant judgments.

AI is a vast field in itself. Not only does it covers an extensive range of topics, but it also has a lot of depth as the AI algorithms use a lot of advanced mathematics. Thus, the eligibility for an AI course can depend on the nature of the course. However, if the course is not getting into extreme levels of depth (regarding the exact functioning of various AI algorithms), then the typical eligibility would be working knowledge of analytics tools especially Python for Data Science**,** while candidates from different educational backgrounds can take up artificial intelligence courses, having knowledge of mathematical concepts such as Calculus can give one a slight edge in understanding the mathematical functioning of the algorithms, Knowledge of basic Data Science is required which includes data manipulation and statistical modelling.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	**U.G.**
Programme Code:	
Duration:	**3 years [UG]**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others;

	analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self-awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability to embrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demon starting the ability to identify ethical issues related to one‟s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring

	vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	**PSO1**: To enable students to apply basic microeconomic, macroeconomic and monetary concepts and theories in real life and decision making. **PSO 2**: To sensitize students to various economic issues related to Development, Growth, International Economics, Sustainable Development and Environment. **PSO 3**: To familiarize students to the concepts and theories related to Finance, Investments and Modern Marketing. **PSO 4**: Evaluate various social and economic problems in the society and develop answer to the problems as global citizens. **PSO 5:** Enhance skills of analytical and critical thinking to analyze effectiveness of economic policies.

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**
PSO 1	Y	Y	Y	Y	Y	Y	Y	Y
PSO 2	Y	Y	Y	Y	Y	Y	Y	Y
PSO3	Y	Y	Y	Y	Y	Y	Y	Y
PSO 4	Y	Y	Y	Y	Y	Y	Y	Y
PSO 5	Y	Y	Y	Y	Y	Y	Y	Y

3 – Strong, 2- Medium, 1- Low

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 Mathematics 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 - Artificial Intelligence.

ValueadditionsintheRevampedCurriculum:

Semester	NewlyintroducedComponents	Outcome/ Benefits
I	**FoundationCourse** To ease the transition of learningfrom higher secondary to highereducation,providinganoverviewof thepedagogyoflearningLiteratureand analyzing theworldthroughtheliterarylens Givesrisetoanewperspective.	➢ Instill confidenceamongstudents ➢ Createinterest for the subject
I,II,III,IV	**SkillEnhancementpapers**(Discipline centric /Generic/Entrepreneurial)	➢ Industry readygraduates ➢ Skilledhumanresource ➢ Studentsareequippedwithessentialskillsto Makethememployable
		➢ Trainingonlanguageandcommunicationskillsenablethestudents gain knowledge and exposureinthecompetitiveworld.
		➢ Discipline centric skillwillimprovetheTechnical knowhow ofsolvingreallife problems.
III,IV,V& VI	Electivepapers	➢ Strengthening thedomainknowledge ➢ Introducing thestakeholdersto theState-of Arttechniquesfrom the streamsofmulti-disciplinary,crossdisciplinaryandinterdisciplinarynature ➢ Emerging topics inhigher education/industry/communicationnetwork/healthsectoretc.areintroducedwith hands-on-training.

IV	ElectivePapers	➢ Exposuretoindustrymouldsstudentsintosolutionproviders ➢ GeneratesIndustryreadygraduates ➢ Employmentopportunitiesenhanced
V	Electivepapers	➢ Self-learning isenhanced ➢ Applicationoftheconcepttorealsituationisconceivedresulting Intangibleoutcome
VI	Electivepapers	➢ Enriches the studybeyondthe course. ➢ Developingaresearchframework and presenting their independent and intellectual ideaseffectively.
ExtraCredits: ForAdvancedLearners/Honorsdegree		➢ Tocatertotheneedsofpeerlearners/ research aspirants
SkillsacquiredfromtheCourses		Knowledge, Problem Solving, Analytical ability,ProfessionalCompetency,ProfessionalCommunicationandTransferrable Skill

Credit Distribution for UG Programme

Sem I	Credit	Sem II	Credit	Sem III	Credit	Sem IV	Credit	Sem V	Credit	Sem VI	Credit
1.1. Language - Tamil	3	2.1. Language - Tamil	3	3.1. Language - Tamil	3	4.1. Language - Tamil	3	5.1 Core Course – \CC IX	4	6.1 Core Course – CC XIII	4
1.2 English	3	2.2 English	3	3.2 English	3	4.2 English	3	5.2 Core Course – CC X	4	6.2 Core Course – CC XIV	4
1.3 Core Course – CC I	4	2.3 Core Course – CC III	4	3.3 Core Course – CC V	4	4.3 Core Course – CC VII Core Industry Module	4	5. 3.Core Course CC -XI	4	6.3 Core Course – CC XV	4
1.4 Core Course – CC II	4	2.4 Core Course – CC IV	4	3.4 Core Course – CC VI	4	4.4 Core Course – CC VIII	4	5. 3.Core Course –/ Project with viva-voce CC -XII	4	6.4 Elective -VII Generic/ Discipline Specific	3
1.5 Elective I Generic/ Discipline Specific	3	2.5 Elective II Generic/ Discipline Specific	3	3.5 Elective III Generic/ Discipline Specific	3	4.5 Elective IV Generic/ Discipline Specific	3	5.4 Elective V Generic/ Discipline Specific	3	6.5 Elective VIII Generic/ Discipline Specific	3
1.6 Skill Enhancement Course SEC-1 (NME)	2	2.6 Skill Enhancement Course SEC-2 (NME)	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	4.6 Skill Enhancement Course SEC-6	2	5.5 Elective VI Generic/ Discipline Specific	3	6.6 Extension Activity	1
1.7Ability Enhancement Compulsory Course (AECC) Soft Skill-1	2	2.7 Skill Enhancement Course –SEC-3	2	3.7 Skill Enhancement Course SEC-5	2	4.7 Skill Enhancement Course SEC-7	2	5.6 Value Education	2	6.7 Professional Competency Skill	2
1.8 Skill Enhancement - (Foundation Course)	2	2.8 Ability Enhancement Compulsory Course (AECC) Soft Skill-2	2	3.7 Ability Enhancement Compulsory Course (AECC) Soft Skill-3	2	4.7 7Ability Enhancement Compulsory Course (AECC) Soft Skill-4	2	5.5 Summer Internship /Industrial Training	2		
				3.8 E.V.S	-	4.8 E.V.S	2				
	23		**23**		**22**		**25**		**26**		**21**
	Total CreditPoints										**140**

CREDIT DISTRIBUTION FOR B.Sc. Computer Science (Artificial Intelligence)

3 – Year UG Programme in B.Sc. Computer Science (Artificial Intelligence) Credits Distribution			
		No. of Papers	**Credits**
Part I	Tamil(3 Credits)	4	12
Part II	English(3 Credits)	4	12
Part III	Core Courses (4 Credits)	15	84
	Elective Courses :Generic / Discipline Specific (3 Credits)	8	
		Total	**108**
Part IV	SEC1,SEC2(NME)(2 Credits)	2	4
	SkillEnhancement Courses 3,5,6,7(2 Credits)	4	8
	(SEC 4)EntrepreneurialSkill -1(1 Credit)	1	1
	Ability Enhancement Courses 1,2,3,4(2 Credits)	4	8
	Professional Competency Skill (2 Credits)	1	2
	EVS (2 Credits)	1	2
	Value Education (2 Credits)	1	2
	Foundation Course(2 Credits)	1	2
	Summer Internship(2 Credits)	1	2
		Part IV Credits	**31**
Part V	Extension Activity (NSS / NCC / Physical Education)		1
Total Credits for the UG Programme in B.Sc. Computer Science (Artificial Intelligence)			**140**

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	11	11	11	11	22	18	84
Part IV	6	6	5	8	4	2	31
Part V	-	-	-	-	-	1	1
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 (Artificial Intelligence)

Credit Distribution for all UG courses with LAB Hours

Semester I

Component	List of courses	No. of Hrs	Credits	Internal Marks	External Marks
Part I	Language – Tamil	6	3	25	75
Part II	English	4	3	25	75
Part-III	**Core Course CC- I** Programming in C	4	4	25	75
Part-III	**Core Course CC-II** Practical - Programming in C Lab	5	4	25	75
Part-III	**Elective Course I -** Discrete Mathematics – I**(Generic/Discipline Specific)** Refer Annexure I	5	3	25	75
Part- IV	Skill Enhancement Course SEC – I(Non-Major Executive) Fundamentalsof Computers	2	2	25	75
Part- IV	Ability Enhancement Compulsory Course (AECC) Soft Skill-1	2	2	25	75
Part- IV	Skill Enhancement (Foundation Course) Problem Solving Technique	2	2	25	75
TOTAL		**30**	**23**		

Semester II

Component	List of courses	No. of Hrs	Credits	Internal Marks	External Marks
Part I	Language – Tamil	6	3	25	75
Part II	English	4	3	25	75
Part III	**Core Course CC III** Object Oriented Programming with C++	4	4	25	75
Part III	**Core Course CC IV** Practical II - Object Oriented Programming with C++ Lab	5	4	25	75
Part III	**Elective Course II** Numerical Methods – I**(General /Discipline Specific)**	5	3	25	75

	Refer Annexure I				
Part IV	Skill Enhancement Course SEC II (Non-Major Executive) Fundamentals of Information Technology	2	2	25	75
Part IV	Skill Enhancement Course SEC III- Advanced Excel Refer Annexure II	2	2	25	75
Part IV	Ability Enhancement Compulsory Course (AECC) Soft Skill-2	2	2	25	75
TOTAL		**30**	**23**		

Semester – III

Component	**List of courses**	**No. of Hrs**	**Credits**	**Internal Marks**	**External Marks**
Part I	Language – Tamil	6	3	25	75
Part II	English	4	3	25	75
Part-III	**Core Course CC V** Data Structures and Computer Algorithms	5	4	25	75
Part-III	**Core Course CC VI** Data Structures and Computer Algorithms Lab	4	4	25	75
Part-III	**Elective Course III -** Mathematical Statistics – I **(Generic / Discipline Specific)** Refer Annexure I	4	3	25	75
Part-IV	Skill Enhancement Course SEC IV (Entrepreneurial Skill) E-Commerce	2	1	25	75
Part-IV	Skill Enhancement Course SEC V- Bio Metrics Refer Annexure II	2	2	25	75
Part-IV	Ability Enhancement Compulsory Course (AECC) Soft Skill-3	2	2	25	75
Part-IV	Environmental Studies	1	-	-	-
TOTAL		**30**	**22**		

Semester – IV

Component	List of courses	No. of Hrs	Credits	Internal Marks	External Marks
Part I	Language – Tamil	6	3	25	75
Part II	English	4	3	25	75
Part III	**Core Course CC VII** JavaProgramming	4	4	25	75
Part III	**Core Course CC VIII** JavaProgramming Lab	4	4	25	75
Part III	**Elective Course IV -** Financial Analytics **Discipline Specific** Refer Annexure I	4	3	25	75
Part IV	Skill Enhancement Course - SEC-VIPHP Programming Refer Annexure II	2	2	25	75
Part IV	Skill Enhancement Course - SEC-VII Web Technology Refer Annexure II	2	2	25	75
Part IV	Ability Enhancement Compulsory Course (AECC) Soft Skill-4	2	2	25	75
Part IV	Environmental Studies	2	2	25	75
TOTAL		**30**	**25**		

Semester – V

Component	List of courses	No. of Hrs	Credits	Internal Marks	External Marks
Part-III	**Core Course CC IX** Relational Database Management System	5	4	25	75
Part-III	**Core Course Lab CC X** RDBMS Lab using ORACLE	5	4	25	75
Part-III	**Core Course CC XI** Machine Learning	5	4	25	75

Part-III	**Elective Course V-** Software Engineering **(Generic /Discipline Specific)** Refer Annexure I	5	3	25	75
Part-III	**Elective Course VI -** Information Security **(Generic /Discipline Specific)** Refer Annexure I	4	3	25	75
Part-III	**Core Course CC XII** Project with Viva Voce Project (Individual)	4	4	25	75
Part-IV	Value Education	2	2	25	75
Part-IV	Summer Internship /Industrial Training	-	2		
TOTAL		**30**	**26**		

Semester – VI

Component	List of courses	No. of Hrs	Credits	Internal Marks	External Marks
Part III	**Core Course CC XIII** IoT and Cloud Technologies	5	4	25	75
Part III	**Core Course Lab CC XIV** IoT and Cloud Technologies Lab	5	4	25	75
Part III	**Core Course CC XV** Artificial Intelligence	5	4	25	75
Part III	**Elective Course VII-**Data Mining and Warehousing **(Generic / Discipline Specific)** Refer Annexure II	6	3	25	75
Part III	**Elective Course VIII-** Robotics and Applications **(Generic / Discipline**	5	3	25	75

	Specific) – Refer Annexure II				
Part IV	Professional Competency Skill- Quantitative Aptitude Refer Annexure II	4	2	25	75
Part V	**Extension Activity**	-	1		
		30	**21**		

Total Credits: 140

Remarks: English Soft Skill Two Hours Will be handled by English Teachers (4+2 = 6 hours for English).

ANNEXURE I

SUGGESTED TOPICS IN CORE COURSE COMPONENTS

1. Machine learning Techniques
2. Machine learning lab
3. Python Programming
4. Python Programming Lab
5. Data Science
6. Data Science lab
7. Mobile Application Development
8. Mobile Application Development Lab
9. Software Project Management
10. Software Engineering Lab and more.

SUGGESTED TOPICS IN GENERIC ELECTIVES

1. Discrete Mathematics – I
2. Discrete Mathematics – II
3. Numerical Methods – I
4. Numerical Methods – II
5. Mathematical Statistics – I

6. Mathematical Statistics – II
7. Electronics Science
8. Nanotechnology
9. Optimization Technique / Operational Research
10. Introduction to Linear Algebra
11. Graph Theory and Its Applications
12. Digital Logic Fundamentals
13. Microprocessor & Micro Controller

ANNEXURE I
DISCIPLINE SPECIFIC ELECTIVE

1. Analyticsfor Service Industry
2. Financial Analytics
3. Marketing Analytics
4. Data Communication And Computer Networks
5. Computer Networks
6. Cryptography
7. Operating System
8. Artificial Neural Networks
9. Software Engineering
10. Software Metrics
11. Distributed Computing
12. Agile Project Management
13. Computing Intelligence
14. Information Security
15. Grid Computing and more.

Annexure II

SKILL ENCHANCEMENT

1	INTRODUCTION TO HTML
2	OFFICE AUTOMATION
3	QUANTITATIVE APTITUDE
4	CYBER FORENSICS
5	MULTIMEDIA SYSTEMS
6	SOFTWARE TESTING
7	DATA MINING AND WAREHOUSING
8	BIO METRICS
9	ENTERPRISE RESOURCE PLANNING
10	WEB TECHNOLOGY
11	ROBOTICS AND APPLICATIONS
12	SIMULATION AND MODELING
13	PATTERN RECOGNITION
14	ADVANCED EXCEL
15	OPEN SOURCE SOFTWARE TECHNOLOGIES
16	PHP PROGRAMMING
17	NETWORK SECURITY
18	IMAGE PROCESSING and more…

FIRST YEAR –SEMESTER- I

PROGRAMMING IN C

Subject Code	L	T	P	S	Credits	Inst. Hours	Marks		
							CIA	External	Total
CCI	**4**	0	0	**I**	**4**	**4**	**25**	**75**	**100**
Learning Objectives									
LO1	To familiarize the students with the understanding of code organization								
LO2	To improve the programming skills								
LO3	Learning the basic programming constructs.								
Prerequisites:									

Unit	Contents	No. of Hours
I	**Studying Concepts of Programming Languages**- Language Evaluation Criteria - Language design - Language Categories - Implementation Methods – Programming Environments - Overview of C: History of C- Importance of C- Basic Structure of C Programs- Executing a C Program- Constants, Variables and Data types - Operators and Expressions - Managing Input and Output Operations	**12**
II	**Decision Making and Branching**: Decision Making and Looping - Arrays - Character Arrays and Strings	**12**
III	**User Defined Functions:** Elements of User Defined Functions- Definition of Functions- Return Values and their Types- Function Call- Function Declaration- Categories of Functions- Nesting of Functions- Recursion	**12**
IV	**Structures and Unions:** Introduction- Defining a Structure- Declaring Structure Variables Accessing Structure Members- Structure Initialization- Arrays of Structures- Arrays within Structures- Unions- Size of Structures.	**12**
V	**Pointers:** Understanding Pointers- Accessing the Address of a Variable- Declaring Pointer Variables- Initializing of Pointer Variables- Accessing a Variable through its Pointer- Chain of Pointers- Pointer Expressions- Pointer and Scale Factor- Pointer and Arrays- Pointers and Character Strings- Array of Pointers- Pointer as Function Arguments- Functions Returning Pointers- Pointers to Functions- **File Management in C**	**12**
TOTAL		**60**

CO	Course Outcomes
CO1	Outline the fundamental concepts of C programming languages, andits features
CO2	Demonstrate the programming methodology.
CO3	Identify suitable programming constructs for problem solving.
CO4	Select the appropriate data representation, control structures, functions and concepts based on the problem requirement.
CO5	Evaluate the program performance by fixing the errors.

Textbooks

- Robert W. Sebesta, (2012), ―Concepts of Programming Languages‖, Fourth Edition, Addison Wesley (Unit I : Chapter – 1)
- E. Balaguruswamy, (2010), ―Programming in ANSI C‖, Fifth Edition, Tata McGraw

	Hill Publications
Reference Books	
1.	Ashok Kamthane, (2009), ―Programming with ANSI & Turbo C‖, Pearson Education
2.	Byron Gottfried, (2010), ―Programming with C‖, Schaums Outline Series, Tata McGraw Hill Publications
NOTE: Latest Edition of Textbooks May be Used	
Web Resources	
1.	http://www.tutorialspoint.com/cprogramming/
2.	http://www.cprogramming.com/
3.	http://www.programmingsimplified.com/c-program-examples
4.	http://www.programiz.com/c-programming
5.	http://www.cs.cf.ac.uk/Dave/C/CE.html
6.	http://fresh2refresh.com/c-programming/c-function/

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 of course contributed to each PSO	15	14	11	15	10	10

PROGRAMMING IN C LAB

Subject Code	L	T	P	S	Credits	Inst. Hours	Marks		
							CIA	External	Total
CCII	0	0	5	I	4	5	25	75	100
Learning Objectives									
LO1	The Course aims to provide exposure to problem-solving through C programming								
LO2	It aims to train the student to the basic concepts of the C -Programming language								
LO3	Apply different concepts of C language to solve the problem								
Prerequisites:									

Contents
1. Programs using Input/ Output functions 2. Programs on conditional structures 3. Command Line Arguments 4. Programs using Arrays 5. String Manipulations 6. Programs using Functions 7. Recursive Functions 8. Programs using Pointers 9. Files 10. Programs using Structures & Unions **TOTAL 60**

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

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 of course contributed to each PSO	**15**	**14**	**11**	**15**	**11**	**10**

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
SEC –I	**FUNDAMENTALS OF COMPUTER**	**SEC NME**	2	-	-	I	2	25	75	100
Learning Objectives										

LO1	Discuss the Introduction about Computer and its Components.	
LO2	To Perform the Microsoft Word, Excel, PowerPoint and its operations.	
LO3	To get Knowledge about the Internet and Intranet	
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 to Computers** - Generations of Computer – Data and Information – Components of Computer – Software – Hardware – Input Devices - Output Devices — Types of Operating System.	**6**
II	**MS Word**: Introduction – Elements of Window – Files, Folders and Directories – Text Manipulating: Cut, Copy, Paste, Drag and Drop – Text Formatting: Font – Style, Size, Face and Colors (Both foreground and background) – Alignment - Bullets and Numbering - Header and footer-watermark – inserting objects (images, other application document) – Table creation – Mail merge.	**6**
III	**MS Excel**: Introduction – Inserting rows and columns – Sizing rows and columns – Implementing formulas – Generating series - Functions in excel – Creation of Chart – Inserting objects – Filter – Sorting – Inserting worksheet.	**6**
IV	**MS PowerPoint**: Introduction – Slides Manipulation (Inserting new, Copy, paste, delete and duplicate slides) – Slide show– Types of Views – Types of Animations – Inserting Objects – Implementing multimedia (Video and Audio) – Templates (Built-in and User-Defined).	**6**
V	**Internet**: Introduction to Internet and Intranet – Services of Internet - Domain Name – URL – Browser – Types of Browsers – Search Engine - E-Mail – Basic Components of E-Mail –.How to send group mail. **E-Commerce**: Digital Signature – Digital Currency – Online shopping and transaction.	**6**
	TOTAL HOURS	**30**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Understand the basics of Computer and its Generations. Be able to understand the components of computer.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	To Understand the introduction about MS Word. Be able to perform the Elements of window, Text Formatting, Text	PO1, PO2, PO3, PO4,

	Manipulating options in MS Word.	PO5, PO6
CO3	To Understand the introduction about MS Excel. Be able to inserting and sizing the cells Implementing formulas and inserting worksheet.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	To Understand the introduction about MS PowerPoint Be able to perform the slides manipulation. Implementing Multimedia and templates.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	To Understand the introduction about Internet and Intranet. Be able to access the browsers. To get knowledge about basic components of E-Mail and E-Commerce	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	G. Manjunath, "Computer Basics", Vasan Publications, 2010.	
2	Pradeep K. Sinha&PritiSinha, "Computer Fundamentals", 6th Edition, BPB Publications, 2004.	
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://www.tutorialspoint.com/computer_fundamentals/index.htm	
2.	https://www.tutorialspoint.com/basics_of_computers/index.htm	
3.	https://www.tutorialspoint.com/word/index.htm	
4.	https://www.tutorialspoint.com/excel/index.htm	
5.	https://www.tutorialspoint.com/powerpoint/index.htm	

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	2	3	3	2

CO 3	2	3	3	3	3	3
CO 4	3	3	2	3	3	3
CO 5	3	3	3	3	2	3
WeightageofcoursecontributedtoeachPSO	14	14	13	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**
FC	**PROBLEM SOLVING TECHNIQUES**	**FC**	2	-	-	I	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 codeto 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,	**6**

	documenting and testing a program: Comment lines and types of errors. **Program design:** Modular Programming.	
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

FIRST YEAR –SEMESTER- II

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
CC III	**OBJECT ORIENTED PROGRAMMING WITH C++**	**core**	4	-	-	II	4	25	75	100

Learning Objectives	
LO1	To understand Principles of Object Oriented Programming
LO2	To understandToken Expressions & Control Structures
LO3	To apply Functions in C++, Classes & Objects.
LO4	To analyze Constructors & Destructors, Operator Overloading, Inheritance
LO5	To know the applications of Pointers, Virtual Functions &Polymorphism, Working with Files, Exception handling

UNIT	Contents	No. Of. Hours
I	Principles of Objective Oriented Programming Object Oriented Programming Paradigm, Basic Concepts of Object Oriented Programming, Benefits of Object Oriented Programming, Object Oriented Languages, Applications of Object Oriented Programming, Beginning with C++. Modeling as Design Technique: Modeling; abstraction; The three models. Class Modeling: Object and class concepts; Link and associations concepts; Generalization and inheritance; A sample class model; Navigation of class models.	**15**

II	Token Expressions & Control Structures Tokens, Keywords, Identifiers and Constants, Data Types, Type Compatibility, Variables, Operators in C++,Implicit Conversions, Operator Overloading, Operator Precedence, Control Structures.	**15**
III	Functions in C++, Classes & Objects. The Main Function, Function Prototyping, Call by Reference, Return by Reference, Inline Functions, Function Overloading, Friend and Virtual Functions. Specifying a class, Member Functions, Arrays within a class, Static Member Functions, Arrays of Objects, Friendly Functions	**15**
IV	Constructors & Destructors, Operator Overloading, Inheritance Constructors, Parameterized Constructors, Copy Constructors, Dynamic Constuctors, Destructors, Defining Operator Overloading, Overloading Operators, Rules for Overloading Operators, Type Conversions	**15**
V	Pointers, Virtual Functions & Polymorphism, Working with Files, Exception handling Pointers, Pointers to Objects, this pointer, Pointer to Derived Classes, Virtual Functions, Classes for File Stream Operations, Opening and Closing a File, File Modes, File Pointers, Input Output Operations, Updating a File.	**15**
	TOTAL HOURS	**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	understanding Token Expressions & Control Structures	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Applying Functions in C++, Classes & Objects.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Analyzing Constructors & Destructors, Operator Overloading, Inheritance	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Knowing the applications of Pointers, Virtual Functions &Polymorphism, Working with Files, Exception handling	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Understanding the Token Expressions & Control Structures	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	Object Oriented Design by Rumbaugh (Pearson publication)

2	Object-oriented programming in Turbo C++ By Robert Lafore, Galgotia Publication.
3	Object-oriented programming with C++ by E.Balagurusamy, 2nd Edition, TMH.
	Reference Books
1.	SouravSahay, (2017), "Object Oriented Programming with C++", 2ndEdition, Oxford University Press
2.	ReemaThareja, (2015), "Object Oriented Programming with C++", 1st Edition, Oxford University Press
	Web Resources
1.	https://www.w3schools.com/cpp/cpp_oop.asp
2.	https://www.geeksforgeeks.org/object-oriented-programming-in-cpp/
3.	https://www.javatpoint.com/cpp-oops-concepts

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	1	3
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	3	2
Weightage of course contributed to each PSO	15	15	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
CC IV	**OBJECT ORIENTED PROGRAMMING WITH C++LAB**	**core**	-	-	5	II	4	25	75	100

Objectives

To predict the performance of different algorithms in order to guide design decisions, provide theoretical estimation for the required resources of an algorithm to solve a specific computational problem

LIST OF PROGRAMS

1. Write a Program to find Simple Interest and Compound Interest.
2. Write a Program to demonstrate the working of following Loops: While, Do While, For, If-Else, switch
3. Write a Program to find greatest of three numbers.
4. Write a Program to add and subtract two matrices.
5 Write a Program to display elements of an array.
6 Write a Program to calculate Sum and Average of an array.
7. Write a Program to sort elements of an array using Bubble sort.
8. Write a Program to calculate Factorial of a number.
9. Write a Program to generate Fibonacci series.
10. Write a Program to show function Overloading.
11. Write a Program to create a class and access member function of a class
12. Write a program to show Constructor and Destructor in a class
13. Write a program to convert the temperature in Fahrenheit to Celsius and vice-a-verse

TOTAL HOURS : 75

Course Outcomes	
CO	On completion of this course, students will
CO1	To understand basics of Object Oriented Programming
CO2	To understand Token Expressions & Control Structures
CO3	To apply Functions in C++, Classes & Objects.
CO4	To analyze Constructors & Destructors, Operator Overloading, Inheritance
CO5	To know the applications of Pointers,

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	2	2	3	3
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	1	2
Weightage of course contributed to each PSO	15	15	14	14	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
SEC II	**FUNDAMENTALS OF INFORMATION TECHNOLOGY**	**SEC**	2	-	-	II	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,	**6**

	EEPROM. Secondary Storage: Magnetic Tapes, Magnetic Disks. Cartridge tape, hard disks, Floppy disks Optical Disks, Compact Disks, Zip Drive, Flash Drives	
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	G. Manjunath, "Computer Basics", Vasan Publications, 2010.
2	Pradeep K. Sinha&PritiSinha, "Computer Fundamentals", 6th Edition, BPB Publications, 2004.
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

SECOND YEAR –SEMESTER- III

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
CC V	**DATA STRUCTURES AND COMPUTER ALGORITHMS**	**core**	5	-	-	III	4	25	75	100
Learning Objectives										
LO1	Understand the meaning asymptotic time complexity analysis and various data structures									

LO2	To enhancing the problem solving skills and thinking skills	
LO3	To write efficient algorithms and Programs	
LO4	To make the students learn best practices in PYTHON programming	
LO5	To understand how to handle the files in Data Structure	
UNIT	**Contents**	**No. Of. Hours**
I	**Arrays and ordered Lists** Abstract data types – asymptotic notations – complexity analysis- Linked lists: Singly linked list – doubly linked lists - Circular linked list, General lists- stacks – Queues – Circular Queues – Evaluation of expressions	**15**
II	**Trees and Graphs** Trees – Binary Trees – Binary Tree Traversal – Binary Tree Representations – Binary Search Trees - threaded Binary Trees - Application of trees (Sets). Representation of Graphs – Graph implementation – graph Traversals - Minimum Cost Spanning Trees – Shortest Path Problems-Application of graphs	**15**
III	**Searching and Sorting** Sorting – Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Selection Sort. Searching – Linear search, Binary search	**15**
IV	**Greedy Method and Dynamic programming** Greedy Method: Knapsack problem– Job Sequencing with deadlines – Optimal storage on tapes. General method – Multistage Graph Forward Method– All pairs shortest path – Single source shortest path – Search Techniques for Graphs – DFS – Connected Components – Bi-Connected Components	**15**
V	**Backtracking** General Method – 8-Queen‟s – Sum Of Subsets – Graph Colouring – Hamiltonian Cycles – Branch And Bound: General Method – Travelling Sales Person Problem	**15**
	TOTAL HOURS	**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	To understand the asymptotic notations and analysis of time and space complexity To understand the concepts of Linked List, Stack and Queue.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	To understand the Concepts of Trees and Graphs Perform traversal operations on Trees and Graphs. To enable the applications of Trees and Graphs.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	To apply searching and sorting techniques	PO1, PO2, PO3, PO4, PO5, PO6

CO4	To understand the concepts of Greedy Method To apply searching techniques.	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	Seymour Lipshutz(2011),Schaum‟s Outlines - Data Structures with C, Tata McGraw Hill publications.
2	Ellis Horowitz and SartajSahni (2010), Fundamentals of Computer Algorithms, Galgotia Publications Pvt., Ltd.
3	Dr. K. NageswareRao, Dr. Shaik Akbar, ImmadiMurali Krishna, Problem Solving and Python Programming(2018)

Reference Books

1.	Gregory L.Heileman(1996), Data Structures, Algorithms and Object-Oriented Programming, McGraw Hill International Edition, Singapore.
2.	A.V.Aho, J.D. Ullman, J.E.Hopcraft(2000). Data Structures and Algorithms, Addison Wesley Publication.
3.	Ellis Horowitz and SartajSahni, Sanguthevar Raja sekaran (2010) ,Fundamentals of Computer Algorithms, Galgotia Publications Pvt.Ltd.

Web Resources

1.	https://www.tutorialspoint.com/data_structures_algorithms/index.htm
2.	https://www.programiz.com/dsa
3.	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	3	3	3	3
CO 3	3	3	3	3	1	3
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	3	2
Weightage of course contributed to each PSO	15	15	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
CC VI	**DATASTRUCTURES AND COMPUTER ALGORITHMS LAB**	**core**	-	-	4	II	4	25	75	100

Objectives

To predict the performance of different algorithms in order to guide design decisions, provide theoretical estimation for the required resources of an algorithm to solve a specific computational problem

LIST OF PROGRAMS	**Required Hour**
1. Perform stack operations 2. Perform queue operations 3. Perform tree traversal operations 4. Search an element in an array using linear search. 5. Search an element in an array using binary search 6. Sort the given set of elements using Merge Sort. 7. Sort the given set of elements using Quick sort. 8. Search the Kth smallest element using Selection Sort 9. Find the Optimal solution for the given Knapsack Problem using Greedy Method. 10. Find all pairs shortest path for the given Graph using Dynamic Programming method 11. Find the Single source shortest path for the given Travelling Salesman problem using Dynamic Programming method 12. Find all possible solution for an N Queen problem using backtracking method 13. Find all possible Hamiltonian Cycle for the given graph using backtracking method	**60**

Course Outcomes	
CO	On completion of this course, students will
CO1	To understand the concepts of Linked List, Stack and Queue.
CO2	Concepts of Trees and Graphs. Perform traversal operations on Trees and Graphs. To enable the applications of Trees and Graphs.
CO3	To apply searching and sorting techniques

CO4	To determine the concepts of Greedy Method To apply searching techniques.
CO5	Usage of File handlings in python, Concept of reading and writing files, Do programs using files.

LearningResources:

- **RecommendedTexts**

1. Ellis Horowitz , SartajSahni, Susan Anderson Freed, Second Edition , "Fundamentals of Data in C", Universities Press

2. E. Horowitz, S. Sahni and S. Rajasekaran, Second Edition ,"Fundamentals of Computer Algorithms " Universities Press

- **ReferenceBooks**

1. Seymour Lipschutz ,"Data Structures with C", First Edition, Schaum's outline series in computers, Tata McGraw Hill.
2. .2. R.Krishnamoorthy and G.IndiraniKumaravel, Data Structures using C, Tata McGrawHill – 2008.
3. A.K.Sharma, Data Structures using C , Pearson Education India,2011.
4. . G. Brassard and P. Bratley, "Fundamentals of Algorithms", PHI, New Delhi, 1997.
5. 4, . A.V. Aho, J.E. Hopcroft, J.D. Ullmann,, "The design and analysis of Computer
6. Algorithms", Addison Wesley, Boston, 1974
7. 5. Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009
8. SanjoyDasgupta, C.Papadimitriou and U.Vazirani , Algorithms , Tata McGraw-Hill, 2008.

Course Outcomes

CO	On completion of this course, students will
CO1	Implement data structures using C
CO2	Implement various types of linked lists and their applications
CO3	Implement Tree Traversals
CO4	Implement various algorithms in C

CO5	Implement different sorting and searching algorithms

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	2	2	3	3
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	1	2
Weightage of course contributed to each PSO	15	15	14	14	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
SEC IV	**E-COMMERCE**	**SEC**	2	-	-	III	1	25	75	100

Learning Objectives	
LO1	Understanding of the foundations and importance of E-commerce
LO2	Understanding of retailing in E-commerce by in terms of branding and pricing strategies and determining the effectiveness of market research.
LO3	Assess the Internet trading relationships including Business to Consumer, Business- to-Business, Intra-organizational.
LO4	Knowing key features of Internet, Intranets and Extranets and how they relate to each other.
LO5	Understanding legal issues and privacy in E-Commerce.

UNIT	Contents	No. Of. Hours
I	**E-Commerce:** E-Commerce Framework – E-Commerce and Media Convergence – The anatomy of E-commerce applications - E-Commerce Consumer Applications - E- Commerce Organization Applications.	**6**
II	**The Internet:** The Internet Terminology – NSFNET – Architecture and Components– National Research and Education Network – Internet Governance – An overview of Internet Applications. The Business of Internet Commercialization: Telco/Cable/Online companies - National Independent ISPs – Regional level ISPs – Local level ISPs.	**6**

III	**E-Commerce and the World Wide Web:** Architectural Framework for E-commerce – WWW as the architecture – Technology behind the web – Security and the web.	**6**
IV	**Electronic Payment Systems:** Types of Electronic Payment Systems – Digital token Electronic Payment Systems – Credit Card Based Electronic Payment Systems – Risk and Electronic Payment Systems. Electronic Data Interchange: Legal, Security and Privacy issues.	**6**
V	**Advertising and Marketing on the Internet:** E-Commerce Catalogs – Information Filtering – Consumer Data Interface – Emerging tools. Software Agents: Characteristics and Properties of Software Agents – Technology behind Software Agents - Applets, Browsers, and Software Agents.	**6**
	TOTAL HOURS	**30**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Demonstrate E-Commerce Frameworks. Distinguish E-Commerce and media Convergence. Illustrate E-Commerce Applications.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Describe the E-Commerce Networks and Research Networks, Analyze the Internet Commercialization	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Evaluate the E-Commerce how incorporate the Internet, Construct the Web Security	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Distinguish the different payment system. Illustrate the data interchange	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Understanding the Advertising and Marketing on the Internet, Describe Software Agents	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	**Ravi Kalakota& Andrew Whinston,** "*Frontiers of Electronic-Commerce*", Addison Wesley.

Reference Books

1.	**EfraimTurvanJ.Lee, David Kug andChung**, "Electronic Commerce", Pearson Education, Asia.
2.	**Manlyn Greenstein and Miklos**, "Electronic Commerce", TMH.

Web Resources

1.	https://www.the-reference.com/en/expertise/creation-and…/e-commerce
2.	https://en.wikipedia.org/wiki/E-commerce
3.	https://www.tutorialspoint.com/e_commerce/index.htm

SECOND YEAR –SEMESTER- IV

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
CC VII	JAVA PROGRAMMING	core	4	-	-	IV	4	25	75	100

Learning Objectives	
LO1	Object Oriented Programming with Java.
LO2	Apply the OOPs concept in JAVA programming.
LO3	Become proficient programmers through the java programming language.
LO4	Give insight into real world applications.
LO5	Get the attentions of users in user interface using graphics

UNIT	Contents	No. Of. Hours
I	**Introduction:** Introduction to Java-Features of Java-Object Oriented Concepts-Software Evolution – Software Development, SDLC Models – SDLC steps – Software Testing – Software Quality – Lexical Issues-Data Types – Variables – Arrays – Operators – Control Statements – Classes – Objects –Constructors – Overloading method – Access control – static and fixed methods – Inner classes – Inheritance-Overriding Methods-Using super-Abstract class.	**12**
II	**Packages & Threads:** Packages-Access Protection-Importing Packages-Interfaces-Exception Handling-Throw and Throws- Thread-Synchronization-Messaging- Runnable Interface-Inter thread communication-Deadlock-suspending, resuming and stopping threads-Multithreading	**12**
III	**Input/Output& Collection API:** I/O Streams-File Streams-String Objects-String Buffer-Char Array – Java Utilities-Collections interface – Collection classes-Enumeration – Vector –Stack –Hash tables – String class.	**12**
IV	**Networking:** Networking –Networking basics – java and the Net – Inet Address- TCP/IP Client Sockets –URL- URL Connection – TCP/IP Server Sockets – Datagrams.	**12**
V	**Graphical User Interface in Java:** Working with windows using AWT Classes – Class Hierarchy of Window and Panel – AWT controls – Layout Managers – Menus- Menu bars - Dialog Boxes- File Dialog- Applets-Lifecycle of Applet-Types of Applets-Event handling-Applet tags - JDBC and connecting	**12**

	to Databases – CRUD operations.	
	TOTAL HOURS	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Use the syntax and semantics of java programming language and basic concepts of OOP.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Develop reusable programs using the concepts of inheritance, polymorphism, interfaces and packages	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Apply the concepts of Multithreading and Exception handling to Develop efficient and error free codes.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Design event driven GUI and web related applications which mimic the real word scenario	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Build the internet-based dynamic applications using the concept of applets	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	**P.Naughton and H.Schildt**(1999), Java 2 (The Complete Reference), Third Edition, Tata MCGraw Hill Edition
2	**K.K. Aggarwal&Yogesh Sing** (2008), Software Engineering, Revised Third Edition, New Age International Publishers.

Reference Books

1.	Cay S. Horstmann, Gary Cornell(2012), Core Java 2 Volume I, Fundamentals- Ninth Edition Addision Wesley
2.	K.Arnold and J.Gosling, The Java Programming Language- Second Edition, ACM Press/Addison-Wesley Publishing Co. New York

Web Resources

1.	https://www.w3schools.com/java/java_oop.asp#:~:text=OOP%20provides%20a%20clear%20structure,code%20and%20shorter%20development%20time
2.	https://www.geeksforgeeks.org/object-oriented-programming-oops-concept-in-java/
3.	https://www.javatpoint.com/java-oops-concepts
4.	https://www.coursera.org/learn/object-oriented-java
5.	https://docs.oracle.com/javase/tutorial/java/concepts/index.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	3	3	3	3	3	3
CO 3	3	3	2	3	3	3
CO 4	3	3	3	3	3	3
CO 5	3	3	3	3	2	3
Weightage of course contributed to each PSO	15	15	14	15	14	15

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
CC VIII	**JAVA PROGRAMMING LAB**	**core**	-	-	4	IV	4	25	75	100

Learning Objectives:

1. Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.
2. Read and make elementary modifications to Java programs that solve real-world problems.
3. Be able to create an application using string concept.
4. Be able to create a program using files in application.
5. Be able to create an Applet to create an application.

	Required Hour

Lab Exercises: 1. Program using Class and Object. 2. Program using Constructors. 3. Program using Command-Line Arguments. 4. Program using Random Class. 5. Program using Vectors. 6. Program using String Tokenizer Class. 7. Program using Interface. 8. Program using all forms of Inheritance. 9. Program using String class. 10. Program using String Buffer class. 11. Program using Exception Handling. 12. Implementing Thread based applications 13. Program using Packages. 14. Program using Files. **Applets:** 15. Working with Colors and Fonts. 16. Parameter passing technique. 17. Drawing various shapes using Graphical statements. 18. Usage of AWT components and Listener in suitable applications.	**60**

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	2	3	3	2
CO 4	3	3	3	3	3	3
CO 5	3	2	3	3	2	3
Weightageof coursecontributedtoeachPSO	15	14	14	15	14	14

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

THIRD YEAR –SEMESTER- V

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
CC IX	**RELATIONAL DATABASE MANAGEMENT SYSTEM**	**core**	5	-	-	V	4	25	75	100

Learning Objectives	
LO1	To understand the different issues involved in the design and implementation of a database system.
LO2	To study the physical and logical database designs, database modeling, relational, hierarchical, and network models
LO3	To understand and use data manipulation language to query, update, and manage a database
LO4	To develop an understanding of essential DBMS concepts such as: database security, integrity, concurrency,
LO5	To design and build a simple database system and demonstrate competence with the fundamental tasks involved with modeling, designing, and implementing a DBMS.

UNIT	Contents	No. Of. Hours
I	**Introduction:** Database System-Characteristics of Database Management Systems- Architecture of Database Management Systems-Database Models-System Development Life Cycle-Entity Relationship Model.	**15**
II	**Relational Database Model:** Structure of Relational Model-Types of keys. Relational Algebra: Unary operations-Set operations-Join operations. Normalization: Functional Dependency- First Normal form-Second Normal Form-Third Normal form- Boyce-Codd Normal Form-Fourth Normal Form.	**15**
III	**SQL:** Introduction. Data Definition Language: Create, alter, drop, rename and truncate statements. Data Manipulation Language: Insert, Update and Delete Statements. Data Retrieval Language: Select statement. Transaction Control Language: Commit, Rollback and Savepoint statements. Single row functions using dual: Date, Numeric and Character functions. Group/Aggregate functions: count, max, min, avg and sum functions. Set Functions: Union, union all, intersect and	**15**

	minus. Subquery: Scalar, Multiple and Correlated subquery. Joins: Inner and Outer joins.Defining Constraints: Primary Key, Foreign Key, Unique, Check, Not Null.	
IV	**PL/SQL:** Introduction-PL/SQL Basic-Character Set-PL/SQL Structure-SQL Cursor-Subprograms-Functions-Procedures.	**15**
V	**Exception Handling:** Introduction-Predefined Exception-User Defined Exception-Triggers-Implicit and Explicit Cursors-Loops in Explicit Cursor.	**15**
	TOTAL HOURS	**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	To demonstrate the characteristics of Database Management Systems. To study about the concepts and models of database. To impart the concepts of System Development Life Cycle and E-R Model.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	To classify the keys and the concepts of Relational Algebra. To impart the applications of various Normal Forms Classification of Dependency.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	To elaborate the different types of Functions and Joins and their applications. Introduction of Views, Sequence, Index and Procedure.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Representation of PL-SQL Structure. To impart the knowledge of Sub Programs, Functions and Procedures.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Representation of Exception and Pre-Defined Exception. To Point out the Importance of Triggers, Implicit and Explicit Cursors.	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1 **Pranab Kumar Das Gupta and P. Radha Krishnan,** "Database Management System Oracle SQL and PL/SQL", Second Edition, 2013, PHI Learning Private Limited.

Reference Books

1 **RamezElmasri and Shamkant B. Navathe**, "*Fundamentals of Database Systems*", Seventh Edition, Pearson Publications.

2 **Abraham Silberschatz, Henry Korth, S. Sudarshan**, "*Database System Concepts*", Seventh Edition, TMH.

	Web Resources
1	http://www.amazon.in/DATABASE-MANAGEMENT-SYSTEM-ORACLE-SQLebook/dp/B00LPGBWZ0#reader_B00LPGBWZ0

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	Marks		
								CIA	External	Total
CC X	**RDBMS LAB USING ORACLE**	**core**	-	-	5	V	4	25	75	100

Learning Objectives:

1. To explain basic database concepts, applications, data models, schemas andinstances.
2. To demonstrate the use of constraints and relational algebra operations
3. Describe the basics of SQL and construct queries using SQL.
4. To emphasize the importance of normalization in databases
5. To facilitate students in Database design

LAB EXERCISES:

SQL:

1. DDL commands.
2. Specifying constraints-Primary Key, Foreign Key, Unique, Check, Not Null.
3. DML commands.
4. Set Operations.
5. Joins.
6. Sub-queries.

PL/SQL:

7. Control Constructs.
8. Exception Handlers.
9. Implicit Cursor.
10. Explicit Cursor.
11. Procedures.
12. Functions.
13. Triggers.
14. TCL Commands usage (Commit, Rollback, Savepoint)

TOTAL HOURS: 75

Course Outcomes	
CO	On completion of this course, students will
CO1	To demonstrate the characteristics of Database Management Systems. To study about the concepts and models of database. To impart the concepts of System Development Life Cycle and E-R Model.
CO2	To classify the keys and the concepts of Relational Algebra. To impart the applications of various Normal Forms Classification of Dependency.
CO3	To elaborate the different types of Functions and Joins and their applications. Introduction of Views, Sequence, Index and Procedure.
CO4	Representation of PL-SQL Structure. To impart the knowledge of Sub Programs, Functions and Procedures.
CO5	Representation of Exception and Pre-Defined Exception. To Point out the Importance of Triggers, Implicit and Explicit Cursors.

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
Weightageof coursecontributedtoeachPSO	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**	**Marks**		
								CIA	**External**	**Total**
CC XI	**MACHINE LEARNING**	**core**	5	-	-	V	4	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-Learning – Temporal Difference Learning.	**15**
	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

Textbooks

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

THIRD YEAR –SEMESTER- VI

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
CC XIII	**IOT AND CLOUD TECHNOLOGIES**	**core**	5	-	-	VI	4	25	75	100

Learning Objectives	
LO1	Learn basic concepts of Cloud Computing.
LO2	To get an overview of Map Reduce Concepts.
LO3	To learn about infrastructure security, Data Security and Privacy.
LO4	To understand access based on access management in data security
LO5	To generate security and privacy access for the end user

UNIT	Contents	No. Of. Hours
I	**IoT Introduction:** Introduction to IoT – IoT definition – Characteristics – IoT Complete Architectural Stack – IoT enabling Technologies – IoT Challenges. Sensors and Hardware for IoT – Hardware Platforms – Arduino, Raspberry Pi, Node MCU - Protocols for IoT.	**15**
II	**Introduction to Cloud Computing** Cloud Computing – Definition – SPI Framework – Software Model – Cloud Services Delivery Model – Deployment Models – Key drivers – Impact on Users – Governance in the cloud – Barriers to Cloud Computing Adoption in the enterprise. Examples of Cloud Service Providers: Amazon Web services – Google – Microsoft Azure Services Platform – Sun Open Cloud Platform.	**15**
III	**Virtual Machines Provisioning and Migration Services** Introduction and Inspiration -Background and Related Work- Virtual Machines	**15**

	Provisioning and Manageability-Virtual Machine Migration Services-VM Provisioning and Migration in Action -Provisioning in the Cloud Context - Future Research Directions- The Anatomy of Cloud Infrastructures -Distributed Management of Virtual Infrastructures-Scheduling Techniques for Advance Reservation of Capacity- Capacity Management to meet SLA Commitments.	
IV	**Data Security, Identity and Access Management Data security and storage:** Aspects of Data Security -Data Security Mitigation -Provider Data and Its Security. Identity and Access Management: Trust Boundaries and IAM -Why IAM? - IAM Challenges- IAM Definitions-IAM Architecture and Practice-Getting Ready for the Cloud - Relevant IAM Standards and Protocols for Cloud Services - IAM Practices in the Cloud-Cloud Authorization Management- Cloud Service Provider IAM Practice.	**15**
V	**Security and Privacy Security Management: Standards** – Security Management in the Cloud – Availability Management – Access Control. Privacy: What is Privacy – Data Life Cycle – Key Privacy Concerns – Who is responsible for protecting Privacy – Privacy Risk Management – Legal and Regulatory Implications.IoT and Cloud Integration: IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipment.	**15**
	TOTAL HOURS	**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Design an IoT system with cloud infrastructure.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Implement the M2M Communication protocols in a prototype	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Understand the basic concepts of the main sensors used in electromechanical systems	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Understand/implement computer models of common engineering information types.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Understand storage mechanisms / analysis algorithms for data management in distributed & data intensive applications	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks	
1	"The Internet of Things: Enabling Technologies, Platforms, and Use Cases"**, by Pethuru Raj and Anupama C. Raman ,CRC Press.**

2	**Adrian McEwen,** Designing the Internet of Things, Wiley, 2013.
3	**Tim Mather, SubraKumaraswamy, ShahedLatif (2010),** Cloud Security and Privacy, OREILLY Media.
4	**RajkumarBuyya, James Broberg, AndrzejGoscinski(2011),**CLOUD COMPUTING Principles and Paradigms, John Wiley & Sons, Inc., Hoboken, New Jersey
	Reference Books
1.	**Ronald L. Krutz and Russell Dean Vines(2010),** Cloud Security, Wiley – India

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	3	3	3
CO 3	3	3	3	3	3	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	14	15	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
XIV	**IOT AND CLOUD TECHNOLOGIES LAB**	**core**	-	-	5	VI	4	25	75	100

Objectives

To improve efficiency and bringing important information to the surface more quickly than a system depending on human intervention, provide easy, scalable access to computing resources and IT services.

LIST OF PROGRAMS

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for

1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smart phone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when "1"/"0" is received from smart phone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thing speak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thing speak cloud.
11. To install MySQL database on Raspberry Pi and perform basic SQL queries.
12. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.
13. Write a program on Arduino/Raspberry Pi to subscribe to MQTT broker for temperature data and print it.
14. Write a program to create TCP server on Arduino/Raspberry Pi and respond with humidity data to TCP client when requested.
15. Write a program to create UDP server on Arduino/Raspberry Pi and respond with humidity data to UDP client when requested.

TOTAL HOURS: 75

Course Outcomes	
CO	On completion of this course, students will
CO1	Design an IoT system with cloud infrastructure.
CO2	Implement the M2M Communication protocols in a prototype
CO3	Understand the basic concepts of the main sensors used in electromechanical systems
CO4	Understand/implement computer models of common engineering information types.
CO5	Understand storage mechanisms / analysis algorithms for data management in distributed & data intensive applications

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

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
CC XV	**ARTIFICIAL INTELLIGENCE**	**core**	5	-	-	VI	4	25	75	100

Learning Objectives	
LO1	Describe the concepts of Artificial Intelligence
LO2	Understand the method of solving problems using Artificial Intelligence
LO3	Understand natural language processing
LO4	Introduce the concept of Expert system, Fuzzy logic
LO5	Understand about operating system and their uses

UNIT	Contents	No. Of. Hours
I	**Introduction to Artificial Intelligence** What is Artificial Intelligence? AI Technique, Representation of a problem as State space search, production systems, Problem characteristics, Production System characteristics – Issues in the design of search programs, Heuristic Search Techniques - Generate & Test Hill Climbing, Best First search, Problem reduction, Constraint satisfaction, Means-End Analysis	**15**

II	**Knowledge Representation** Approaches and issues in knowledge representation –Using Predicate Logic – Representing simple facts in logic – Representing Instance and ISA relationship – Computable functions and predicates – resolution – Natural deduction - Representing knowledge using rules –Procedural versus declarative knowledge – Logic programming - Forward versus backward reasoning – Matching – Control Knowledge - Symbolic reasoning under uncertainty - Logics for Nonmonotonic reasoning – Implementation Issues – Augmenting a problem solver – Implementation: Depth first search, Breadth first search	**15**
III	**Statistical Reasoning** Probability and Bayes‟ Theorem - Certainty factors and rule-based systems- Bayesian networks – Dempster - Shafer Theory - Weak slot-filler structure - Semantic nets – frames. Strong slot-filler structure- Conceptual dependency – Scripts – CYC – Syntatic – Semantic spectrum of Representation – Logic and slot-and-filler structure – Other representational Techniques	**15**
IV	**Game Playing, Planning & NLP**Minimax search procedure-Adding alpha-beta cutoffs- Additional Refinements – Iterative Deepening – Reference on specific games Planning - Components of a Planning system – Goal stack planning – Nonlinear planning using constraint posting- Hierarchical planning – Reactive systems.Natural Language Processing - Syntactic Analysis, Semantic Analysis, Discuses and Pragmatic Processing – Statistical Natural Language processing	**15**
V	**Learning & Advanced Topics in AI** What is learning? – Rote learning – Learning by taking advice – Learning in problem solving – Learning from examples: Induction – Explanation based learning – Discovery – Analogy – Formal learning theory - Neural Net learning and Genetic learning - Expert System: Representation-Expert System shells-Knowledge Acquisition. Fuzzy logic system – Crisp sets – Fuzzy sets – Fuzzy terminology – Fuzzy logic control – Sugeno style of Fuzzy inference processing – Fuzzy Hedges – Neuro Fuzzy systems.	**15**
	TOTAL HOURS	**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Design user interfaces to improve human–AI interaction and real-time decision-making. Evaluate the advantages, disadvantages, challenges, and ramifications of human–AI augmentation.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Demonstrate awareness and a fundamental understanding of various applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning	PO1, PO2, PO3, PO4, PO5, PO6

	models.	
CO4	Extract information from text automatically using concepts and methods from natural language processing (NLP), including stemming, n-grams, POS tagging, and parsing	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	**Elaine Rich, Kevin Knight** (2008), Shivsankar B Nair, Artificial Intelligence, Third Edition, Tata McGraw Hill Publication	
	Reference Books	
1.	**Russel S, Norvig P** (2010), Artificial Intelligence : A Modern approach,Third Edition, Pearson Education	
2.	**Dan W Patterson** (2007), Introduction to Artificial Intelligence and Expert System, Second Edition, Pearson Education Inc.	
3.	**Jones M**(2006), Artificial Intelligence application Programming, Second Edition, Dreamtech Press	
4.	**Nilsson** (2000), Artificial Intelligence : A new synthesis, Nils J Harcourt Asia PTE Ltd.	

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	3	3
CO 3	3	3	2	3	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	14	14	15	15	15

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

ANNEXURE I

SUGGESTED CORE COURSES

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
CC	**MACHINE LEARNING TECHNIQUES**	**cc**	6	-	-	-	4	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									**18**
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.									**18**
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.									**18**
IV	**Instant based learning** K- Nearest Neighbour Learning – Locally weighted Regression – Radial Basis Functions – Case Based Learning.									**18**
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-Learning – Temporal Difference Learning.									**18**

	TOTAL HOURS	**90**

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
Textbooks		
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
Weightageof coursecontributedtoeachPSO	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
CC	MACHINE LEARNING LAB	CC	-	-	5	-	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 & numericdata

LAB EXERCISES	Required Hour
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	**75**

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

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
Weightageof coursecontributedtoeachPSO	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	Marks		
								CIA	External	Total
CC	PYTHONPROGRAMMING	**CC VII**	5	-	-	IV	4	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, Dreamtech 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
Weightageof coursecontributedtoeachPSO	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
CC	PYTHON PROGRAMMING LAB	**CCVIII**	-	-	4	I	4	25	75	100

Course Objectives:

1. Be able to design and program Python applications.
2. Be able to create loops and decision statements in Python.
3. Be able to work with functions and pass arguments in Python.
4. Be able to build and package Python modules for reusability.
5. 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.	**60**

Course Outcomes	
On completion of this course, students will	
CO1	Demonstrate the understanding of syntax and semantics of
CO2	Identifytheproblem andsolve usingPYTHON programmingtechniques.
CO3	Identifysuitableprogrammingconstructsforproblem solving.
CO4	AnalyzevariousconceptsofPYTHON languagetosolvethe problem inanefficientway.
CO5	DevelopaPYTHONprogramforagivenproblem andtestforits 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
Weightageof coursecontributedtoeachPSO	15	15	13	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**
CC	**DATA SCIENCE**	**CC**	5	-	-	-	4	25	75	100

Learning Objectives	
LO1	To understand the basic concepts of Data Science
LO2	To understand the principles of algorithms, flowchart and source code
LO3	To acquire a solid foundation in Python.
LO4	To visualize data using plots in python
LO5	To understand and handle database and visualize.

UNIT	**Contents**	**No. Of. Hours**
I	**Introduction to Data Science** Introduction: Data Science - Big Data and Data Science hype – getting past the hype - Datafication - Current landscape of perspectives - Skill sets needed - Statistical Inference - Exploratory Data Analysis and the Data Science Process - Basic tools (plots, graphs and summary statistics) of EDA – Applications of Data Science - Data Science in Business - Business Intelligence vs Data Science – Data Analytics Life Cycle - Machine Learning	**15**
II	**Introduction to Python** Features of Python - How to Run Python – Identifiers- Reserved Keywords- Variables - Comments in Python - Indentation in Python - Multi-Line Statements- Input, Output and Import Functions- Operators. Data Types and Operations: Numbers -Strings -List - Tuple - Set -Dictionary - Mutable and Immutable Objects - Data Type Conversion. Flow Control: Decision Making-Loops-Nested Loops-Control Statements- Types of Loops-List Comprehensions-Set Comprehensions-Dictionary Comprehensions-Nested Dictionaries.	**15**
III	**Functions** Function Definition - Function Calling - Function Arguments - Anonymous Functions (Lambda Functions) - Recursive Functions - Modules and Packages: Built-in Modules - Creating Modules - import Statement- Namespaces and Scope - The dir() function - The reload() function -Packages in Python - Date and Time Modules – Numpy Libraries and Data Manipulation Using Pandas	**15**
IV	**File Handling and Object Oriented Programming** Opening a File-Closing a File - Writing to a File - Reading from a File - File Methods - Renaming a File - Deleting a File - Directories in Python. Regular	**15**

	Expressions. Class Definition - Creating Objects - Built-in Attribute Methods - Built-in Class Attributes - Destructors in Python - Encapsulation - Data Hiding – Inheritance-Method Overriding – Polymorphism - Exception Handling	
V	**Database Programming and Visualizations** Connecting to a Database - Creating Tables - INSERT Operation - UPDATE Operation - DELETE Operation - READ Operation - Transaction Control -Disconnecting from a Database - Exception Handling in Databases - GUI Programming - CGI Programming- Data Visualizations using Matplotlib – histograms, bar charts, pie charts.	**15**
	TOTAL HOURS	**75**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	To explain the basic concepts of data science and its application	PO1, PO2, PO3, PO4, PO5, PO6
CO2	To explain the Features of Python To demonstrate Control Statements and Looping Statements	PO1, PO2, PO3, PO4, PO5, PO6
CO3	To understand Python Functions To create and illustrate Numpy Libraries To perform Data Manipulation using Pandas.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	To understand the File Concepts Apply Exception Handling Techniques	PO1, PO2, PO3, PO4, PO5, PO6
CO5	To Create and manipulate Database To create Data Visualization using Mat plot lib	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	Doing Data Science**,** Straight Talk From The Frontline**, Cathy O'Neil and Rachel Schutt, O'Reilly** (2014)
2	Big Data Analytics, paperback 2nd ed.,**SeemaAcharya, SubhasiniChellappan, Wiley**
3	**Dr. Jeeva Jose (2018) ,**Taming Python By Programming, Khanna Publishers
4	**Jake Vanderplas,** Python Data Science Handbook: Essential Tools for Working with Data 1st Edition.

Reference Books

1.	LjubomirPerkovic(2012),Introduction to Computing Using Python: An Application DevelopmentFocus, John Wiley & Sons
2.	John V Guttag(2013), Introduction to Computation and Programming Using Python‟, Revised and expanded Edition, MIT Press.
3	Kenneth A. Lambert(2012), Fundamentals of Python: First Programs, Cengage Learning

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	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	3	3
CO 5	2	3	3	3	3	3
Weightageof coursecontributedtoeachPSO	14	14	15	15	15	15

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
CC	**DATA SCIENCE LAB**	**CC**	-	-	4	-	4	25	75	100

OBJECTIVES:
To build websites and software, automate tasks, and conduct data analysis.Open Source andCommunity Development.

	Required Hours
LIST OF PROGRAMS 1. Demonstrate the working of "id" and "type" functions. 2. Find all prime numbers within a given range. 3. Print n terms of Fibonacci series using iteration. 4. Demonstrate use of slicing in string. 5. Compute the frequency of the words from the input. The output should output after sorting thekey alphanumerically. 6. Write a program that accepts a comma separated sequence of words as input and prints thewords in a comma-separated sequence after sorting them alphabetically. 7. Demonstrate use of list & related functions. 8. Demonstrate use of Dictionary & related functions. 9. Demonstrate use of tuple & related functions. 10. Implement stack using list. 11. Implement queue using list. 12. Read and write from a file. 13. Copy a file. 14. Demonstrate working of classes and objects.	**60**

15. Demonstrate class method & static method. 16. Demonstrate constructors. 17. Demonstrate inheritance. 18. Demonstrate aggregation/composition. 19. Create a small GUI application for insert, update and delete in a table. 20. Bar charts, histograms and pie charts	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
CO 1	3	2	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	3	3
CO 5	2	3	3	3	3	3
Weightageof coursecontributedtoeachPSO	14	14	15	15	15	15

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	**CC**	6	-	-	-	4	25	75	100
Learning Objectives										
LO1	Develop in-depth Knowledge about the architecture and features of Android									
LO2	Implementing the various options available in views.									
LO3	Understand the file handling concepts and thereby enabling to manage data efficiently.									
LO4	Able to describe clearly the features of SMS messaging.									
LO5	Illustrate the concepts of Location Based Services									
UNIT	**Contents**									**No. Of. Hours**
I	**Android Fundamentals:** Android overview and Versions –Features of Android – Architecture of Android - Setting up Android Environment (Eclipse/Android Studio, SDK, AVD)- Anatomy of an Android Application - Simple Android Application Development.									**18**

II	**Android User Interface:** Layouts: Linear, Relative, Frame and Scrollview- Managing changes to Screen Orientation. Views: TextView, Button, ImageButton, EditText, CheckBox, RadioButton, RadioGroup, ProgressBar, AutoCompleteTextView, ListViews and WebView	**18**
III	**Data Persistence:** Saving and Loading User Preferences. File Handling: File System-Internal and External Storage-Permissions-File Manipulation-Managing Data using Sqlite: Creation of database-Insertion, Retrieval and Updation of records.	**18**
IV	**SMS Messaging:** Sending and Receiving messages - Sending E-mail– Networking: Downloading Binary Data – Downloading Text Files.	**18**
V	**Location Based Services:** Displaying maps- Displaying zoom control-Changing view – Adding Markers- Getting the location – Geo-coding Publishing Android Applications:Preparing for publishing-Deploying APK Files.	**18**
	TOTAL HOURS	**90**

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

Textbooks

1 **WeiMeng Lee (2012),** "*Beginning Android Application Development*", WroxPublications (John Wiley, New York)

Reference Books

1. **Ed Burnette**, "*Hello Android: Introducing Google's Mobile Development Platform*", 3rd edition, 2010, The Pragmatic Publishers.

2	**Reto Meier**, "*Professional Android 4 Application Development*", 2012, Wrox Publications (John Wiley, New York).
Web Resources	
1.	https://www.tutorialspoint.com/mobile_development_tutorials.htm
2	https://www.tutorialspoint.com › Android › Android - Home

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	2	3
CO 3	3	2	3	2	3	3
CO 4	3	3	2	3	3	3
CO 5	3	3	3	3	3	3
Weightageof coursecontributedtoeachPSO	15	14	14	13	14	15

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	**CC**	-	-	5	-	4	25	75	100

Course Objectives:

- To explain user defined functions and the concepts of class.
- To demonstrate the creation cookies and sessions
- 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.	**75**

Course Outcomes	
CO	On completion of this course, students will
CO1	To understand the concepts of counters 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
Weightageof coursecontributedtoeachPSO	15	15	15	13	15	14

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

SOFTWARE PROJECT MANAGEMENT

Subject Code	L	T	P	S	Credits	Inst. Hours	Marks		
							CIA	External	Total
CC	**5**	**0**	**0**	**-**	**4**	**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	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.	**15**
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.	**15**

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.	**15**
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.	**15**
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	**15**
TOTAL		**75**

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

➢	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.	NPTEL & MOOC courses titled Software Project Management

2.	www.smartworld.com/notes/software-project-management

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**

SOFTWARE ENGINEERING LAB

Subject Code	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
							CIA	**External**	**Total**
CC	**0**	**0**	**5**	**-**	**4**	**5**	**25**	**75**	**100**

Learning Objectives	
LO1	To Impart Practical Training in Software Engineering
LO2	To understand about different Software Testing
LO3	Learn to write test cases using different testing techniques.

List of Exercises

Do the following 8 exercises for any project projects (Eg. Student Portal, Online exam registration)

1) Development of problem statement.

2) Preparation of Software Requirement Specification Document.

3) Preparation of Software Configuration Management and Risk Management related documents.

4) Draw the entity relationship diagram

5) Draw the data flow diagrams at level 0 and level 1

6) Draw use case diagram

7) Draw activity diagram of all use cases.

8) Performing the Design by using any Design phase CASE tools.

9) Develop test cases for unit testing and integration testing

10) Develop test cases for various white box and black box testing techniques

TOTAL	**75**

CO	**Course Outcomes**
CO1	An ability to use the methodology and tools necessary for engineering practice.
CO2	Ability to elicit, analyze and specify software requirements.
CO3	Analyze and translate specifications into a design.
CO4	Ability to derive test cases for different testing.
CO5	Apply software engineering perspective through requirements analysis, software design and construction, verification, and validation to develop solutions to modern problems

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

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

SUGGESTED TOPICS IN GENERIC ELECTIVES

1. Discrete Mathematics – I
2. Discrete Mathematics – II
3. Numerical Methods – I
4. Numerical Methods – II
5. Mathematical Statistics – I
6. Mathematical Statistics – II
7. Electronics Science
8. Nanotechnology
9. Optimization Technique / Operational Research
10. Introduction to Linear Algebra
11. Graph Theory and Its Applications
12. Digital Logic Fundamentals
13. Microprocessor & Micro Controller

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
EC-GS	Discrete Mathematics – I	**Elective**	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	The Foundations: Logic and Proofs: Propositional logic – Applications of Propositional logic – Propositional equivalences – (Exclude Propositional satisfiability, Applications of satisfiability, Solving satisfiability problems, and its related problems) – Predicates and Quantifiers – Rules of inference.	**12**
II	Relations: Relations and their properties – Representing relations – Closures of relations – Partial orderings (Theorems statement only; Exclude lexicographic ordering - Exclude Lattices)	**12**
III	Counting: The basic of counting - The pigeonhole principle – Permutation and Combinations – Applications of recurrence relations – Solving recurrence relations – Divide and Conquer algorithms and recurrence relations. (All theorems and Results statement only)	**12**
IV	Graphs: Graphs and Graphs models, (Excluding Biological networks; Tournaments; all its related examples and problems) – Graph terminology and special types of graphs – Representing graphs and Graph isomorphism – Connectivity (paths – connectedness in undirected graphs – paths and isomorphism – counting paths between vertices) – shortest path problems.	**12**
V	Matrices: Introduction – operations – inverse – Rank of a matrix, solution of simultaneous linear equations – Eigen values and Eigen Vectors.	**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)	
Reference Books		
1.	Modern Algebra - S.Arumugam and A. Thangapandi Isaac, Scitech publications 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	**Elective**	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 explain he Sum and product rule	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	Numerical Methods -I	**Elective**	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 algebraic and transcendental equations-Bisection method – Fixed point iteration method – Newton Raphson method –linear system of equations – Gauss elimination method – Gauss Jordan method .	**12**
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	Numerical Methods - II	**Elective**	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	Algebraic and Transcendental equations – Errors in numeric computations – Iteration method – Aitken's Δ 2 Method – Bisection method – Regula-falsi method – Newton's Raphson method .	
II	Simultaneous equations: Back substitution – Gauss elimination method – Gauss Jordan method – Calculation of inverse of a matrix – Gauss Jacobi iteration method – Gauss Seidal iteration method.	
III	Finite differences – Difference operators – Other difference operators - Difference equations – Formation of difference equations – Linear difference equations.	
IV	Interpolation: Newton's interpolation formula – Central difference interpolation formulae – Lagrange's interpolation formulae – Divided difference formula – Inverse interpolation.	
V	Numerical differentiation – Derivatives using Newton's forward difference formula – Derivatives using Newton's backward difference formula - Derivatives using Newton's central difference formula – Maxima and minima of the interpolating polynomial – Attributes.	
Total hours		**60**

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

CO1	Understanding the concept of Algebraic and Transcendental equations	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Learn to solve the Simultaneous equations	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Analyse the Finite differences	PO1, PO2, PO3, PO4, PO5, PO6
CO4	To apply interpolation and approximation on examples.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	To solve linear systems, numerical solution of ordinary differential equations.	PO1, PO2, PO3, PO4, PO5, PO6
Text Book		
1	Dr. S. Arumugam, Prof. A. Thangapandi Isaac and Dr. A. Somasundaram, Numerical Analysis with Programming in C, New Gamma Publishing House, June 2015. Unit I: Chapter 1 Unit II: Chapter 2 Unit III: Chapter 3 Unit IV: Chapter 4 Unit V: Chapter 5 and Chapter 8 – Section 1	
Reference Books:		
1.	T. Veerarajan and T. Ramachandran, Numerical Methods with Programming in C, McGraw Hill Education, 2008. 2. S. S. Sastry, Introductory Methods of Numerical Analysis, PHI Learning Pvt Ltd., New Delhi, 2012.	

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
EC-GS	Mathematical Statistics - I	**Elective**	4	-	-		3	25	75	100
Learning Objectives										
LO1	Organizing and summarizing the data. Analyzing the data and drawing conclusions from it. Assessing the strengths of the conclusions and evaluating their uncertainty									
LO2	Define the principal concepts about probability.									

LO3	Explain the concept of a random variable and the probability distributions.	
LO4	To understanding the concept of conditional probability	
LO5	To explain the Random Variable and Mathematical expectation	
UNIT	**Contents**	**No. Of. Hours**
I	Nature and Scope of Statistical Methods and Their Limitations — Classifications, Tabulation and Diagrammatic Representation of various types of statistical data — Frequency Curves and Ogives — Graphical determination of percentiles quartiles and their properties — Merits and Demerits.	**12**
II	Measures of Location — Arithmetic Mean, Median, Mode, Geometric Mean, Harmonic Mean and their properties — Merits and Demerits	**12**
III	Measures of Dispersion — Range, Mean Deviation, Quartile Deviation, Standard Deviation, Coefficient of Variation, Skewness and Kurtosis and their properties	**12**
IV	Probability of an event — Finitely additive probability sopace addition and multiplication theorems — Independence of events — Conditional Probability	**12**
V	Concepts of Random Variable — Mathematical expectation — Moments of random variable (raw and central moments) — Moment generating function — Chebychev's inequality — Simple Problems.	**12**
Total hours		**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	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
CO2	Derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions	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	Analyse the different Statistical measures of data	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Understanding the Random Variable and Mathematical expectation	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	Mathematical Statistics - II	**Elective**	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, Piediagrams‘ – 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	Nano Technology	**Elective**	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 Nano structured 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 structure – molecules & phases – energy at the nanoscale molecular and atomic size -quantum effects- types of nanotechnology and nano machines	**12**
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 and Architects, 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	Operational Research	**Elective**	4	-	-		3	25	75	100

Learning Objectives	
LO1	To introduce the Linear Programming problem
LO2	To explain the duality theory and simplex method
LO3	To understanding the concepts of Transportation problem
LO4	To know the LPP method
LO5	To explain the replacement problems

UNIT	Contents	No. Of. Hours
I	Linear Programming problem - Formulation of LPP Mathematical form - Solution of LPP - Graphical Method - Simplex method.	
II	Two-Phase method – Duality - Axioms of duality theory - Dual simplex method.	
III	Transportation problem - Mathematical form - Initial solutions by Northwest corner rule - Maxima and Minima method - Vogel's approximation method - Optimality test by Modi method for both balanced and unbalanced T.P - Assignment Problem - Hungarian method.	
IV	Game theory - Two person zero sum game - Maximin and minimax principle of optimality - Saddle point - Solution of the game using formula - Graphical solution of (2 x n) and (m x 2) games - LPP method.	
V	Sequencing - Optimal sequencing algorithms - Replacement problems	
	Total Hours	**60**

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

CO1	To find an optimal solution to the problem.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	To apply the Duality and simplex method	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Solve the transportation problem	PO1, PO2, PO3, PO4, PO5, PO6
CO4	To apply the LPP method	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Solve the replacement problems	PO1, PO2, PO3, PO4, PO5, PO6
Text Book		
1	T. Veerarajan, Operations Research, Universities Press, 2017. Unit I: Chapter 1 Unit II: Chapter 2 and Chapter 4. Unit III: Chapter 8 Unit IV: Chapter 10 Unit V: Chapter 9 and 12.	
	Reference Books:	
2	1. Dr. S. Arumugam and Prof. ThangapandiIssac, Linear Programming, New Gamma Publishing House, March 2015. 2. KantiSwarup, P. K. Gupta, Manmohan, Operations Research, Sultan Chand & Sons, New Delhi, 1978.	
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	**Elective**	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.	
II	Linear independence – Basis and dimensions – Rank and Nullity – Matrix of a linear transformation.	
III	Inner product Spaces: Definition and examples – Orthogonality – Orthogonal Complement	
IV	Matrices – Elementary transformations – Rank of a matrix – Simultaneous linear equations – Characteristic equations and Cayley Hamilton theorem – Eigen values and eigen vectors.	
V	Bilinear forms – Quadratic forms.	
	Total hours	**60**

Course Outcomes		**Programme Outcomes**
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	Determine Rank of a matrix	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Understand **algebraic** and geometric representations	PO1, PO2, PO3, PO4, PO5, PO6

Text books

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.
1.	**Reference Books:** I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd, 2006. 2. A. R. Vasishtha, Modern Algebra, Krishna Publication, January 2015.
2.	A. R. Vasishtha, Modern Algebra, Krishna Publication, January 2015
	Web Resources
	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	**Elective**	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 graph.	**12**
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 colour Problem with n vertices in a Graph and Shortest Path finding Problem using Directed and Undirected Graphs	PO1, PO2, PO3, PO4, 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	Digital Logic Fundamentals	**Elective**	4	-	-		3	25	75	100

Learning Objectives	
LO1	ItaimstotrainthestudenttothebasicconceptsofDigitalLogic Fundamentals
LO2	To impart the in-depth knowledge of logic gates, Boolean algebra,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**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
EC-GS	**Microprocessor and Microcontroller**	**Elective**	4	-	-	-	3	5	25	75	100
Learning Objectives											
LO1	To introduce the internal organization of Intel 8085 Microprocessor.										
LO2	To know about various instruction sets and classifictions										
LO3	To enable the students to write assembly language programs using 8085.										
LO4	To interface the peripheral devices to 8085 using Interrrupt controller and DMA interface.										

LO5	To provide real-life applications using microcontroller.	
UNIT	**Contents**	**No. of Hours**
I	Digital Computers - Microcomputer Organization-Computer languages –Microprocessor Architecture and its operations – Microprocessor initiated operations and 8085 Bus organization – Internal Data operations and 8085 registers - Peripheral or External initiated operations.	15
II	8085 Microprocessor – Pinout and Signals – Functional block diagram - 8085 Instruction Set and Classifications.	15
III	BCD to Binary and Binary to BCD conversions - ASCII to BCD and BCD to ASCII conversions - Binary to ASCII and ASCII to Binary conversions. BCD Arithmetic - BCD addition and Subtraction - Multibyte Addition and Subtraction - Multiplication and Division.	15
IV	The 8085 Interrupts – RIM AND SIM instructions-8259 Programmable Interrupt Controller-Direct Memory Access (DMA) and 8257 DMA controller.	15
V	Introduction to Microcontroller - Microcontroller Vs Microprocessor - 8051 Microcontroller architecture - 8051 pin description. Timers and Counters – Operating Modes- Control Registers. Interrupts – Interrupts in 8051 - Interrupts Control Register – Execution of interrupt.	15
	Total	**75**

Course Outcomes		**ProgrammemeOutcomea**
CO	On completion of this course, students will	
CO1	Remember the Basic binary codes and their conversions. Binary concepts are used in Microprocessor programming and provide a good understanding of the architecture of 8085o introduce the internal organization of Intel 8085 Microprocessor..	PO1

CO2	Understanding the 8085 instruction set and their classifications, enables the students to write the programs easily on their own using different logic	PO1,PO2
CO3	Applying different types of instructions to convert binary codes and analyzing the outcome. The instruction set is applied to develop programs on multibyte arithmetic operations.	PO4,PO6
CO4	Analyze how peripheral devices are connected to 8085 using Interrupts and DMA controller.	PO4,PO5,PO6
CO5	An exposure to create real time applications using microcontroller.	PO3,PO6
Text Book		
1	R. S. Gaonkar- "Microprocessor Architecture- Programming and Applications with 8085"- 5th Edition- Penram International Publications,2009. [For unit I to unit IV]	
2	Soumitra Kumar Mandal -"Microprocessors and Microcontrollers – Architectures, Programming and Interfacing using 8085, 8086, 8051", Tata McGraw Hill Education Private Limited. [for unit V].	
Reference Books		
1.	Mathur- "Introduction to Microprocessor"- 3rd Edition- Tata McGraw-Hill -1993.	
2.	Raj Kamal - "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005.	
3.	Krishna Kant, "Microprocessors and Microcontrollers – Architectures, Programming and System Design 8085, 8086, 8051, 8096", PHI, 2008	
Web Resources		
1.	E-content from open source libraries	
2.	https://www.bing.com/, https://theopennotes.in/	

ANNEXURE I – DISCIPLINE SPECIFIC

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
EC-DS	ANALYTICSFOR SERVICE INDUSTRY	Elective	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
Weightageof coursecontributedtoeachPSO	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	**FINANCIAL ANALYTICS**	**Elective**	4	-	-	-	3	25	75	100

Learning Objectives		
LO1	To analyze and model financial data.	
LO2	To construct and optimize asset portfolios.	
LO3	To evaluate and model Risk on various financial assets.	
LO4	To use the most powerful and sophisticated routines in R for analytical finance.	
LO5	To acquire logical & analytical skills in financial analytics.	
UNIT	**Contents**	**No. Of. Hours**
I	**Financial Analytics:** Introduction: Meaning-Importance of Financial Analytics uses-Features-Documents used in Financial Analytics: Balance Sheet, Income Statement, Cash flow statement-Elements of Financial Health: Liquidity, Leverage, Profitability. Financial Securities: Bond and Stock investments - Housing and Euro crisis - Securities Datasets and Visualization - Plotting multiple series.	**12**
II	**Descriptive Analytics:** Data Exploration, Dimension Reduction and Data Clustering Geographical Mapping, Market Basket Analysis. Predictive Analytics, Fraud Detection, Churn Analysis, Crime	**12**

	Mapping, Content Analytics, Sentiment Analysis. Analyzing financial data and implement financial models. Process of Data analytics: obtaining publicly available data, refining such data, implement the models and generate typical output, Prices and individual security returns, Portfolio returns, Risks, Factor Models.	
III	**Forecasting Analytics:** Estimating Demand Curves and Optimize Price, Price Bundling, Non Linear Pricing and Price Skimming, Forecasting, Simple Regression and Correlation Multiple Regression to forecast sales. Modeling Trend and Seasonality Ratio to Moving Average Method, Winter's Method.	**12**
IV	**Business Intelligence &Tableau:** Definition of BI – A Brief History of BI – The Architecture of BI. The origin and Drivers of BI. Successful BI Implementation – Analytics Overview – Descriptive, Predictive and Perspective Analytics. Business reporting and Visualization – components - A brief history of data visualization – Different types of charts and graphs – The emergence of data visualization and visual analytics – Performance dashboards – Dashboard design – Best practices in dashboarddesign – Business performance management – Balanced Scorecards – Six sigma as a performance measurement system.	**12**
V	**Visualizations:** Using Tableau to Summarize Data, Slicing and Dicing Financial Data, Charts to Summarize Marketing Data. Functions to Summarize Data, Pricing Analytics, Risk based pricing, Fraud Detection and Prediction, Recovery Management, Loss Risk Forecasting, Risk Profiling, Portfolio Stress Testing.	**12**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Interpret and discuss the outputs of given financial models and create their own models.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Design and create visualizations that clearly communicate financialdatainsights.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Gain essential knowledge and hands-on experience in the data analysis process, including data scraping, manipulation, and exploratory data analysis.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Be prepared for more advanced applied financial modeling	PO1, PO2, PO3, PO4,

	courses.	PO5, PO6
CO5	Improve leadership, teamwork and critical thinking skills for financial decision making.	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Analysis of Economic Data, Gary Koop, (4th Edition), Wiley.	
2	Statistics and Data Analysis for Financial Engineering: with R examples; David Ruppert, David S. Matteson, Springers	
Reference Books		
1.	Analyzing Financial Data and Implementing Financial Models Using „R", Ang Clifford, Springers.	
2.	Microsoft Excel 2013: Data Analysis and Business Modeling, Wayne L. Winston, Microsoft Publishing	
Web Resources		
1.	https://www.techtarget.com/searcherp/definition/financial-analytics	
2.	https://www.teradata.com/Glossary/What-is-Finance-Analytics	

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	2	2
CO 4	3	3	3	3	2	3
CO 5	3	3	3	3	3	3
Weightageof coursecontributedtoeachPSO	14	15	15	15	12	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	MARKETING ANALYTICS	Elective	4	-	-	-	3	25	75	100

Learning Objectives	
LO1	Understand the importance of marketing analytics for forward looking and systematic allocation of marketing resources 2.
LO2	Know how to use marketing analytics to develop predictive marketing dashboard for organization
LO3	Recognize challenges in dealing with data sets in marketing.
LO4	Identify and apply appropriate algorithms for analyzing the social media and web data
LO5	Make choices for a model for new machine learning tasks.

UNIT	Contents	No. Of. Hours
I	**Marketing Analytics :**Introduction to marketing research, Research design setup, Qualitative research, Quantitative research, Concept development, scale development, Exploring Data, Descriptive Statistics.Product analytics- features, attributes, benefits, Price analytics, Promotion analytics, Channel analytics, Multiple Discriminate analysis.	**12**
II	**Customer Analytics:** Customer Analytics, Analyzing customer satisfaction, Prospecting and Targeting the Right Customers, Covariance and Correlation analysis, Developing Customers, Retaining Customers, Customer lifetime value case, Factor analysis. Market Segmentation & Cluster Analysis, Scatterplots & Correlation Analysis, Linear Regression, Model Validation & Assessment, Positioning analytics, Cross tabulation**.**	**12**
III	**Social Media Analytics (SMA)** :Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas Network fundamentals and models: The social networks perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. Information visualization.	**12**
IV	**Facebook Analytics:** Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post- performance on FB. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis. 9 (LinkedIn, Instagram, YouTube Twitter etc. Google analytics. Introduction.	**12**

	(Websites)	
V	**Web Analytics and making connections** :Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity. Web analytics tools: Clickstream analysis, A/B testing, online surveys, Web crawling and Indexing.	**12**
	TOTAL HOURS	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Critically evaluate the key analytical frameworks and tools used in marketing. Apply key marketing theories, frameworks and tools to solve marketing problems.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Utilize information of a firm's external and internal marketing environment to identify and prioritize appropriate marketing strategies.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Exercise critical judgment through engagement and reflection with existing marketing literature and new developments in the marketing environment.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Critically evaluate the marketing function and the role it plays in achieving organizational success both in commercial and non-commercial settings.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Evaluate and act upon the ethical and environmental concerns linked to marketing activities.	PO1, PO2, PO3, PO4, PO5, PO6

Textbooks

1	Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World, ChuckHemann& Ken Burbary, Pearson, ISBN 9780789750303
2	Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Eric Siegel, Pearson.
3	Marketing Analytics: Optimize Your Business with Data Science in R, Python, and SQL, Dave Jacobs.
4	Matthew Ganis, AvinashKohirkar. Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media. Pearson 2016.
5	Jim Sterne. Social Media Metrics: How to Measure and Optimize Your Marketing Investment. Wiley, 2020.

6	Marshall Sponder. Social Media Analytics. McGraw Hill Latest edition.
Reference Books	
1.	Marketing Analytics: A practical guide to real marketing science, Mike Grigsby, Kogen Page, ISBN 9780749474171
2.	Cutting Edge Marketing Analytics: Real World Cases and Data Sets for Hands on Learning, Raj Kumar Venkatesan, Paul Farris, Ronald T. Wilcox.
3.	Marketing Metrices3e, Bendle, Farris, Pferfery, Reibstein
Web Resources	
1.	https://www.coursera.org/learn/uva-darden-market-analytics
2.	https://www.wrike.com/marketing-guide/marketing-analytics/

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	2	2
CO 4	3	3	2	3	2	3
CO 5	3	3	3	3	3	3
Weightageof coursecontributedtoeachPSO	14	15	14	15	12	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	**DATA COMMUNICATION AND COMPUTER NETWORKS**	**Elective**	4	-	-	-	3	25	75	100
Learning Objectives										
LO1	To introduce the fundamental network architecture concepts and their core principle issues in the emerging communication / data networks.									
LO2	To have a complete picture of the data and computer networks systematically									

LO3	To provide a strong foundation in networking concepts and technology	
LO4	To know the significance of various Flow control and Congestion control Mechanisms	
LO5	To know the Functioning of various Application layer Protocols.	
UNIT	**Contents**	**No. Of. Hours**
I	**Data Communications:** Introduction– Networks – The Internet – Protocols and Standards- Network Models: OSI model – TCP/IP protocol suite – Transmission Media: Guided media – Unguided Media.	**12**
II	**Data Link Layer:** Error Detection and Correction: Introduction- Block coding – Linear block codes – Cyclic Codes – Checksum. Framing – Flow and Error Control: Protocols –Noiseless Channels: Stop- and –Wait – Noisy Channel: Stop-and Wait Automatic Repeat Request-Go-Back –N.	**12**
III	**Medium Access and Network Layer:**Multiple Access: Random Access – Controlled access- Channelization. Network LayerLogical addressing: IPv4 addresses – IPv6 addresses. Transport Layer: Process to Process delivery: UDP – TCP. Congestion Control – Quality of Service	**12**
IV	**Application Layer:** Domain Naming System: Name Space - Domain Name Space - Distribution of Name Space - DNS in the INTERNET - Resolution–Remote logging – E-mail – FTP.	**12**
V	**Wireless Networks:**Wireless Communications – Principles and Fundamentals. WLANs – WPAN- Satellite Networks - Ad-hoc Networks	**12**
	TOTAL HOURS	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Understand the basics of data communication, networking, internet and their importance.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Analyze the services and features of various protocol layers in data networks.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Differentiate wired and wireless computer networks	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Analyze TCP/IP and their protocols.	PO1, PO2, PO3, PO4, PO5, PO6

CO5	Recognize the different internet devices and their functions.	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Forouzan, A. Behrouz. (2006), Data Communications & Networking, Fourth Edition, Tata McGraw Hill Education	
2	Nicopolitidis, Petros, Mohammad SalamehObaidat, G. L. Papadimitriou(2018), Wireless Networks, John Wiley & Sons.	
Reference Books		
1.	Fred Halsall(1996), Data Communications Computer Networks and Open Systems, Fourth Edition, Addison Wesley.	
Web Resources		
1.	https://www.tutorialspoint.com/data_communication_computer_network/index.htm	
2.	https://www.geeksforgeeks.org/data-communication-definition-components-types-channels/	

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	2	2
CO 4	3	3	3	3	2	3
CO 5	3	3	3	3	3	3
Weightageof coursecontributedtoeachPSO	14	15	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
EC-DS	**COMPUTER NETWORKS**	**Elective**	4	-	-	-	3	25	75	100

Learning Objectives		
LO1	To make students understand the concepts of Network hardware and Network Software.	
LO2	To analyze different network models	
LO3	To impart knowledge on Design Issues of Data Link Layer	
LO4	To impart knowledge on IP Addresses and Routing algorithm	
LO5	To make the students understand the establishment of Network connection	
UNIT	**Contents**	**No. Of. Hours**
I	Introduction – Uses of Computer Networks – Network Hardware- Network Software- OSI Reference Model – TCP/IP Reference Model**.**	**12**
II	Physical Layer – Guided Transmission media – Wireless Transmission – Public Switched Telephone Network –Local Loop – Trunks – Multiplexing- Switching.	**12**
III	Data Link Layer – Design Issues- Error Detection and Correction- Simplex Stopand Wait Protocol- Sliding Window Protocol.	**12**
IV	Network Layer – Design Issues – Routing Algorithm- IP Protocol – IP Addresses-Internet Control Protocols.	**12**
V	Transport Layer: Addressing- Connection Establishment-Connection Release.Internet Transport Protocol: UDP-TCP. Application Layer: DNS- Electronic Mail-World Wide Web.	**12**
	TOTAL HOURS	**60**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Usage of computer networks. Describe the functions of each layer in OSI and TCP/IP model.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Basics of Physical layer and apply them in real time applications. Techniques in multiplexing and switching.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Design of Data link layer. Deduction of errors and correction. Flow control using protocols	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Design of Network layers.Generate IP address to find out the route through Routing algorithms	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Design of transport layer.Protocols needed for End–End delivery of packets. Role of Application layer in real time applications	PO1, PO2, PO3, PO4,

		PO5, PO6
Textbooks		
1	A. S. Tanenbaum, “Computer Networks”, Prentice-Hall of India 2008, 4th Edition.	
Reference Books		
1.	Stallings, “Data and Computer Communications”, Pearson Education 2012, 7th Edition	
2.	B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill 2007, 4th Edition.	
3.	F. Halsall, “Data Communications, Computer Networks and Open Systems”, Pearson Education 2008.	
4.	D. Bertsekas and R. Gallagher, “Data Networks”, PHI 2008, 2nd Edition.	
5.	Lamarca, “Communication Networks”, Tata McGraw Hill 2002.	
Web Resources		
1.	https://www.geeksforgeeks.org/basics-computer-networking/	
2.	https://en.wikipedia.org/wiki/Computer_network	
3.	https://www.tutorialspoint.com/computer_fundamentals/computer_networking.htm	
4.	https://www.javatpoint.com/computer-network-tutorial	
5.	http://ceit.aut.ac.ir/~91131079/SE2/SE2%20Website/Lecture%20Slides.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	2	3
CO 3	3	3	3	3	2	2
CO 4	3	3	3	3	2	3
CO 5	3	3	3	3	3	3
Weightageof coursecontributedtoeachPSO	14	15	15	15	12	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	Elective	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**: SecureSocketLayer and 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
Weightageof coursecontributedtoeachPSO	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	Marks		
								CIA	External	Total
EC-DS	**OPERATING SYSTEM**	**Elective**	4	- –	-	-	3	25	75	100

Learning Objectives		
LO1	To understand the fundamental concepts and role of Operating System.	
LO2	To learn the Process Management and Scheduling Algorithms.	
LO3	To understand the Memory Management policies.	
LO4	To gain insight on I/O and File management techniques.	
LO5	Analyze resource management techniques	
UNIT	**Contents**	**No. Of. Hours**
I	**Introduction**- views and goals – OperatingSystem Services - User and OperatingSystem interface - System Call- Types of System Calls – Operating System Design andImplementation - Operating System Structure. **Process Management**: Processconcept- Process Scheduling - Operations on Processes- InterprocessCommunication.**Threads**: Types of threads	**12**
II	**Process Scheduling**:BasicConcepts-Scheduling Criteria Scheduling Algorithm Multiple Processor Scheduling CPU Scheduling. **Synchronization**: The Critical-SectionProblem Synchronization Hardware – Semaphores- Classic Problem ofSynchronization.	**12**
III	**Deadlocks:** Deadlock Characterization - Methods for Handling Deadlocks-Deadlock Prevention- Deadlock Avoidance - Deadlock Detection- Recovery from Deadlock.	**12**
IV	**Memory**-Management Strategies: Swapping - Contiguous Memory AllocationSegmentation- Paging - Structure of the Page Table. **Virtual-Memory Management**: Demand Paging - Page Replacement - Allocation of Frames -Thrashing.	**12**
V	**Storage Management:** File System- File Concept - Access Methods- Directory andDisk Structure -File Sharing- Protection. Allocation Methods - Free- SpaceManagement - Efficiency and Performance – Recovery.	**12**
	TOTAL HOURS	**60**

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

CO1	Define OS with its view and goals and services rented by it Deign of Operating System with itsstructure. Message through Inter process communication.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Describe the allocation of process through scheduling algorithms. Define critical section problems and its usage.Prevention of multiple process executing through the concept of semaphores.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Describe the concept of Mutual exclusion, Deadlock detection and agreement protocols for deadlockprevention and its avoidance.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Analyze the strategies of Memory management schemes and the usage of Virtual memory. Apply Replacement algorithms to avoid thrashing.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Brief study of storage management. Categorize the methods to allocate files for proper protection.	PO1, PO2,PO3, PO4, PO5, PO6
Textbooks		
1	A. SilberschatzP.B.Galvin, Gange. "Operating System Concepts", Ninth Edition, 2013, Addison WesleyPublishingCo..	
Reference Books		
1.	Anderw S Tanenbaum, Albert S. Woodhull, " Operating System Design and Impletation", prentice-Hall India Publication.	
2.	William Stallings, "Operating Systems Internals and Design Principles", Pearson, 2018, 9th Edition.	
3.	Operating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition	
4.	Operating System Concepts (2nd Ed) by James L. Peterson, Abraham Silberschatz, Addison – Wesley.	
5.	Operating Systems Design & implementation Andrew S. Tanenbam, Albert S. Woodhull Pearson.	
Web Resources		
1.	https://www.guru99.com/operating-system-tutorial.html	
2.	https://www.mygreatlearning.com/blog/what	
3.	https://en.wikipedia.org/wiki/Operating_system	
4.	https://www.geeksforgeeks.org/what-is-an-operating-system/	
5.	http://www.cs.kent.edu/~farrell/osf03/oldnotes/2. th-edition.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	2	3	3	3	2	3
CO 3	3	3	3	3	2	2
CO 4	3	3	3	3	2	3
CO 5	3	3	3	3	3	3
Weightageof coursecontributedtoeachPSO	14	15	15	15	12	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	**ARTIFICIAL NEURAL NETWORK**	**Elective**	4	-	-	-	3	25	75	100

Learning Objectives:

The objective of this course is to teach the basics of artificial neural networks, learning process, single layer and multi-layer perceptron networks.

Course Outcomes:

CO1: Understand the basics of artificial neural networks and its architecture.

CO2: Understand the various learning algorithms and their applications.

CO3: Identify the appropriate neural network model to a particular application.

CO4: Apply the selected neural network model to a particular application.

CO5: Analyze the performance of the selected neural network.

Units	Contents	Required 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, Perceptron Learning Algorithm, Perceptron 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 Perceptron 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 Boltzmann Machines, Training of DNN and Applications	**12**

Learning Resources:

- **Recommended Texts**

  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.

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	2	2	3	3
CO 4	2	3	3	3	2	3
CO 5	3	2	3	3	3	3

Weightageof coursecontributedtoeachPSO	14	13	14	12	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**
EC-DS	**SOFTWARE ENGINEERING**	**Elective**	4	-	-	-	3	25	75	100

Learning Objectives:

- To understand the software engineering concepts and to create a system model in real life applications

Course Outcomes:(for students: To know what they are going to learn)

CO1: Gain basic knowledge of analysis and design of systems

CO2: Ability to apply software engineering principles and techniques

CO3: Model a reliable and cost-effective software system

CO4: Ability to design an effective model of the system

CO5: Perform Testing at various levels and produce an efficient system.

Units	**Contents**	**Required Hours**
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.	**12**
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	**12**
III	**Function-Oriented Software Design:** Overview of SA/SD methodology, structured analysis, data flow diagrams (DFD's), structured design, detailed design.	**12**
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.	**12**
V	**Software Maintenance:** Characteristic of software	**12**

	maintenance; software reverse engineering; software maintenance process models; estimation of maintenance cost;	
		60

Learning Resources:

- **Recommended Texts**
  1. Rajib Mall, Fundamentals of Software Engineering, Fifth Edition, Prentice-Hall of India, 2018

- **Reference 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
CO 1	3	3	3	2	3	2
CO 2	2	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
Weightageof coursecontributedtoeachPSO	13	13	15	12	14	14

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

SOFTWARE QUALITY ASSURANCE

Subject Code	L	T	P	S	Credits	Inst. Hours	Marks		
							CIA	External	Total
EC-DS	**4**	**0**	**0**	**0**	**3**	**4**	**25**	**75**	**100**

Learning Objectives	
LO1	Learn the basic concepts of Software Quality Assurance.

LO2	Understand quality management processes	
LO3	Understand the importance of standards in the quality management process and their impact on the final product.	
LO4	Understand to apply software testing techniques in commercial environment	
LO5	Gain knowledge of the various software development methodologies and their impact on quality assurance processes.	
Unit	Contents	**No. of Hours**
I	Introduction- quality and the quality system – standards and procedures technical activities. Software tasks –management responsibility – quality system – contract review – design control – document control – purchasing product identification and traceability.	**12**
II	Process control–checking– identification of testing tools– control of non conforming product –corrective action.	**12**
III	Handling, storage, packing and delivery –quality records- internal quality audits –training –servicing –statistical techniques.	**12**
IV	QA and new technologies –QA and Human–computer interface- process modeling–standards and procedures.	**12**
V	ISO-9001-ElementsofISO9001-improvingqualitysystem– Case study.	**12**
TOTAL		**60**
CO	**Course Outcomes**	
CO1	To have broad understanding of the role of Quality Assurance in Software Engineering.	
CO2	Illustrate the role of automation in software quality assurance and gain practical experience in using automated testing tools	
CO3	Apply the concepts in preparing the quality plan & documents.	
CO4	Analyze and executing software test plans, test cases, and test scripts.	
CO5	Evaluate information quality, software quality and business value of information system.	
Textbooks		
➢	Darrel Ince “An introduction to software quality assurance and its implementation”, MGH 1994. Darrel Ince “ISO 9001 software quality assurance”, MGH 1994.	
Reference Books		
1.	Alan C. Gillies, “Software Quality: Theory and Management”, International Thomson	

	Computer Press, 1997.
2.	Mordechai Ben-Menachem "Software Quality: Producing Practical Consistent Software", International Thompson Computer Press, 1997
Web Resources	
1.	NPTEL & MOOC courses titled Software Quality Assurance
2.	https://www.linkedin.com/learning/topics/software-quality-assurance

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**
Weightage of course contributed to each PSO	**13**	**11**	**10**	**13**	**13**	**12**

SOFTWARE METRICS

Subject Code	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
							CIA	**External**	**Total**
EC-DS	**4**	**0**	**0**	**0**	**3**	**4**	**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	**12**

	measurement, Measurement and models, Measurement scales and scale types, meaningfulness in measurement	
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 andMeaningful Studies	**12**
III	**Software Metrics Data Collection:** Defining good data, Data collection for incident reports, How to collect data, Reliability of data collectionProcedures **Analyzing software measurement data:** Statistical distributions and hypothesis testing, Classical data analysis techniques, Examples of simple analysis techniques	**12**
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 Structural attributes and measures	**12**
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	**12**
TOTAL		**60**

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

➢	Software Metrics A Rigorous and Practical Approach, Norman Fenton, James Bieman , ThirdEdition, 2014
Reference Books	
1	Software metrics, Norman E, Fenton and Shari Lawrence Pfleeger, International Thomson ComputerPress, 1997
2	Metric and models in software quality engineering, Stephen H.Kan, Second edition, 2002, AddisonWesley 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**
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	3	3	3	3	2	3
CO 5	3	2	3	3	3	3
Weightageof coursecontributedtoeachPSO	15	13	15	12	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**
EC-DS	Distributed Computing	**Elective**	4	-	-		3	25	75	100
Learning Objectives										
LO1	Define the introductory concepts of Distributed Systems, Types of Communication									
LO2	Explain the Types of Processes and entities									

LO3	What do you mean by Synchronization and Consultancy of Distributed Systems	
LO4	Identify Fault Tolerance and Security Issues of Distributed Systems	
LO5	Summarize Distributed File System and Case Study	
UNIT	**Contents**	**No. Of. Hours**
I	Introduction to Distributed System: Goals, Hardware concepts, Software concepts, and Client-Server model. Examples of distributed systems. Communication: Layered protocols, Remote procedures call, Remote object invocation, Message-oriented communication, Stream-oriented communication.	**12**
II	Processes: Threads, Clients, Servers, Code Migration, Software agent. Naming: Naming entities, Locating mobile entities, Removing un-referenced entities.	12
III	Synchronization: Clock synchronization, Logical clocks, Global state, Election algorithms, Mutual exclusion, Distributed transactions. Consistency and Replication: Introduction, Data centric consistency models, Client centric consistency models, Distribution protocols, Consistency protocols.	**12**
IV	Fault Tolerance: Introduction, Process resilience, Reliable client server communication, Reliable group communication. Distributed commit, Recovery. Security: Introduction, Secure channels, Access control, Security management.	12
V	Distributed File System: Sun network file system, CODA files system. Case Study: CORBA, Distributed COM, Globe, Comparison of CORBA, DCOM, and Globe.	12
Total hours		**60**
Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Understand the design principles in distributed systems and the architectures for distributed systems.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Apply various distributed algorithms related to clock synchronization, concurrency control, deadlock detection, load balancing, voting etc.	PO1, PO2, PO3, PO4, PO5, PO6

CO3	Analyze fault tolerance and recovery in distributed systems and algorithms for the same	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Analyze the design and functioning of existing distributed systems and file systems.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Implement different distributed algorithms over current distributed platforms	PO1, PO2, PO3, PO4, PO5, PO6
Text Book		
1	Distributed Systems: Principles and Paradigms A.S. TanenbaumandM. van Steen, Pearson/Prentice-Hall, 2nd Edition, 2007. Unit I : Chapters 1,2 and 4 Unit II : Chapters 3 and 5 Unit III : Chapters 6 and7 Unit IV : Chapters 8 and9 Unit V : Chapters 11	
Reference Book		
1	Distributed Systems: Concepts and Design G. Coulouris, J. Dollimore,and T. Kindberg, 5th edition, Addison-Wesley, 2012	
2	Advanced Concepts in Operating Systems M. Singhal, N. Shivaratri, McGraw-Hill Education (India) Pvt. Limited, 2001.	
3	Distributed Operating Systems: Concepts and Design, Pradeep K Sinha,Prentice Hall of India, 2007.	
	Web Resources	
	Web resources from NDL Library, E-content from open-source libraries	

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**O**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
EC-DS	**Organizational Behaviour**	**Elective**	4	-	-	-	3	5	25	75	100

Learning Objectives		
CO1	To have extensive knowledge onOB and the scope of OB.	
CO2	To create awareness of Individual Behaviour.	
CO3	To enhance the understanding of Group Behaviour	
CO4	To know the basics of Organisational Culture and Organisational Structure	
CO5	To understand Organisational Change, Conflict and Power	
UNIT	**Details**	**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)	12
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 JudgementFactors; Linking perception to individual decision making:	12
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-	12

	Goal);	
IV	ORGANISATIONAL CULTURE AND STRUCTURE : Concept of culture; Impact (functions and liability); Creating and sustaining culture: Concept of structure, Prevalent organizational designs: New design options	12
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.	12
	TOTAL	**60**
Course Outcomes	On Completion of the course the students will	**Program Outcomes**
CO1	To define OrganisationalBehaviour, Understand the opportunity through OB.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	To apply self-awareness, motivation, leadership and learning theories at workplace.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	To analyze the complexities and solutions of group behaviour.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	To impact and bring positive change in the culture of the organisation.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	To create a congenial climate in the organization.	PO1, PO2, PO3, PO4, PO5, PO6
Reading List		
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.
5.	John Newstrom, *Organizational Behaviour: HumaBehaviour at Work*, McGraw Hill Education; 12th edition (1 July 2017)
Web Resources	
1	https://www.iedunote.com/organizational-behavior
2	https://www.london.edu/faculty-and-research/organisational-behaviour
3	Journal of Organizational Behavior on JSTOR
4	International Journal of Organization Theory & Behavior | Emerald Publishing
5	https://2012books.lardbucket.org/pdfs/an-introduction-to-organizational-behavior-v1.1.pdf

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	3	3	3	3	2	3
CO 5	3	2	3	2	3	3
Weightageof coursecontributedtoeachPSO	15	13	15	11	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
EC-DS	**AGILE PROJECT MANAGEMENT**	**Elective**	4	-	-	-	3	25	75	100

Learning Objectives:

- To provide students with a theoretical as well as practical understanding of Agile software development practices and how small teams can apply them to creating high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To provide a detailed examination and demonstration of Agile development and testing techniques.
- To provide an understanding of the benefits and pitfalls of working in an Agile team.

Course Outcomes:

CO1: Understanding of the Agile manifesto and its advantages over other SDLC paradigms.

CO2: Understanding essential Agile concepts.

CO3: Understanding how to plan and execute a project using Agile concepts

CO4: Understanding Agile management concepts.

CO5: Practical application of Agile principles.

Units	Contents	Required 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 12 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 – 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	**12**
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's different 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 an 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	**12**

	for project success – Ten metrics for Agile Organizations.	

Learning Resources:

- **Recommended Texts**
  1. Mark C. Layton, Steven J. Ostermiller, *Agile Project Management for Dummies*, 2nd Edition, Wiley India Pvt. Ltd., 2018.
  2. 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.
- **Webresources**
  1. www.agilealliance.org/resources

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	2	3	3
Weightageof coursecontributedtoeachPSO	14	13	15	11	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
EC-DS	**COMPUTING INTELLIGENCE**	**Elective**	4	-	-	-	3	25	75	100

Learning Objectives:

- To provide strong foundation on fundamental concepts in Computing Intelligence

• To apply basic principles of Artificial Intelligence and solutions that require problem solving, influence, perception, knowledge representation and learning		
Course Outcomes: **CO1:** Describe the fundamentals of artificial intelligence concepts and searching techniques. **CO2:** Develop the fuzzy logic sets and membership function and defuzzification techniques. **CO3:**Understand the concepts of Neural Network and analyze and apply the learning techniques **CO4:** Understand the artificial neural networks and its applications **CO5:** Understand the concept of Genetic Algorithm and Analyze the optimization problems using GAs.		
Units	**Contents**	**Required 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 Climbing.	**12**
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**

Learning Resources:

Recommended Texts

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.

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	3	3	3	3	2	3
CO 5	3	3	3	2	3	3
Weightageof coursecontributedtoeachPSO	15	14	15	11	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
EC-DS	**INFORMATION SECURITY**	**Elective**	4	-	-	-	3	25	75	100

Learning Objectives:

- To know the objectives of information security
- Understand the importance and application of each of confidentiality, integrity, authentication and availability
- Understand various cryptographic algorithms

- Understand the basic categories of threats to computers and networks

Course Outcomes:

CO1: Understand network security threats, security services, and countermeasures

CO2: Understand vulnerability analysis of network security

CO3: Acquire background on hash functions; authentication; firewalls; intrusion detection techniques.

CO4: Gain hands-on experience with programming and simulation techniques for security protocols.

CO5: Apply methods for authentication, access control, intrusion detection and prevention.

Units	Contents	Required Hours
I	Introduction to Information Security : Security mindset, Computer Security Concepts (CIA), Attacks, Vulnerabilities and protections, Security Goals, Security Services, Threats, Attacks, Assets, malware, program analysis and mechanisms.	**12**
II	The Security Problem in Computing: The meaning of computer Security, Computer Criminals, Methods of Defense. Cryptography: Concepts and Techniques: Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption	**12**
III	Symmetric and Asymmetric Cryptographic Techniques: DES, AES, RSA algorithms .Authentication and Digital Signatures: Use of Cryptography for authentication, Secure Hash function, Key management – Kerberos.	**12**
IV	Program Security : Non-malicious Program errors – Buffer overflow, Incomplete mediation, Time-of-check to Time-of-use Errors, Viruses, Trapdoors, Salami attack, Man-in-the-middle attacks, Covert channels. File protection Mechanisms, User Authentication Designing Trusted O.S: Security polices, models of security, trusted O.S design, Assurance in trusted O.S. Implementation examples.	**12**
V	Security in Networks: Threats in networks, Network Security Controls – Architecture, Encryption, Content Integrity, Strong Authentication, Access Controls, Wireless Security, Honeypots, Traffic flow security. Web Security: Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction.	**12**

Learning Resources:

- **Recommended Texts**

  1. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education

  2. Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson

- **Reference Books**

  1.Cryptography and Network Security: C K Shyamala, N Harini, Dr T R Padmanabhan, Wiley India, lst Edition.

  2. Cryptography and Network Security : ForouzanMukhopadhyay, McGraw Hill, 2"d Edition

  3. Information Security, Principles and Practice: Mark Stamp, Wiley India.

  4. Principles of Computer Sceurity: WM.Arthur Conklin, Greg White, TMH

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	3	3	3	3	2	3
CO 5	3	3	3	2	3	2
Weightageof coursecontributedtoeachPSO	15	14	15	11	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
EC-DS	**GRID COMPUTING**	**Elect**	4	-	-	-	3	25	75	100

Learning Objectives:

- To provide the knowledge on the basic construction and use of Grid computing.
- To know and understand the grid computing applications.
- To assess the efficiency of the grid computing in solving large scale scientific problems

Course Outcomes:

CO1: To understand the basic elements and concepts related to Grid computing

CO2: To identify the Grid computing toolkits and Framework.

CO3: To know about the concepts of Virtualization

CO4: To analyze the concept of service oriented architecture.

CO5: To Gain knowledge on grid and web service architecture.

Units	Contents	Required 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**

Learning Resources:

Recommended Texts

1. Joshy Joseph and Craig Fellenstein, Grid computing, Pearson / IBM Press, PTR, 2004.

Reference Books

2. Ahmer Abbas and Graig computing, A Practical Guide to technology and applications, Charles River Media, 2003.

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	3	3	3
CO 3	3	3	3	2	3	3
CO 4	3	3	3	3	2	3
CO 5	3	3	2	3	3	3
Weightageof coursecontributedtoeachPSO	15	14	14	13	14	14

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

ANNEXURE II

SKILL ENHANCEMENT BASED

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
SEC	**INTRODUCTION TO HTML**	**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:** Introduction to Java-Features of Java-Object Oriented Concepts-Software Evolution - Software Development, SDLC Models – SDLC steps – Software Testing – Software Quality - Lexical Issues-Data Types – Variables – Arrays – Operators - Control Statements – Classes – Objects –Constructors - Overloading method - Access control - static and fixed methods - Inner classes -Inheritance-Overriding Methods-Using super-Abstract class.	**6**

II	**Packages & Threads:** Packages-Access Protection-Importing Packages-Interfaces-Exception Handling-Throw and Throws-Thread-Synchronization-Messaging- Runnable Interface-Inter thread communication-Deadlock-suspending, resuming and stopping threads-Multithreading	**6**
III	**Input/Output& Collection API:** I/O Streams-File Streams-String Objects-String Buffer-Char Array - Java Utilities-Collectionsinterface - Collection classes-Enumeration – Vector - Stack –Hash tables - String class.	**6**
IV	**Networking:** Networking –Networking basics – java and the Net – InetAddress- TCP/IP Client Sockets –URL- URLConnection – TCP/IP Server Sockets – Datagrams.	**6**
V	**Graphical User Interface in Java:** Working with windows using AWT Classes - Class Hierarchy of Window and Panel -AWT controls - Layout Managers – Menus- Menu bars - Dialog Boxes-File Dialog- Applets-Lifecycle of Applet-Types of Applets-Event handling-Applet tags - JDBC and connecting to Databases – CRUD operations.	**6**
	TOTAL HOURS	**30**

Course Outcomes		**Programme Outcomes**
CO	On completion of this course, students will	
CO1	Knows the basic concept in HTML Concept of resources in HTML	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Knows Design concept. Concept of Meta Data Understand the concept of save the files.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Understand the page formatting. Concept of list	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Creating Links. Know the concept of creating link to email address	PO1, PO2, PO3, PO4, PO5, PO6
CO5	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	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
Weightageof coursecontributedtoeachPSO	15	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
SEC	**OFFICE AUTOMATION**	**SEC**	2	-	-	-	2	25	75	100

LearningObjectives:(forteachers:whattheyhavetodointheclass/lab/field)

- The major objective in introducing the Computer Skills course is to impart training forstudents in Microsoft Office which has different components like MS Word, MS Excel andPowerpoint.
- Thecourseishighlypracticeorientedratherthanregularclassroomteaching.
- Toacquireknowledgeoneditor,spreadsheetandpresentationsoftware.

Course Outcomes:(for students: To know what they are going to learn)

CO1: Understand the basics of computer systems and its components.

CO2: Understand and apply the basic concepts of a word processing package.

CO3: Understand and apply the basic concepts of electronic spreadsheet software.

CO4: Understand and apply the basic concepts of database management system.

CO5: Understand and create a presentation using PowerPoint tool.

Units	Contents	Required Hours
I	**Introductory concepts:** Memory unit– CPU-Input Devices: Key board, Mouse and Scanner.Outputdevices:Monitor,Printer.Introductionto Operatingsystems&itsfeatures:DOS– UNIX– Windows. IntroductiontoProgrammingLanguages.	**6**
II	**Word Processing:** Open, Save and close word	**6**

	document; Editing text – tools, formatting, bullets;SpellChecker - Document formatting – Paragraph alignment, indentation, headers and footers,numbering;printing–Preview,options,merge.	
III	**Spreadsheets:**Excel-opening,enteringextenddata,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**
		30

Learning Resources:

- **Recommended Texts**

1. PeterNorton,"IntroductiontoComputers"–TataMcGraw-Hill.

- **Reference Books**

1. JenniferAckermanKettel,GuyHat-Davis,CurtSimmons,"Microsoft2003",TataMcGraw-Hill.

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	2	3	3	2
CO 4	3	3	2	3	3	3
CO 5	3	3	3	3	3	3
Weightageof coursecontributedtoeachPSO	15	15	12	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
SEC	Quantitative Aptitude	SEC	2	-	-	-	2	25	75	100

LearningObjectives:(forteachers:whattheyhavetodointheclass/lab/field)

- Toimprovethequantitativeskillsofthestudents
- Topreparethestudentsforvariouscompetitiveexams

CourseOutcomes:(forstudents:Toknowwhattheyaregoingtolearn)

CO1: To gain knowledge on LCM and HCF and its related problems

CO2: To get an idea of age, profit and loss related problem solving.

CO3: Able to understand time series simple and compound interests

CO4: Understanding the problem related to probability, and series

CO5: Able to understand graphs, charts

Units	Contents	RequiredHours
I	Numbers-HCFandLCMofnumbers-Decimalfractions-Simplification-Squarerootsandcuberoots-Average-problemsonNumbers	6
II	Problems on Ages - Surds and Indices - percentage - profits and loss - ratio andproportion-partnership-Chainrule.	6
III	Time and work - pipes and cisterns - Time and Distance - problems on trains -Boats and streams - simple interest - compound interest - Logarithms - Area -Volumeandsurfacearea-racesandGamesofskill.	6

IV	Permutationandcombination-probability-TrueDiscount-BankersDiscount - HeightandDistances-Oddmanout&Series.	
V	Calendar - Clocks - stocks and shares - Data representation - Tabulation – BarGraphs-Piecharts-Linegraphs	**6**

LearningResources:

- **RecommendedTexts**
  1. ."QuantitativeAptitude",R.S.AGGARWAL.,S.Chand&CompanyLtd.,
- **Webresources: Authentic** Web resources related to Competitive examinations

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**3**	**2**	**2**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**3**
CO3	**3**	**2**	**2**	**2**	**3**	**3**
CO4	**3**	**3**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**13**	**13**	**13**	**14**	**15**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
SEC	**CYBER FORENSICS**	**SEC**	2	-	-	-	2	25	75	100

Learning Objectives:

- To correctly define and cite appropriate instances for the application of computer forensics.
- To Correctly collect and analyze computer forensic evidence and data seizure. Identify the essential and up–to–date concepts, algorithms, protocols, tools, and methodology of Computer Forensics.

Course Outcomes:

CO1: Understand the definition of computer forensics fundamentals.

CO2: Evaluate the different types of computer forensics technology.

CO3: Analyze various computer forensics systems.

CO4: Apply the methods for data recovery, evidence collection and dataseizure.

CO5: Gain your knowledge of duplication and preservation of digital evidence.

Units	Contents	Required Hours
I	**Overview of Computer Forensics Technology:** • Computer Forensics Fundamentals: What is Computer Forensics? Use of Computer • Forensics in Law Enforcement, Computer Forensics Assistance to Human • Resources/Employment Proceedings, Computer Forensics Services, Benefits of professional • Forensics Methodology, Steps taken by Computer Forensics Specialists. Types of Computer. • Forensics Technology: Types of Business Computer Forensic, Technology–Types of	**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: Electronic Document 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, Documenting • The Intrusion on Destruction of Data, System Testing.	**6**

Learning Resources:

- **Recommended Texts**

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 DigitalCrime", TMH 2005.

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**3**	**3**	**2**	**2**	**2**
CO2	**2**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**14**	**13**	**14**	**14**	**14**	**13**

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
SEC	**MULTIMEDIA SYSTEMS**	SEC	2	-	-	-	2	25	75	100

Learning Objectives:

- Tounderstandthestandardsavailablefordifferentaudio,videoandtextapplications
- Tolearnvariousmultimediaauthoringsystemsinmultimediaproductionteam

Course Outcomes:

CO1: Write action script for a particular problem.

CO2: Design and Draw customized GUI components.

CO3: Apply Transformations on Components.

CO4: To make use of fundamental concepts and formulate best practices

CO5: Apply technical concepts and practices in specialized areas

Units	Contents	Required Hours
I	MultimediaDefinition-UseOfMultimedia-Delivering Multimedia- Text:About Fonts and Faces - Using Text in Multimedia - Computers and Text – FontEditingandDesignTools-HypermediaandHypertext.	6
II	Images: Plan Approach - Organize Tools - Configure Computer Workspace -Making Still Images - Color - Image File Formats. Sound: The Power of Sound -DigitalAudio-MidiAudio-Midivs.	6
III	Animation: The Power of Motion-PrinciplesofAnimation – AnimationbyComputer - Making Animations that Work. Video: Using Video - Working withVideoandDisplays-DigitalVideoContainers-Obtaining Video Clips - ShootingandEditingVideo.	6
IV	Making Multimedia: The Stage of Multimedia Project - The Intangible Needs -The Hardware Needs - The Software Needs – An Authoring System Needs-MultimediaProductionTeam.	6
V	PlanningandCosting:TheProcessofMakingMultimedia-Scheduling-Estimating - RFPs and Bid Proposals. Designing and Producing - Content andTalent:AcquiringContent-OwnershipofContentCreatedforProject-AcquiringTalent.	6

Learning Resources:

- **Recommended Texts**

  1. Tay Vaughan, "Multimedia: Making It Work", 8th Edition, Osborne/McGraw- Hill, 2001.

- **Reference Books**

  1. RalfSteinmetz&KlaraNahrstedt"MultimediaComputing,Communication& Applications",PearsonEducation,2012

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**3**	**3**	**3**	**3**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**13**	**14**	**15**	**15**	**13**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
SEC	**SOFTWARE TESTING**	**SEC**	2	-	-	-	2	25	75	100

Learning Objectives:

- TostudyvariousSoftwaretechniques
- Tostudyfundamental concepts in softwaretesting

Course Outcomes:

CO1: Understand and describe the basic concepts of functional (black box) software testing.
CO2: Understand the basic application of techniques used to identify useful ideas for tests.
CO3: Help determine the mission and communicate the status of your testing with the rest of your project team.
CO4: Characterize a good bug report, peer-review the reports of your colleagues, and improve your own report writing.
CO5: Understand where key testing concepts apply within the context of unified processes.

Units	Contents	Required Hours
I	Introduction:Purpose– ProductivityandQualityinSoftware– TestingVsDebugging–ModelforTesting–Bugs–Types of Bugs – Testing and DesignStyle.	**6**
II	Flow / Graphs and Path Testing – Achievable paths – Path instrumentation –Application– TransactionFlowTestingTechniques	**6**
III	Data Flow Testing Strategies - Domain Testing:Domains and Paths – DomainsandInterfaceTesting.	**6**
IV	Linguistic–Metrics – Structural Metric – Path Products and Path Expressions.SyntaxTesting– Formats–TestCases.	**6**
V	LogicBasedTesting–DecisionTables– TransitionTesting– States, StateGraph,StateTesting.	**6**

Learning Resources:

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

- **Reference Books**

1. Burnstein,2003,"PracticalSoftwareTesting",SpringerInternationalEdn.
2. . Kit, 1995, "Software Testing in the Real World: Improving the Process",PearsonEducation,Delhi.
3. R.RajaniandP, P.Oak, 2004, "SoftwareTesting", TataMcgrawHill, NewDelhi.

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**3**	**2**	**2**	**2**
CO2	**2**	**3**	**3**	**2**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Weightage of course contributed to each PSO	**14**	**13**	**14**	**13**	**14**	**13**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
SEC	**DATA MINING AND WAREHOUSING**	**SEC**	2	-	-	-	2	25	75	100

Learning Objectives:

- To provide the knowledge on Data Mining and Warehousing concepts and techniques.
- To study the basic concepts of cluster analysis
- Tostudyasetoftypicalclustering methodologies, algorithms andapplications.

Course Outcomes:

CO1: To understand the basic concepts and the functionality of the various data mining and data warehousing component

CO2: To know the concepts of Data mining system architectures

CO3: To analyze the principles of association rules

CO4: To get analytical idea on Classification and prediction methods.

CO5: To Gain knowledge on Cluster analysis and its methods.

Recap:(notforexamination)Motivation/previouslecture/relevantportionsrequiredforthe course)[Thisisdoneduring2Tutorialhours)

Units	**Contents**	**Required Hours**
I	Introduction: Data mining – Functionalities – Classification – Introduction to Data Warehousing – Data Preprocessing: Preprocessing the Data – Data cleaning – Data Integration and Transformation – Data Reduction.	**6**
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.	**6**

III	Mining Association Rules: Basic Concepts – Single Dimensional Boolean Association Rules From Transaction Databases, Multilevel Association Rules from transaction databases.	**6**
IV	Classification and Prediction: Introduction – Issues – Decision Tree Induction – Bayesian Classification – Classification of Back Propagation.	**6**
V	Cluster Analysis: Introduction – Types of Data in Cluster Analysis, Petitioning Methods – Hierarchical Methods-Density Based Methods	**6**

Learning Resources:

- **Recommended Texts**

  1. Han and M. Kamber, "Data Mining Concepts and Techniques", 2001, Harcourt India Pvt. Ltd, New Delhi.

- **Reference Books**

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

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**3**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**3**	**3**	**3**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**14**	**14**	**14**	**14**	**13**

Subject Code	**Subject Name**	**C a .**	**L**	**T**	**P**	**S**	**C**	**Marks**

								CIA	External	Total
SEC	**BIOMETRICS**	**SEC**	2	-	-	-	2	25	75	100

Learning Objectives:(forteachers:whattheyhavetodointheclass/lab/field)

- To learn and understand biometric technologies and their functionalities.
- To learn the role of biometrics, computational methods, context of Biometric Applications.
- To learn to develop applications with biometric security

Course Outcomes: (forstudents:Toknowwhattheyaregoingtolearn)

CO1: Identify the various biometric technologies.

CO2: Design of biometric recognition.

CO3: Develop simple applications for privacy

CO4: Understand the need of biometric in the society

CO5: Understand the scope of biometric techniques

Units	Contents	Required Hours
I	**Introduction**: What is Biometrics, History,Types of biometric Traits, General architecture of biometric systems, Basic working of biometric matching. **Face Biometrics:** Introduction, Background of Face Recognition, Design of Face Recognition System.	**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.	**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.	**6**
IV	**WatermarkingTechniques:** Introduction, Data Hiding Methods, Basic Framework of Watermarking, Classification of Watermarking, Applications of Watermarking, Attacks on Watermarks, Performance Evaluation, Characteristics of Watermarks, General Watermarking Process.	**6**
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	**6**

	Border Security, Smart Card Technology and Biometrics.	

Learning Resources:

- **Recommended Texts**
  1. Biometrics: Concepts and Applications by G.R Sinha and SandeepB.Patil , Wiley, 2013
- **Reference 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

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**2**	**2**	**2**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**12**	**13**	**13**	**14**	**13**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
SEC	**ENTERPRISE RESOURCE PLANNING**	**SEC**	2	-	-	-	2	25	75	100

Learning Objectives:(forteachers:whattheyhavetodointheclass/lab/field)

- Understand the concept of ERP and the ERP model; define key terms; identify the levels of ERP maturity.
- To integrate business processes; define and analyze a process; create a process map and improve and/or simplify the process; apply the result to an ERP implementation.
- To know the elements of a value chain, and explain how core processes relate; identify how the organizational infrastructure supports core business processes; explain the effect of a new product launch on the three core business processes

Course Outcomes:(forstudents:Toknowwhattheyaregoingtolearn)

CO1: Understand the basic concepts of ERP.
CO2: Identify different technologies used in ERP
CO3: Understand and apply the concepts of ERP Manufacturing Perspective and ERP Modules
CO4: Discuss the benefits of ERP
CO5: Apply different tools used in ERP

Units	Contents	Required 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.	**6**
III	ERP Marketplace and Marketplace Dynamics: Market Overview, Marketplace Dynamics, the Changing ERP Market. ERP- Func-tional Modules: Introduction, Functional Modules of ERP Software, Integration of ERP, Supply chain.	**6**
IV	ERP Implementation Basics, , ERP implementation Strategy, ERP Implementation Life Cycle ,Pre- Implementation task,Role of SDLC/SSAD, Object Oriented Architecture,	**6**

	Consultants, Vendors and Employees.	
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**

Learning Resources:

- **Recommended Texts**
  1. Enterprise Resource Planning – Alexis Leon, Tata McGraw Hill.
- **Reference Books**
  1.Enterprise Resource Planning – Diversified by Alexis Leon, TMH.
  2.Enterprise Resource Planning – Ravi Shankar & S. Jaiswal , Galgotia

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**3**	**3**	**2**	**2**	**2**
CO2	**2**	**3**	**3**	**3**	**3**	**2**
CO3	**2**	**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	**13**	**15**	**15**	**14**	**14**	**13**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
	ROBOTICS AND	**SEC**	2	-	-	-	2	25	75	100

SEC	ITS APPLICATIONS									

LearningObjectives:(forteachers:whattheyhavetodointheclass/lab/field)

- To make the students familiar with the various drive systems of robots, sensors and their applications in robots
- To introduce the parts of robots, basic working concepts and types of robots

Course Outcomes: (forstudents:Toknowwhattheyaregoingtolearn)

CO1: Describe the different physical forms of robot architectures

CO2: Kinematically model simple manipulator and mobile robots

CO3: Mathematically describe a kinematic robot system.

CO4: Analyze manipulation and navigation problems using knowledge of coordinate frames, kinematics, optimization, control, and uncertainty.

CO5: Program robotics algorithms related to kinematics, control, optimization, and uncertainty.

Units	Contents	Required Hours
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.	6
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	6
III	Localization:Self-localizations and mapping - Challenges in localizations – IR based localizations – vision based localizations – Ultrasonic based localizations - GPS localization systems.	6
IV	Path Planning :Introduction, path planning-overview-road map path planning-cell decomposition path planningpotential field path planning-obstacle avoidance-case studies	6
V	Application: Ariel robots-collision avoidance robots for agriculture-mining-exploration-underwater-civilian- and military applications-nuclear applications-space applications	6

Learning Resources:

- **Recommended Texts**

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

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**12**	**14**	**14**	**14**	**13**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
SEC	**SIMULATION AND MODELING**	**SEC**	2	-	-	-	2	25	75	100

LearningObjectives:(forteachers:whattheyhavetodointheclass/lab/field)

In this course, modeling and simulation (M&S) methodologies considering the theoretical aspects. A wide range of Modeling and Simulation concepts that will lead you to develop your own M&S applications. Students learn the methodologies and tools for simulation and modeling of a real time problem/ mathematical model.

Course Outcomes:(forstudents:Toknowwhattheyaregoingtolearn)

CO1: Introduction To Modeling & Simulation, Input Data Analysis and Modeling.

CO2: Random Variate and Number Generation. Analysis of Simulations and methods.

CO3: Comparing Systems via Simulation

CO4: Entity Body Modeling, Visualization, Animation.

CO5: Algorithms and Sensor Modeling.

Units	Contents	Required 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	**6**
II	Random Variate Generation – Random Numbers – Random Number Generators – General principles – Inverse Transform Method –Acceptance Rejection Method – Composition Method –Relocate and Rescale Method - Specific distributions-Output Data Analysis	**6**
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 -	**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)	**6**
V	Optimization Algorithms – Genetic Algorithms – Simulated Annealing Examples: Sensor Systems Modeling – Human Eye Modeling – Optical Sensor Modeling – Radar Modeling.	**6**

Learning Resources:

- **Recommended Texts**

  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.

- **Reference Books**

  1. Andrew F. Seila, Vlatko Ceric, PanduTadikamalla, "Applied Simulation Modeling", Thomson Learning Inc., 2003.

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**3**
CO4	**3**	**2**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**12**	**15**	**14**	**14**	**13**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Marks**		
								CIA	**External**	**Total**
SEC	**PATTERN RECOGNITION**	**SEC**	2	-	-	-	2	25	75	100

Learning Objectives: (forteachers:whattheyhavetodointheclass/lab/field)
To study the Pattern Recognition techniques and its applications

Course Outcomes: (forstudents:Toknowwhattheyaregoingtolearn)

CO1: To learn the fundamentals of Pattern Recognition techniques

CO2: To learn the various Statistical Pattern recognition techniques

CO3: To learn the linear discriminant functions and unsupervised learning and clustering

CO4: To learn the various Syntactical Pattern recognition techniques

CO5: To learn the Neural Pattern recognition techniques

Recap:(notforexamination)Motivation/previouslecture/relevantportionsrequiredforthe course)[Thisisdoneduring2Tutorialhours)

Units	**Contents**	**Required Hours**
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**
II	STATISTICAL PATTERN RECOGNITION: Introduction to statistical Pattern Recognition-supervised Learning using Parametric and Non-Parametric Approaches.	**6**

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**
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**
V	NEURAL PATTERN RECOGNITION: Introduction to Neural Networks-Feedforward Networks and training by Back Propagation-Content Addressable Memory Approaches and Unsupervised Learning in Neural PR	**6**

Learning Resources:

- **Recommended Texts**
  1. Robert Schalkoff, "Pattern Recognition: Statistical Structural and Neural Approaches", John wiley& sons.
- **Reference Books**

  1. Earl Gose, Richard Johnson baugh, Steve Jost, "Pattern Recognition and Image Analysis", Prentice Hall of India, Pvt Ltd, New Delhi.
  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.

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**3**	**3**	**2**	**2**
CO2	**2**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**2**	**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	**14**	**13**	**15**	**15**	**14**	**13**

Title of the Course/ Paper	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
Skill Enhancement course	**ADVANCED EXCEL**	SEC	2	-	-	-	2	2	25	75	100

Course Objective	
C1	Handle large amounts of data
C2	Aggregate numeric data and summarize into categories and subcategories
C3	Filtering, sorting, and grouping data or subsets of data
C4	Create pivot tables to consolidate data from multiple files
C5	Presenting data in the form of charts and graphs

UNIT	**Details**	**No. of Hours**
I	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	6
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	6
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.	6
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- WhatIf Analysis - Goal Seek- Data Tables- Scenario	6

	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.	6
	Total	**30**

Course Outcomes		**Programme Outcome**
CO	Upon completion of the course the students would be able to:	
1	Handle large amounts of data	PO1, PO6
2	Aggregate numeric data and summarize into categories and subcategories	PO2
3	Filtering, sorting, and grouping data or subsets of data	PO4 ,PO7
4	Create pivot tables to consolidate data from multiple files	PO6
5	Presenting data in the form of charts and graphs	PO7,PO8

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 TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**2**	**3**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**

Weightage of course contributed to each PSO	**15**	**12**	**14**	**13**	**14**	**13**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
SKILL ENHANCEMENT COURSE	**Open Source Software Technologies**	SEC	2	-	-	-	2	2	25	75	100

Course Objective	
C1	Able to Acquire and understand the basic concepts in Java,application of OOPS concepts.
C2	Acquire knowledge about operators and decision-making statements.
C3	To Identify the significance and application of Classes, arrays and interfaces and analyzing java arrays
C4	Understand about the applications of OOPS concepts and analyze overriding and packages through java programs.
C5	Can Create window-based programming using applet and graphics programming.

UNIT	**Details**	**No. of Hours**	**CO**
I	Open Source – open source vs. commercial software – What is Linux? – Free Software – Where I can use Linux? - Linux kernel – Linux distributions.	6	C1
II	Introduction Linux Essential Commands – File System concept – Standard Files –The Linux Security Model – Introduction to Unix – Unix Components Unix Files –	6	C2
III	Introduction - Apache Explained – Starting, Stopping and Restarting Apache –Modifying the Default configuration – Securing Apache – Set user and Group	6	C3
IV	**MySQL:** Introduction to MySQL – The show databases and table – The USE command –Create Database and Tables – Describe Table –	6	C4
V	I**ntroduction** –PHP Form processing – Database Access with PHP – MySQL, MySQLFunctions – Inserting Records – Selecting Records – Deleting Records – Update Records.	6	C6
	Total	**30**	

Course Outcomes		Programme Outcome
CO	On completion of this course, students will	
1	Acquire and understand the basic concepts in Java,application of OOPS concepts.	Po1
2	Acquire knowledge about operators and decision-making statements.	Po1,Po2
3	Identify the significance and application of Classes, arrays and interfaces and analyzing java arrays	Po4,Po6
4	Understand about the applications of OOPS concepts and analyze overriding and packages through java programs.	Po4,Po5,Po6
5	Create window-based programming using applet and graphics programming.	Po3,Po8
Text Book		
1	1. James Lee and Brent Ware "Open Source Web Development with LAMP using	
2	2. LINUX, Apache, MySQL, Perl and PHP", Dorling Kindersley (India) Pvt. Ltd, 2008.	
Reference Books		
1.	Eric Rosebrock, Eric Filson, "Setting up LAMP: Getting Linux, Apache, MySQL and PHP and working together", John Wiley and Sons, 2004.	
2.	2. Anthony Butcher , "Teach Yourself MySQL in 21 days", 2nd Edition, Sams Publication.	
3.	3. Rich Bower, Daniel Lopez Ridreejo, AlianLiska , "Apache Administrator's Handbook", Sams Publication.	
4.	4. Tammy Fox, "RedHat Enterprise Linux 5 Administration Unleashed", Sams Publication.	
5.	5. NaramoreEligabette, Gerner Jason, Wrox Press, Wiley Dreamtech Press, "Beginning PHP5, Apache, MySQL Web Development", 2005.	
Web Resources		
1.	Introduction to Open-Source and its benefits - GeeksforGeeks	
2.	https://www.bing.com/	

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**3**	**2**	**3**	**2**
CO2	**2**	**3**	**3**	**3**	**3**	**2**
CO3	**2**	**2**	**3**	**3**	**3**	**3**
CO4	**3**	**3**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**13**	**13**	**14**	**14**	**15**	**13**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
SKILL ENHANCEMENT COURSE	**PHP Programming**	SEC	-	-	2	-	2	2	25	75	100

LearningObjectives:(forteachers:whattheyhavetodointheclass/lab/field)

The objective of this course is to teach the fundamentals of quantum information processing, including quantum computation, quantum cryptography, and quantum information theory.

CourseOutcomes:(forstudents:Toknowwhattheyaregoingtolearn)

CO1: Analyze the behaviour of basic quantum algorithms

CO2: Implement simple quantum algorithms and information channels in the quantum circuit model

CO3: Simulate a simple quantum error-correcting code

CO4: Prove basic facts about quantum information channels

CO5:

Units	**Contents**	**RequiredHours**
I	**(related program to this)** Introduction to PHP -Basic Knowledge of websites - Introduction of Dynamic Website -Introduction to PHP - Scope of PHP -XAMPP and WAMP Installation- PHP Programming Basics -Syntax of PHP	**30**

II	Introduction to PHP Variable -Understanding Data Types -Using Operators -Using Conditional Statements -If(), else if() and else if condition Statement -Switch() Statements -Using the while() Loop -Using the for() Loop	
III	PHP Functions -PHP Functions -Creating an Array -Modifying Array Elements -Processing Arrays with Loops -Grouping Form Selections with Arrays -Using Array	
IV	PHP Advanced Concepts -Reading and Writing Files -Reading Data from a File -Managing Sessions and Using Session Variables	
V	OOPS Using PHP -OOPS Concept-Class, Object, Abstractions, Encapsulation, Inheritance, Polymorphism -Creating Classes and Object in PHP-Cookies and Session Management	

LearningResources:

- **RecommendedTexts**

  Head First PHP & MySQL: A Brain-Friendly Guide- 2009-Lynn mighley and Michael Morrison.

- **ReferenceBooks**

  The Joy of PHP: A Beginner's Guide to Programming Interactive Web Applications with PHP and MySQL- Alan Forbes

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**2**	**3**	**3**	**3**

Weightage of course contributed to each PSO	**15**	**12**	**13**	**14**	**14**	**13**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
SKILL ENHANCEMENT COURSE	**WEB TECHNOLOGY**	SEC	2	-	-	-	2	2	25	75	100

LearningObjectives:(forteachers:whattheyhavetodointheclass/lab/field)

- To learn the basic web concepts and to create rich internet applications that use most recent client-side programmingtechnologies.
- To learn the basics of HTML, DHTML, XML, CSS, Java Script and AJAX.

Course Outcomes:(forstudents:Toknowwhattheyaregoingtolearn)

CO1: Ability to Develop and publish Web pages using Hypertext Markup Language(HTML).

CO2: Ability to optimize page styles and layout with Cascading Style Sheets(CSS).

CO3: Ability to Understand, analyze and apply the role of languages to create acapstone

CO4: Website using client-side web programming languages like HTML, DHTML, CSS, XML, JavaScript, and AJAX

CO5: Able to understand the concept of jQuery and AngularJS

Units	**Contents**	**Required Hours**
I	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	**6**
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	**6**
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).	**6**
IV	JavaScript: Client side scripting, What is JavaScript, How to develop JavaScript, simple JavaScript, variables, functions, conditions, loops and repetition.	**6**
V	Ajax: Introduction, advantages &disadvantages, Purpose of it, ajax based web application, alternatives of ajax Java Script & AJAX: Introduction to	**6**

	array-operators, making statements-date & time-mathematics- strings-Event handling-form properties. AJAX. Introduction to jQuery and AngularJS	

Learning Resources:

- **Recommended Texts**

1. Pankaj Sharma, "*Web Technology*", SkKataria&SonsBangalore, 2011.(UNIT I, II, III &IV).
2. Achyut S Godbole&AtulKahate, "*Web Technologies*", 2002, 2nd Edition. (UNIT V:AJAX)

- **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, 2ndEdition.

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**3**	**2**
CO3	**3**	**2**	**3**	**3**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**2**	**3**	**3**
Weightage of course contributed to each PSO	**15**	**12**	**14**	**13**	**14**	**13**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
SKILL ENHANCEMENT COURSE	**NETWORK SECURITY**	SEC	2	-	-	-	2	2	25	75	100

LearningObjectives:(forteachers:whattheyhavetodointheclass/lab/field)

- Tostudythenumbertheoryusedfornetworksecurity
- Tounderstandthedesignconceptofcryptographyandauthentication
- Todevelopexperimentsonalgorithmusedforsecurity

Course Outcomes:(forstudents:Toknowwhattheyaregoingtolearn)

CO1: Develop an understanding of the fundamentals of networking and security

CO2: Gain an appreciation for the complexities of protecting networks and systems from attack

CO3: Learn about the tools used to detect and protect against malicious attacks

CO4: Develop the skills to configure various security-related technologies

CO5: Utilize protocols such as TLS/SSL, IPSec, and SNMP in order to build secure systems.

Units	Contents	Required Hours
I	Modelofnetworksecurity– Securityattacks,servicesandattacks– OSIsecurity architecture – Classical encryption techniques – SDES – Block cipherPrinciplesDES– StrengthofDES–Blockcipherdesign principles – Blockcipher mode of operation	**6**
II	NumberTheory–Primenumber–Modulararithmetic– Euclid'salgorithm	**6**
III	Authentication requirement – Authentication function – MAC – Hash function –Security of hash function and MAC – SHA - HMAC – CMAC	**6**
IV	Authentication applications – Kerberos – X.509 Authentication services - E-mailsecurity– IPsecurity-Websecurity.	**6**
V	Intruder–Intrusiondetectionsystem– Virusandrelatedthreats–Countermeasures – Firewalls design principles – Trusted systems – Practicalimplementationofcryptographyandsecurity	**6**

Learning Resources:

- **Recommended Texts**

1. WilliamStallings,"Cryptography&NetworkSecurity",PearsonEducation,FourthEdition2010.

- **Reference Books**

1. CharlieKaufman,RadiaPerlman,MikeSpeciner,"NetworkSecurity,Privatecommunicationinpublicworld",PHISecondEdition,2002.
2. BruceSchneier,NeilsFerguson,"PracticalCryptography",WileyDreamtechIndiaPvtLtd,FirstEdition,2003.
3. DouglasRSimson"Cryptography– Theoryandpractice",CRCPress,FirstEdition,1995.

MAPPING TABLE						
CO/PSO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	**PSO6**
CO1	**3**	**2**	**3**	**2**	**3**	**2**
CO2	**2**	**3**	**3**	**3**	**3**	**2**
CO3	**2**	**2**	**2**	**3**	**3**	**3**
CO4	**3**	**2**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**3**	**3**	**3**
Weightage of course contributed to each PSO	**13**	**12**	**13**	**14**	**15**	**13**

Subject Code	**Subject Name**	**Category**	**L**	**T**	**P**	**S**	**Credits**	**Inst. Hours**	**Marks**		
									CIA	**External**	**Total**
SKILL ENHANCEMENT COURSE	**IMAGE PROCESSING**	SEC	2	-	-	-	2	2	25	75	100

LearningObjectives:(forteachers:whattheyhavetodointheclass/lab/field)

- To become familiar with digital image fundamentals
- To get exposed to simple image enhancement techniques in Spatial and Frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods

Course Outcomes:(forstudents:Toknowwhattheyaregoingtolearn)

CO1: Gain a fundamental understanding of digital image processing

CO2: Learn the basics of how digital images are represented and processed

CO3: Understand image enhancement techniques

CO4: Develop your programming skills to apply digital image processing algorithms

CO5: Design solutions for real-world problems that involve digital image processing.

Units	**Contents**	**Required Hours**
I	**DIGITAL IMAGE FUNDAMENTALS:** Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization	**6**
II	**IMAGE ENHANCEMENT**: Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering,	**6**

III	**IMAGE RESTORATION:** Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters	**6**
IV	**IMAGE SEGMENTATION:** Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging	**6**
V	**IMAGE COMPRESSION AND RECOGNITION:** Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG.	**6**

LearningResources:

- **Recommended Texts**
  1. Anil K. Jain , Digital Image Processing: Principles and Applications
  2. Wayne Niblack, "Introduction to Digital Image Processing"
  3. B.S. Manjunath and Srimat T.V. Rao, "Digital Image Processing: An Algorithmic Approach Using Java"
- **Reference Books**
  1. Rafael C. Gonzalez and Richard Eugene Woods, "Digital Image Processing"
- **Webresources**
- https://www.learnopencv.com/
- https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-435j-digital-image-processing-fall-2004/
- http://web.stanford.edu/class/cs155/

MAPPING TABLE

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
CO1	3	2	3	2	2	2
CO2	2	3	3	3	3	2
CO3	2	2	3	3	3	3
CO4	3	2	2	3	3	3
CO5	3	3	3	3	2	3
Weightage of course contributed to each PSO	13	12	14	14	13	13