



THIRUVALLUVAR UNIVERSITY

SERKKADU, VELLORE-632115

B.Sc. DATA SCIENCE

SYLLABUS

FROM THE ACADEMIC YEAR

2023 - 2024

1. Introduction

B.Sc. Data Science

Data Science is a vast field comprising many topics of Statistics, Mathematics, and IT. A Data Science course syllabus for beginners covers basic and advanced concepts of data analytics, machine learning, statistics, and programming languages like Python or R. It also teaches students how to interpret large datasets and identify patterns to create predictive models. Data Science has come a long way. Data Scientists were once referred to as „business problem solvers“ who knew how to make sense of incoherent data clusters. Fast-forward to the present, Data Scientists are the most important resources for any business looking to thrive in this mad rush. They are now the „wizards of all problem solvers“.

The course is enabled to include several interdisciplinary areas like: programming languages, algorithms, operating systems, databases, machine learning, data mining, business intelligence, big data, probability and statistics, data optimization, statistical simulation and data analysis, management decision analysis, decision models and predictive analysis. Data Science 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.

This is the primary reason the syllabus of Data Science courses includes concepts that touch base on cloud computing, big data, natural language processing, and data sentiment analysis. The future of Data Science is estimated to bring opportunities in various areas of banking, finance, insurance, entertainment, telecommunication, automobile, etc. A data scientist will help grow an organization by assisting them in making better decisions. Data science has become important due to

recent technology disruptions. Most fundamental is Moore's Law which has driven an exponential growth in computing, storage, and communications per rupee over the past 50 years. This rate of growth shows no signs of abating. Consequently, today we have the Internet of Things: a plethora of sensors costing 10s of rupees or less, a global Internet with almost limitless bandwidth, and enormous storage in global clouds. The present era is full of technological advances in almost all spectrum of life and we are flooded with enormous amount of data. There is an increasing demand of capturing, analyzing, and synthesizing this large amount of data sets in a number of application domains to better understand various phenomena and to convert the information available in the data into actionable strategies such as new scientific discoveries, business applications, policy making, and healthcare etc.

Data science is the area where applications of various tools and techniques from the disciplines of applied statistics, mathematics and computer science are used to get greater insight and to make better and informed decisions for various purposes by analyzing a large amount of data. Consequently, the study of data science as a discipline has become essential to cater the growing need for professionals and researchers to deal with the future challenges.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	B.Sc., Data Science
Programme Code:	
Duration:	3 years [UG]
Programme Outcomes:	<p>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</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>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</p>

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 demonstrating 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

	<p>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.</p>
<p>Programme Specific Outcomes:</p>	<p>PSO1. Able to apply data analytical skills that rely on mathematical and statistical methods to solve problems in a data-driven world.</p> <p>PSO2. Able to analyze and interpret complex data to produce actionable insights.</p> <p>PSO3. Able to understand the nuances of data analytical skills to evolve innovative ideas and communicate the social relevance and impact of their analytical findings.</p> <p>PSO4. Becoming analytical experts and data entrepreneurs with exemplary behavior safeguarding the public interest.</p> <p>PSO5. To uphold professional ethics, values, standards and social responsibilities to attain a better and more sustainable future</p>

	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.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	Foundation Course To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning Literature and analysing the world through the literary lens gives rise to a new perspective.	<ul style="list-style-type: none"> ➤ Instill confidence among students ➤ Create interest for the subject
I, II, III, IV	Skill Enhancement papers (Discipline centric / Generic / Entrepreneurial)	<ul style="list-style-type: none"> ➤ Industry ready graduates ➤ Skilled human resource ➤ Students are equipped with essential skills to make them employable <ul style="list-style-type: none"> ➤ Training on language and communication skills enable the students gain knowledge and exposure in the competitive world.

		<ul style="list-style-type: none"> ➤ Discipline centric skill will improve the Technical knowhow of solving real life problems.
III, IV, V & VI	Elective papers	<ul style="list-style-type: none"> ➤ Strengthening the domain knowledge ➤ Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature ➤ Emerging topics in higher education/ industry/ communication network / health sector etc. are introduced with hands-on-training.
IV	Elective Papers	<ul style="list-style-type: none"> ➤ Exposure to industry moulds students into solution providers ➤ Generates Industry ready graduates ➤ Employment opportunities enhanced
V Semester	Elective papers	<ul style="list-style-type: none"> ➤ Self-learning ➤ Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Elective papers	<ul style="list-style-type: none"> ➤ Enriches the study beyond the course. ➤ Developing a research framework and presenting their Independent and Intellectual ideas effectively.
Extra Credits: For Advanced Learners / Honors degree		<ul style="list-style-type: none"> ➤ To cater to the needs of peer learners / research aspirants
Skills acquired from the Courses		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course – \CC IX	4	5	6.1 Core Course – CC XIII	4	6
Part.2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X	4	5	6.2 Core Course – CC XIV	4	6
1.3 Core Course – CC I	5	6	2..3 Core Course – CC III	5	5	3.3 Core Course – CC V	5	5	4.3 Core Course – CC VII Core Industry Module	5	5	5. 3.Core Course CC -XI	4	5	6.3 Core Course – CC XV	4	6
1.4 Core Course – CC II	5	5	2.4 Core Course – CC IV	5	5	3.4 Core Course – CC VI	5	5	4.4 Core Course – CC VIII	5	5	5. 4.Core Course –/ Project with viva-voce CC -XII	4	5	6.4 Elective -VII Generic/ Discipline Specific	3	5
1.5 Elective I Generic/ Discipline Specific	3	5	2.5 Elective II Generic/ Discipline Specific	3	6	3.5 Elective III Generic/ Discipline Specific	3	5	4.5 Elective IV Generic/ Discipline Specific	3	6	5.5 Elective V Generic/ Discipline Specific	3	4	6.5 Elective VIII Generic/ Discipline Specific	3	5
1.6 Skill Enhancement Course SEC-1	2	2	2.6 Skill Enhancement Course SEC-2	2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	1	4.6 Skill Enhancement Course SEC-6	2	2	5.6 Elective VI Generic/ Discipline Specific	3	4	6.6 Extension Activity	1	-
1.7 Skill Enhancement -(Foundation Course)	2	2	2.7 Skill Enhancement Course –SEC-3	2	2	3.7 Skill Enhancement Course SEC-5	2	2	4.7 Skill Enhancement Course SEC-7	2	2	5.7 Value Education	2	2	6.7 Professional Competency Skill	2	2
						3.8 E.V.S.	2	2				5.8 Summer Internship /Industrial Training	2				
	23	32		23	32		24	32		23	32		26	30		21	30
Total – 140 Credits																	

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

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses [in Total]	13	16
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		23	32

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	16
Part-4	Skill Enhancement Course -SEC-2	2	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	2	2
		23	32

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	15
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	2	2
		24	32

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	16
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2

	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
		23	32

**Third Year
Semester-V**

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

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses / Elective Based & LAB	18	28
Part-4	Extension Activity	1	-
	Professional Competency Skill (SEC-8)	2	2
		21	30

Consolidated Semester wise and Component wise Credit distribution

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

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

METHODS OF EVALUATION & METHODS OF ASSESSMENT

METHODS OF EVALUATION FOR THEORY SUBJECTS		
Internal Evaluation	Continuous Internal Assessment Test – 10 Marks	25 Marks
	Assignments / Snap Test / Quiz – 5 Marks	
	Seminars – 5 Marks	
	Attendance and Class Participation – 5 Marks	
External Evaluation	End Semester Examination	75 Marks
Total		100 Marks
METHODS OF EVALUATION FOR PRACTICAL SUBJECTS		
Internal Evaluation	Preparation for the Practical Session	25 Marks
	Executing an Exercise within the Stipulated Time	
	Continuous Internal Practical Tests	
	Completing All the Exercises of the Course	
External Evaluation	Coding / Solutions for the Two Problems	60 Marks (Coding:20+20 marks + Solution:10+10 marks)
	Preparation of the Record	10 marks
	Viva	5 marks
Total		100 Marks
METHODS OF ASSESSMENT		
Remembering (K1)	<ul style="list-style-type: none"> The lowest level of questions require students to recall information from the course content Knowledge questions usually require students to identify information in the text book. 	
Understanding (K2)	<ul style="list-style-type: none"> Understanding of facts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. The questions go beyond simple recall and require students to combine data together 	
Application (K3)	<ul style="list-style-type: none"> Students have to solve problems by using / applying a concept learned in the class room. Students must use their knowledge to determine a exact response. 	
Analyze (K4)	<ul style="list-style-type: none"> Analyzing the question is one that asks the students to break down something into its component parts. Analyzing requires students to identify reasons cause or motives and reach conclusions or generalizations. 	
Evaluate (K5)	<ul style="list-style-type: none"> Evaluation requires an individual to make judgment on something. Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. Students are engaged in decision-making and problem – solving. Evaluation questions do not have single right answers. 	

Create (K6)	<ul style="list-style-type: none"> • The questions of this category challenge students to get engaged in creative and original thinking. • Developing original ideas and problem solving skills
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Credit Distribution for all UG courses with LAB Hours

B.Sc. DATA SCIENCE

SEMESTER - I

Part	List of courses	Credits	No. of Hrs
Part I	Language – Tamil	3	6
Part II	English	3	6
Part-III	Core Course CC1-Python Programming	5	6
	Core Course CC2-Practical -Python Lab	5	5
	Elective Course I (Choose one from thelist) Mathematical Statistics – I (or) Numerical Methods – I	3	5
Part- IV	Skill Enhancement Course SEC -I Fundamentals of Information Technology	2	2
	Foundation Course Problem Solving Technique	2	2
TOTAL		23	32

SEMESTER- II

Part	List of courses	Credits	No. of Hrs
Part I	Language – Tamil	3	6
Part II	English	3	6
Part-III	CC3- Data Structure and Algorithm	5	5
	CC4- Practical: Data Structure using Python Lab	5	5
	Elective Course II (Choose one from thelist) Mathematical Statistics –II Numerical Methods – II	3	6
Part- IV	Skill Enhancement Course -SEC2 Introduction to HTML	2	2

	Skill Enhancement Course - SEC3 PHP Programming	2	2
TOTAL		23	32

SEMESTER – III

Part	List of courses	Credits	No. of Hrs
Part I	Language – Tamil	3	6
Part II	English	3	6
Part-III	CC5- Fundamentals of Data Science	5	5
	CC6-Practical : Data Science Lab	5	5
	Elective Course III (Choose one from the list) 1. Discrete Mathematics – I 2. Computer Networks	3	5
Part- IV	Skill Enhancement Course –SEC4 E-Commerce	1	1
	Skill Enhancement Course – SEC5 Big Data Analytics	2	2
	Environmental Studies	2	2
TOTAL		24	32

SEMESTER –IV

Part	List of courses	Credits	No. of Hrs
Part-I	Language – Tamil	3	6
Part-II	English	3	6
Part-III	CC7- Relational Database Management System	5	5
	CC8- RDBMS Lab Using Oracle	5	5
	Elective Course IV (Choose one from the list) 1. Discrete Mathematics – II 2. Network Security	3	3
Part- IV	Skill Enhancement Course –SEC6 Data Mining and Warehousing	2	2
	Skill Enhancement Course – SEC7 Open Source Software Technologies	2	2
TOTAL		23	32

SEMESTER –V

Part	List of courses	Credits	No. of Hrs
Part-III	CC9: Machine Learning	4	5
	CC10: Machine Learning Lab	4	5
	CC11: Software Engineering	4	5
	Elective Course V (Choose one from the list) 1. Information Security 2. Financial Analytics 3. Cryptography	3	4
	Elective Course VI (Choose one from the list) 1. Operating System 2. Simulation and Modeling 3. Quantitative Aptitude	3	4
	Core Course CC12:Project with Viva Voce Project (Individual)	4	5
Part –IV	Value Education	2	2
	Summer Internship /Industrial Training (Summer vacation at the end of IV semester activity)	2	-
TOTAL		26	30

SEMESTER –VI

Part	List of courses	Credits	No. of Hrs
Part-III	CC13: IoT and Cloud Technologies	4	6
	CC14: IoT and Cloud Technologies Lab	4	6
	CC15: Artificial Intelligence	4	6
	Elective Course VII (Choose one from the list) 1. Introduction to Linear Algebra 2. Artificial Neural Networks 3. Analytics for Service Industry	3	5
	Elective Course VIII (Choose one from the list) 1. Computing Intelligence 2. Data Analytics using R Programming 3. Natural Language Processing	3	5
	Skill Enhancement Course – SEC8 Cyber Forensics	2	2
Part –IV	Extension Activity	1	-
TOTAL		21	30
	TOTAL CREDITS	140	

TOTAL CREDITS: 23 +23+22+25+26+21 =140 Credits

FIRST YEAR –SEMESTER- I

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	PYTHON PROGRAMMING	CC1	5	-	-	I	5	25	75	100
Learning Objectives										
LO1	To make students understand the concepts of Python programming.									
LO2	To apply the OOPs concept in PYTHON programming.									
LO3	To impart knowledge on demand and supply concepts									
LO4	To make the students learn best practices in PYTHON programming									
LO5	To know the costs and profit maximization									
UNIT	Contents									No. of Hours
I	Basics of Python Programming: History of Python-Features of Python-Literal-Constants-Variables - Identifiers–Keywords-Built-in Data Types-Output Statements – Input Statements-Comments – Indentation- Operators-Expressions-Type conversions. Python Arrays: Defining and Processing Arrays – Array methods.									15
II	Control Statements: Selection/Conditional Branching statements: if, if-else, nested if and if-elif-else statements. Iterative Statements: while loop, for loop, else suite in loop and nested loops. Jump Statements: break, continue and pass statements.									15
III	Functions: Function Definition – Function Call – Variable Scope and its Lifetime-Return Statement. Function Arguments: Required Arguments, Keyword Arguments, Default Arguments and Variable Length Arguments- Recursion. Python Strings: String operations- Immutable Strings - Built-in String Methods and Functions - String Comparison. Modules: import statement- The Python module – dir() function – Modules and Namespace – Defining our own modules.									15
IV	Lists: Creating a list -Access values in List-Updating values in Lists-Nested lists -Basic list operations-List Methods. Tuples: Creating, Accessing, Updating and Deleting Elements in a tuple – Nested tuples–Difference between lists and tuples. Dictionaries: Creating, Accessing, Updating and Deleting Elements in a Dictionary – Dictionary Functions and Methods - Difference between Lists and Dictionaries.									15

V	Python File Handling: Types of files in Python - Opening and Closing files-Reading and Writing files: write() and writelines() methods- append() method – read() and readlines() methods – with keyword – Splitting words – File methods - File Positions- Renaming and deleting files.	15
TOTAL HOURS		75
Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO1	Learn the basics of python, Do simple programs on python, Learn how to use an array.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Develop program using selection statement, Work with Looping and jump statements, Do programs on Loops and jump statements.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Concept of function, function arguments, Implementing the concept strings in various application, Significance of Modules, Work with functions, Strings and modules.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Work with List, tuples and dictionary, Write program using list, tuples and dictionary.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Usage of File handlings in python, Concept of reading and writing files, Do programs using files.	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Reema Thareja, “Python Programming using problem solving approach”, First Edition, 2017, Oxford University Press.	
2	Dr. R. Nageswara Rao, “Core Python Programming”, First Edition, 2017, Dream tech Publishers.	
Reference Books		
1.	VamsiKurama, “Python Programming: A Modern Approach”, Pearson Education.	
2.	Mark Lutz, ”Learning Python”, Orielly.	
3.	Adam Stewarts, “Python Programming”, Online.	
4.	Fabio Nelli, “Python Data Analytics”, APress.	
5.	Kenneth A. Lambert, “Fundamentals of Python – First Programs”, CENGAGE Publication.	
Web Resources		
1.	https://www.programiz.com/python-programming	
2.	https://www.guru99.com/python-tutorials.html	
3.	https://www.w3schools.com/python/python_intro.asp	
4.	https://www.geeksforgeeks.org/python-programming-language/	
5.	https://en.wikipedia.org/wiki/Python_(programming_language)	

Mapping with Programme Outcomes:

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

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	PYTHON LAB	CC2	-	-	5	I	5	25	75	100
<p>Course Objectives:</p> <ol style="list-style-type: none"> 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	
<ol style="list-style-type: none"> 1. Program using variables, constants, I/O statements in Python. 2. Program using Operators in Python. 3. Program using Conditional Statements. 4. Program using Loops. 5. Program using Jump Statements. 6. Program using Functions. 7. Program using Recursion. 8. Program using Arrays. 9. Program using Strings. 10. Program using Modules. 11. Program using Lists. 12. Program using Tuples. 13. Program using Dictionaries. 14. Program for File Handling. 									75	

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

Mapping with Programme Outcomes:

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

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	FUNDAMENTALS OF INFORMATION TECHNOLOGY	SEC -I	2	-	-	I	2	25	75	100
Learning Objectives										
LO1	Understand basic concepts and terminology of information technology.									
LO2	Have a basic understanding of personal computers and their operation									
LO3	Be able to identify data storage and its usage									
LO4	Get great knowledge of software and its functionalities									
LO5	Understand about operating system and their uses									
UNIT	Contents								No. Of. Hours	

I	Introduction to Computers: Introduction, Definition, .Characteristics of computer, Evolution of Computer, Block Diagram Of a computer, Generations of Computer, Classification Of Computers, Applications of Computer, Capabilities and limitations of computer	6
II	Basic Computer Organization: Role of I/O devices in a computer system. Input Units: Keyboard, Terminals and its types. Pointing Devices, Scanners and its types, Voice Recognition Systems, Vision Input System, Touch Screen, Output Units: Monitors and its types. Printers: Impact Printers and its types. Non Impact Printers and its types, Plotters, types of plotters, Sound cards, Speakers.	6
III	Storage Fundamentals: Primary Vs Secondary Storage, Data storage & retrieval methods. Primary Storage: RAM ROM, PROM, EPROM, EEPROM. Secondary Storage: Magnetic Tapes, Magnetic Disks. Cartridge tape, hard disks, Floppy disks Optical Disks, Compact Disks, Zip Drive, Flash Drives	6
IV	Software: Software and its needs, Types of S/W. System Software: Operating System, Utility Programs Programming Language: Machine Language, Assembly Language, High Level Language their advantages & disadvantages. Application S/W and its types: Word Processing, Spread Sheets Presentation, Graphics, DBMS s/w	6
V	Operating System: Functions, Measuring System Performance, Assemblers, Compilers and Interpreters. Batch Processing, Multiprogramming, Multi Tasking, Multiprocessing, Time Sharing, DOS, Windows, Unix/Linux.	6
TOTAL HOURS		30
Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO1	Learn the basics of computer, Construct the structure of the required things in computer, learn how to use it.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Develop organizational structure using for the devices present currently under input or output unit.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Concept of storing data in computer using two header namely RAM and ROM with different types of ROM with advancement in storage basis.	PO1, PO2, PO3, PO4, PO5, PO6

CO4	Work with different software, Write program in the software and applications of software.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Usage of Operating system in information technology which really acts as a interpreter between software and hardware.	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Anoop Mathew, S. Kavitha Murugesan (2009), “ Fundamental of Information Technology”, Majestic Books.	
2	Alexis Leon, Mathews Leon,” Fundamental of Information Technology”, 2 nd Edition.	
3	P.Rizwan Ahmed, “Introduction to Information Technology”. Margham Publications, 2010	
Reference Books		
1.	Bhardwaj Sushil Puneet Kumar, “Fundamental of Information Technology”	
2.	GG WILKINSON, “Fundamentals of Information Technology”, Wiley-Blackwell	
3.	A Ravichandran , “Fundamentals of Information Technology”, Khanna Book Publishing	
Web Resources		
1.	https://testbook.com/learn/computer-fundamentals	
2.	https://www.tutorialsmate.com/2020/04/computer-fundamentals-tutorial.html	
3.	https://www.javatpoint.com/computer-fundamentals-tutorial	
4.	https://www.tutorialspoint.com/computer_fundamentals/index.htm	
5.	https://www.nios.ac.in/media/documents/sec229new/Lesson1.pdf	

Mapping with Programme Outcomes:

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

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	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 code to implement solutions.									
LO4	Define and use of arrays with simple applications									
LO5	Understand about operating system and their uses									
UNIT	Contents							No. Of. Hours		
I	Introduction: History, characteristics and limitations of Computer. Hardware/Anatomy of Computer: CPU, Memory, Secondary storage devices, Input Devices and Output devices. Types of Computers: PC, Workstation, Minicomputer, Main frame and Supercomputer. Software: System software and Application software. Programming Languages: Machine language, Assembly language, High-level language, 4 GL and 5GL-Features of good programming language. Translators: Interpreters and Compilers.							6		
II	Data: Data types, Input, Processing of data, Arithmetic Operators, Hierarchy of operations and Output. Different phases in Program Development Cycle (PDC). Structured Programming: Algorithm: Features of good algorithm, Benefits and drawbacks of algorithm. Flowcharts: Advantages and limitations of flowcharts, when to use flowcharts, flowchart symbols and types of flowcharts. Pseudocode: Writing a pseudocode. Coding, documenting and testing a program: Comment lines and types of errors. Program design: Modular Programming.							6		
III	Selection Structures: Relational and Logical Operators - Selecting from Several Alternatives – Applications of Selection Structures. Repetition Structures: Counter Controlled Loops –Nested Loops– Applications of Repetition Structures.							6		
IV	Data: Numeric Data and Character Based Data. Arrays: One Dimensional Array - Two Dimensional Arrays – Strings as Arrays of Characters.							6		

V	Data Flow Diagrams: Definition, DFD symbols and types of DFDs. Program Modules: Subprograms-Value and Reference parameters- Scope of a variable - Functions – Recursion. Files: File Basics-Creating and reading a sequential file- Modifying Sequential Files.	6
TOTAL HOURS		30
Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO1	Study the basic knowledge of Computers. Analyze the programming languages.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Study the data types and arithmetic operations. Know about the algorithms. Develop program using flow chart and pseudocode.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Determine the various operators. Explain about the structures. Illustrate the concept of Loops	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Study about Numeric data and character-based data. Analyze about Arrays.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Explain about DFD Illustrate program modules. Creating and reading Files	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Stewart Venit, “Introduction to Programming: Concepts and Design”, Fourth Edition, 2010, Dream Tech Publishers.	
Web Resources		
1.	https://www.codesansar.com/computer-basics/problem-solving-using-computer.htm	
2.	http://www.nptel.iitm.ac.in/video.php?subjectId=106102067	
3.	http://utubersity.com/?page_id=876	

Mapping with Programme Outcomes:

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

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

SEMESTER –II

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks			
								CIA	External	Total	
	DATA STRUCTURE AND ALGORITHM	CC3	5	-	-	II	5	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 – 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.									PO1, PO2, PO3, PO4,	

	To enable the applications of Trees and Graphs.	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	P.Rizwan Ahmed, C++ and Data Structure, Margham Publications, 2012	
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
	DATASTRUCTURE USING PYTHON LAB	CC 4	-	-	5	II	5	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

75

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

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.

Learning Resources:

Recommended Texts

1. Ellis Horowitz , Sartaj Sahni, 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

Reference Books

1. G. Brassard and P. Bratley, "Fundamentals of Algorithms", PHI, New Delhi, 1997.
2. Sanjoy Dasgupta, 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 Python
CO2	Implement various types of linked lists and their applications
CO3	Implement Tree Traversals
CO4	Implement various algorithms in Python
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	
	INTRODUCTION TO HTML	SEC2	-	-	5	II	2	25	75	100	
Learning Objective											
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: Web Basics: What is Internet–Web browsers–What is Webpage –HTML Basics: Understanding tags.								6		

II	Tags for Document structure (HTML, Head, Body Tag).Block level text elements :Headings-paragraph(<p> tag)–Font-style elements:(bold, italic, font, small, strong, strike, big tags)	6
III	Lists: Types of lists: Ordered, Unordered– Nesting Lists–Other tags: Marquee, HR, BR- Using Images –Creating Hyper-links.	6
IV	Tables: Creating basic Table, Table elements, Caption–Table and cell alignment–Row span, Col span–Cell padding.	6
V	Frames: Frameset–Targeted Links–No frame–Forms: Input, Text area, Select, Option.	6
TOTAL HOURS		30
Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO 1	Knows the basic concept in HTML Concept of resources in HTML	PO1, PO2, PO3, PO4, PO5, PO6
CO 2	Knows Design concept. Concept of Meta Data Understand the concept of save the files.	PO1, PO2, PO3, PO4, PO5, PO6
CO 3	Understand the page formatting. Concept of list	PO1, PO2, PO3, PO4, PO5, PO6
CO 4	Creating Links. Know the concept of creating link to email address	PO1, PO2, PO3, PO4, PO5, PO6
CO 5	Concept of adding images Understand the table creation.	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	“Mastering HTML5 and CSS3 Made Easy”, TeachUComp Inc., 2014.	
2	Thomas Michaud, “Foundations of Web Design: Introduction to HTML & CSS”	
3	P.Rizwan Ahmed, Open Source Programming , Margham Publications, Chennai, 2017	
Web Resources		
1	https://www.teachucomp.com/samples/html/5/manuals/Mastering-HTML5-CSS3.pdf	
2	https://www.w3schools.com/html/default.asp	

Mapping with Programme Outcomes:

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

Weightage of course contributed to each PSO	14	15	14	14	15	15
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S-Strong-3 M-Medium-2 L-Low-1

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	PHP Programming	SEC 3	2	-	-	-	2	2	25	75	100
<p>Learning Objectives:(for teachers: what they have to do in the class/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.</p> <p>Course Outcomes:(for students: To know what they are going to learn) 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:</p>											
Units	Contents								Required Hours		
I	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								6		
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								6		
III	PHP Functions -PHP Functions -Creating an Array -Modifying Array Elements -Processing Arrays with Loops -Grouping Form Selections with Arrays -Using Array								6		
IV	PHP Advanced Concepts -Reading and Writing Files -Reading Data from a File -Managing Sessions and Using Session Variables								6		
V	OOPS Using PHP -OOPS Concept-Class, Object, Abstractions, Encapsulation, Inheritance, Polymorphism -Creating Classes and Object in PHP-Cookies and Session Management								6		
Recommended Texts											
1	Head First PHP & MySQL: A Brain-Friendly Guide- 2009-Lynn mighley and Michael Morrison.										
2	P.Rizwan Ahmed, Open Source Programming , Margham Publications, Chennai, 2017										
Reference Books											
1	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

SEMESTER – III

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	FUNDAMENTALS OF DATA SCIENCE	CC 5	5	-	-	III	5	25	75	100
Learning Objectives										
LO1	To understand the basic concepts of Data Science									
LO2	To acquire a solid foundation in pandas									
LO3	To understand the principles of Data Loading, Storage, and File Formats									
LO4	To acquire a solid foundation in Data Wrangling									
LO5	To visualize data using plots in python									
UNIT	Contents									No. Of. Hours
I	Data Science: definition, Datafication, Exploratory Data Analysis, The Data science process, A data scientist role in this process. NumPy Basics: The NumPy ndarray: A Multidimensional Array Object, Creating ndarrays ,Data Types for ndarrays, Operations between Arrays and Scalars, Basic Indexing and Slicing, Boolean Indexing, Fancy Indexing, Data Processing Using Arrays, Expressing Conditional Logic as Array Operations, Methods for Boolean Arrays , Sorting , Unique									15
II	Getting Started with pandas: Introduction to pandas, Library Architecture, Features, Applications, Data Structures, Series, DataFrame, Index Objects, Essential Functionality (Reindexing, Dropping entries from an axis, Indexing, selection, and filtering), Sorting and ranking, Summarizing and Computing Descriptive Statistics, Unique Values, Value Counts, Handling Missing Data, filtering out missing data.									15
III	Data Loading, Storage, and File Formats : Reading and Writing Data in Text Format, Reading Text Files in Pieces, Writing Data Out to Text Format, Manually Working with Delimited Formats, JSON Data, XML and HTML: Web Scraping, Binary Data Formats, Using HDF5 Format, Reading Microsoft Excel Files, Interacting with Databases, Storing and Loading Data in MongoDB									15
IV	Data Wrangling: Combining and Merging Data Sets, Database style DataFrame Merges, Merging on Index, Concatenating Along an Axis, Combining Data with Overlap ,									15

	Reshaping and Pivoting, Reshaping with Hierarchical Indexing, Data Transformation, Removing Duplicates, Replacing Values.	
V	Plotting and Visualization: A Brief matplotlib API Primer, Figures and Subplots, Colors, Markers, and Line Styles, Ticks, Labels, and Legends, Annotations and Drawing on a Subplot, Saving Plots to File, Plotting Functions in pandas, Line Plots, Bar Plots, Histograms and Density Plots, Scatter Plots.	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	Apply principles of NumPy and Pandas to the analysis of data.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Make use of various file formats in loading and storage of data.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Identify and apply the need and importance of pre-processing techniques.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Show the results and present them in a pictorial format	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Wes McKinney, "Python for Data Analysis", O'REILLY, ISBN:978-1-449-31979-3, 1st edition, October 2012.	
2	Rachel Schutt & O'neil, "Doing Data Science", O'REILLY, ISBN:978-1-449-35865-5, 1st edition, October 2013.	
Reference Books		
1.	Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media, 2015	
2.	Matt Harrison, "Learning the Pandas Library: Python Tools for Data Munging, Analysis, and Visualization", O'Reilly, 2016.	

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
Weightage of course contributed to each PSO	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
	DATA SCIENCE LAB	CC 6	-	-	4	III	5	25	75	100

Objectives:

The main objective of the course is to inculcate the basic understanding of Data Science and it's practical implementation using Python.

	Required Hours
1. Creating a NumPy Array a. Basic ndarray b. Array of zeros c. Array of ones d. Random numbers in ndarray e. An array of your choice f. Imatrix in NumPy g. Evenly spaced ndarray	60
2. The Shape and Reshaping of NumPy Array a. Dimensions of NumPy array b. Shape of NumPy array c. Size of NumPy array d. Reshaping a NumPy array e. Flattening a NumPy array f. Transpose of a NumPy array	
3. Expanding and Squeezing a NumPy Array a. Expanding a NumPy array b. Squeezing a NumPy array c. Sorting in NumPy Arrays	
4. Indexing and Slicing of NumPy Array a. Slicing 1-D NumPy arrays b. Slicing 2-D NumPy arrays c. Slicing 3-D NumPy arrays d. Negative slicing of NumPy arrays	
5. Stacking and Concatenating Numpy Arrays a. Stacking ndarrays b. Concatenating ndarrays c. Broadcasting in Numpy Arrays	
6. Perform following operations using pandas a. Creating dataframe b. concat() c. Setting conditions d. Adding a new column	
7. Perform following operations using pandas a. Filling NaN with string	

b. Sorting based on column values c. groupby()	
8. Read the following file formats using pandas a. Text files b. CSV files c. Excel files d. JSON files	
9. Perform following preprocessing techniques on loan prediction dataset a. Feature Scaling b. Feature Standardization c. Label Encoding d. One Hot Encoding	
10. Perform following visualizations using matplotlib a. Bar Graph b. Pie Chart c. Box Plot d. Histogram e. Line Chart and Subplots f. Scatter Plot	
Web References	
1. https://www.analyticsvidhya.com/blog/2020/04/the-ultimate-numpy-tutorial-for-data-science-beginners/ 2. https://www.analyticsvidhya.com/blog/2021/07/data-science-with-pandas-2-minutes-guide-to-key-concepts/ 3. https://www.analyticsvidhya.com/blog/2020/04/how-to-read-common-file-formats-python/ 4. https://www.analyticsvidhya.com/blog/2016/07/practical-guide-data-preprocessing-python-scikit-learn/ 5. https://www.analyticsvidhya.com/blog/2020/02/beginner-guide-matplotlib-data-visualization-explorationpython/	

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
Weightage of course contributed to each PSO	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
	COMPUTER NETWORKS	Elect	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 Stop and 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. Gallager, "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
Weightage of course contributed to each PSO	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
	E-COMMERCE	SEC 4	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.	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.	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	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, “ <i>Frontiers of Electronic-Commerce</i> ”, Addison Wesley.	
2	P.Rizwan Ahmed, E-Commerce and E-Business, Margham Publications, Chennai 2012	
Reference Books		
1.	EfraimTurvanJ.Lee, David Kug and Chung, “ <i>Electronic Commerce</i> ”, 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

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	2	3	3	2	3
Weightage of course contributed to each PSO	15	14	14	14	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
	BIG DATA ANALYTICS	SEC5	4	-	-	-	2	25	75	100
Learning Objectives										
LO1	To know the fundamental concepts of big data and analytics..									
LO2	To explore tools and practices for working with Big data									
LO3	To learn about stream computing.									
LO4	To know about the research that requires the integration of large amounts of data									
LO5	To analyze data by utilizing clustering and classification algorithms.									
UNIT	Contents								No. Of. Hours	
I	Big data Introduction : Big Data introduction - definition and taxonomy - Big data value for the enterprise - The Hadoop ecosystem - Introduction to Distributed computing- Hadoop ecosystem – Hadoop Distributed File System (HDFS) Architecture - HDFS commands for loading/getting data - Accessing HDFS through Java program.								12	
II	Map reduce : Introduction to Map Reduce frame work - Basic Map Reduce Programming: - Advanced Map Reduce programming: Basic template of the Map Reduce program, Word count problem- Streaming in Hadoop- Improving the performance using combiners- Chaining Map Reduce jobs- Joining data from different sources.								12	

III	Pig and Hive : Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - Fundamentals of HBase and ZooKeeper.	12
IV	Mongo DB : No SQL databases: Mongo DB: Introduction – Features - Data types - Mongo DB Query language - CRUD operations – Arrays - Functions: Count – Sort – Limit – Skip – Aggregate - Map Reduce. Cursors – Indexes - Mongo Import – Mongo Export.	12
V	Cassandra : Introduction – Features - Data types – CQLSH - Key spaces - CRUD operations – Collections – Counter – TTL - Alter commands - Import and Export - Querying System tables.	12
TOTAL HOURS		60
Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO1	Understand Big Data and its analytics in the real world	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Design of Algorithms to solve Data Intensive Problems using Map Reduce Paradigm.	PO1, PO2, PO3, PO4, PO5, PO6
CO3	Analyze the Big Data framework like Hadoop and NOSQL to efficiently store and process Big Data to generate analytics.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Design and Implementation of Big Data Analytics using pig and spark to solve data intensive problems and to generate analytics.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Implement Big Data Activities using Hive.	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	JSeema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publication, 2015.	
2	Ramesh Sharda, Dursun Delen, Efraim Turban (2018), Business Intelligence, Pearson Education Services Pvt Ltd.	
Reference Books		
1.	Judith Hurwitz, Alan Nugent, Dr. Fern Halper, Marcia Kaufman, “Big Data for Dummies”, John Wiley & Sons, Inc., 2013.	
2.	Tom White, “Hadoop: The Definitive Guide”, O’Reilly Publications, 2011.	
3.	Kyle Banker, “Mongo DB in Action”, Manning Publications Company, 2012.	
4.	Russell Bradberry, Eric Blow, “Practical Cassandra A developers Approach“, Pearson Education, 2014.	
Web Resources		
1.	https://www.techtarget.com/searchbusinessanalytics/definition/big-data-analytics	

2.	https://www.coursera.org/articles/big-data-analytics
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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
Weightage of course contributed to each PSO	14	15	15	15	12	14

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

SEMESTER –IV

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	RELATIONAL DATABASE MANAGEMENT SYSTEM	CC 7	6	-	-	V	5	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.								18	

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.	18
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 minus. Subquery: Scalar, Multiple and Correlated subquery. Joins: Inner and Outer joins.Defining Constraints: Primary Key, Foreign Key, Unique, Check, Not Null.	18
IV	PL/SQL: Introduction-PL/SQL Basic-Character Set- PL/SQL Structure-SQL Cursor-Subprograms-Functions-Procedures.	18
V	Exception Handling: Introduction-Predefined Exception-User Defined Exception-Triggers-Implicit and Explicit Cursors-Loops in Explicit Cursor.	18
TOTAL HOURS		90
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.	
2	P.Rizwan Ahmed, RDBMS and Oracle, Margham Publications, Chennai. 2018	

Reference Books	
1	RamezElmasri and Shamkant B. Navathe, “ <i>Fundamentals of Database Systems</i> ”, Seventh Edition, Pearson Publications.
2	Abraham Silberschatz, Henry Korth, S. Sudarshan, “ <i>Database System Concepts</i> ”, 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
	RDBMS LAB USING ORACLE	CC X	-	-	5	V	5	25	75	100
Learning Objectives										
1. To explain basic database concepts, applications, data models, schemas and instances.										
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)

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
Weightage of course contributed to each PSO	14	15	15	14	15	14

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	NETWORK SECURITY	Elective	2	-	-	-	3	3	25	75	100

Learning Objectives:(for teachers: what they have to do in the class/lab/field)

- To study the number theory used for network security
- To understand the design concept of cryptography and authentication
- To develop experiments on algorithm used for security

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

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	Model of network security–Security attacks, services and attacks– OSI security architecture – Classical encryption techniques – SDES – Block cipher Principles DES– Strength of DES–Block cipher design principles – Block cipher mode of operation	6
II	Number Theory– Prime number–Modular arithmetic–Euclid’s algorithm	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-mail security–IP security- Web security.	6
V	Intruder–Intrusion detection system–Virus and related threats– Counter measures – Firewalls design principles – Trusted systems – Practical implementation of cryptography and security	6

Learning Resources:

Recommended Texts

1. William Stallings,“ Cryptography& Network Security”, Pearson Education, Fourth Edition 2010.

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. V. Arun Kumar, “*Network Security*”, 2011, First Edition, USP.

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	Marks		
								CIA	External	Total
	DATA MINING AND WAREHOUSING	SEC6	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
- To study a set of typical clustering methodologies, algorithms and applications.

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:(not for examination) Motivation/previous lecture/relevant portions required for the course)[This is done during 2 Tutorial hours)

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	6

	Summarization.	
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, Partitioning 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.		
2. P.Rizwan Ahmed, Data Mining, Margham Publications, Chennai, 2012		
Reference Books		
1. K.P. Soman, Shyam Diwakar, 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	Category	L	T	P	S	Credits	Inst. Hours	Marks		
									CIA	External	Total
	Open Source Software Technologies	SEC7	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	C O
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	Introduction –PHP Form processing – Database Access with PHP – MySQL, MySQL Functions – 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	James Lee and Brent Ware “Open Source Web Development with LAMP using		
2	P.Rizwan Ahmed, Open Source Programming, Margham Publications, Chennai,2017 .		
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.	Anthony Butcher , “Teach Yourself MySQL in 21 days”, 2nd Edition, Sams Publication.		
3.	Rich Bower, Daniel Lopez Ridreejo, Alian Liska , “Apache Administrator’s Handbook”, Sams Publication.		
4.	Tammy Fox, “RedHat Enterprise Linux 5 Administration Unleashed”, Sams Publication.		
5.	Naramore Eligabette, 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

SEMESTER –V

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	MACHINE LEARNING	CC9	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 – Perceptions – 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 theory	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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	MACHINE LEARNING LAB	CC10	-	-	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 & numeric data

LAB EXERCISES	Required Hour
<ol style="list-style-type: none"> 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
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
	SOFTWARE ENGINEERING	CC11	4	-	-	-	4	25	75	100
Learning Objectives:										
<ul style="list-style-type: none"> 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							12		

	testing.	
V	Software Maintenance: Characteristic of software maintenance; software reverse engineering; software maintenance process models; estimation of maintenance cost;	12
		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
Weightage of course contributed to each PSO	13	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
	INFORMATION SECURITY	Elect	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, 1st Edition.
2. Cryptography and Network Security : Forouzan Mukhopadhyay, Mc Graw Hill, 2"d Edition
3. Information Security, Principles and Practice: Mark Stamp, Wiley India.
4. Principles of Computer Security: 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
Weightage of course contributed to each PSO	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
	FINANCIAL ANALYTICS	Elect	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 Mapping, Content Analytics, Sentiment Analysis. Analyzing financial data and implement financial models.								12	
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	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 financial data insights.	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 courses.	PO1, PO2, PO3, PO4, 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, Springer	
Reference Books		
1.	Analyzing Financial Data and Implementing Financial Models Using „R“, Ang Clifford, Springer.	
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
Weightage of course contributed to each PSO	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
	CRYPTOGRAPHY	Elect	4	-	-	-	3	25	75	100
Learning Objectives										
LO1	To understand the fundamentals of Cryptography									
LO2	To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.									
LO3	To understand the various key distribution and management schemes.									
LO4	To understand how to deploy encryption techniques to secure data in transit across data networks									
LO5	To design security applications in the field of Information technology									
UNIT	Contents									No. Of. Hours
I	Introduction: The OSI security Architecture – Security Attacks – Security Mechanisms – Security Services – A model for network Security.									12
II	Classical Encryption Techniques: Symmetric cipher model – Substitution Techniques: Caesar Cipher – Monoalphabetic cipher – Play fair cipher – Poly Alphabetic Cipher – Transposition techniques – Stenography									12
III	Block Cipher and DES: Block Cipher Principles – DES – The Strength of DES – RSA: The RSA algorithm.									12
IV	Network Security Practices: IP Security overview - IP Security architecture – Authentication Header. Web Security: SecureSocket Layer 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 and Practices”.	
2	P.Rizwan Ahmed, Cryptography, Margham Publications, Chennai, 2017	
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
Weightage of course contributed to each PSO	14	13	15	12	14	14

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

Subject	Subject Name	U	a	→	L	T	P	S	U	Marks
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Code								CIA	External	Total
	OPERATING SYSTEM	Elect	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 – Operating System Services - User and Operating System interface - System Call- Types of System Calls – Operating System Design and Implementation - Operating System Structure. Process Management: Process concept- Process Scheduling - Operations on Processes- Interprocess Communication. Threads: Types of threads									12
II	Process Scheduling: Basic Concepts-Scheduling Criteria Scheduling Algorithm Multiple Processor Scheduling CPU Scheduling. Synchronization: The Critical-Section Problem Synchronization Hardware – Semaphores- Classic Problem of Synchronization.									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 Allocation Segmentation- 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 and Disk Structure -File Sharing- Protection. Allocation Methods - Free- Space Management - 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 its structure. 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 deadlock prevention 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. Silberschatz P.B.Galvin, Gange. "Operating System Concepts", Ninth Edition, 2013, Addison Wesley Publishing Co.	
2	P.Rizwan Ahmed, Operating System, Margham Publications, Chennai.2018	
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
Weightage of course contributed to each PSO	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
	SIMULATION AND MODELING	SEC	2	-	-	-	3	25	75	100

Learning Objectives:(for teachers: what they have to do in the class/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:(for students: To know what they are going to learn)
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, Pandu Tadikamalla, "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
	QUANTITATIVE APTITUDE	Elec	2	-	-	-	3	25	75	100
Learning Objectives: (for teachers: what they have to do in the class/lab/field) <ul style="list-style-type: none"> • To improve the quantitative skills of the students • To prepare the students for various competitive exams 										
Course Outcomes: (for students: To know what they are going to learn) <p> 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 </p>										
Units	Contents								Required Hours	

I	Numbers- HCF and LCM of numbers-Decimal fractions-Simplification- Square roots and cube roots- Average-problems on Number	6
II	Problems on Ages - Surds and Indices - percentage - profits and loss - ratio and proportion-partnership- Chain rule.	6
III	Time and work - pipes and cisterns - Time and Distance - problems on trains -Boats and streams - simple interest - compound interest - Logarithms - Area –Volume and surface area-races and Games of skill.	6
IV	Permutation and combination-probability-True Discount-Bankers Discount Height and Distances-Odd man out & Series.	6
V	Calendar - Clocks - stocks and shares - Data representation - Tabulation – Bar Graphs- Pie charts-Line graphs	6

Learning Resources:

Recommended Texts

1.“Quantitative Aptitude”, R.S.AGGARWAL.,S.Chand& Company Ltd.,

Web resources: 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
	Project with Viva voce	CC12	4	-	-		4	25	75	100
Learning Objectives										
LO1	Advance from an intellectually curious student to a creator/maker and an industry professional									
LO2	Apply verbal and written communication skills to explain technical problem solving techniques and solutions to an increasingly diverse and global audience									
LO3	Collaborate within and across disciplinary boundaries to solve problems									
LO4	Apply mathematical and/or statistical methods to facilitate problem solving.									
LO5	Exercise computational thinking over the entire software life cycle									

Project Work

SL	Area of Work	Maximum Marks
1.	PROJECT WORK: (i) Project Proposal and Plan	10
	(ii) Execution of the Project Proposal and Plan / Collection of data, Documentation and Presentation of the report.	40
2.	Viva Voce Examination	25
	TOTAL	75

* CIA Marks =25 marks (Project Review 1, Project Review2 and Project Review 3)

Course Outcomes		Programme Outcomes
CO	On successful completion of this course, students will be able to	
1	show leadership skills and learn time management	PO1, PO2, PO3, PO4, PO5, PO6
2	identify various tools to be applied to a specific problem	PO1, PO2, PO3, PO4, PO5, PO6
3	evaluate the reports	PO1, PO2, PO3, PO4, PO5, PO6
4	take part in a team as well as manage it to deliver stunning outcomes	PO1, PO2, PO3, PO4, PO5, PO6
5	assess and develop the individual skills to present and organize projects	PO1, PO2, PO3, PO4, PO5, PO6

Mapping with Programme Outcomes:

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

Annexure - I

(A typical Specimen of Cover Page & Title Page)

TITLE OF PROJECT

<BOLD><Centralized>

A Project Report

><BOLD><Centralized>

Submitted by:

<Italic>><BOLD><Centralized>

NAME OF THE STUDENT (<University Roll Number>)

><BOLD><Centralized>

in partial fulfillment for the award of the degree

of

<1.5 line spacing><Italic><BOLD><Centralized>

<BOLD><Centralized>

BACHELOR OF SCIENCE

><BOLD><Centralized>

IN

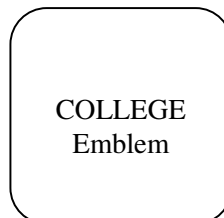
DATA SCIENCE

<BOLD><Centralized>

Under the Supervision of

<NAME OF THE SUPERVISOR(s)>

<BOLD><Centralized>



COLLEGE NAME

DEPARTMENT NAME

MONTH & YEAR

><BOLD><Centralized>

Annexure - 2
CANDIDATE'S DECLARATION

I hereby certify that the project entitled “ _____ ”
submitted by _____ (Student name) & (University Roll no) in partial fulfillment of
the requirement for the award of degree of the B. Sc. (Data Science) submitted at
_____ (College Name) is an authentic record of my own work carried
out during a period from _____ to _____ under the guidance of
Mr./Dr. _____ (Guide name, Designation, Department of Data Science).
The matter presented in this project has not formed the basis for the award of any other degree,
diploma, fellowship or any other similar titles.

Signature of the Student

Place:

Date:

Annexure – 3
CERTIFICATE

This is to certify that the project titled “ _____ ” is the bona fide
work carried out by (Student name) & (University Roll no) in partial fulfillment of the
requirement for the award of degree of the B.Sc. (Data Science) submitted at
_____ (College Name) is an authentic record his/her work carried out
during a period from _____ to _____ under the guidance of
Mr./Dr. _____ Guide name, Designation, Department of Data Science .
The Major Project Viva-Voce Examination has been held
on _____ (DD/MM/YYYY).

Signature of the Guide

Signature of the HoD

Internal Examiner

External Examiner

	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	Internship / Industrial Training	-	-	-	-		2	25	75	100
Learning Objectives										
LO1	Advance from an intellectually curious student to a creator/maker and an industry professional									
LO2	Apply verbal and written communication skills to explain technical problem solving techniques and solutions to an increasingly diverse and global audience									
LO3	Collaborate within and across disciplinary boundaries to solve problems									
LO4	Apply mathematical and/or statistical methods to facilitate problem solving.									
LO5	Exercise computational thinking over the entire software life cycle									

Internship / Industrial Training:

The students to undergo 2 weeks of Internship / Industrial Training in the Industry

Sl.No	Area of Work	Maximum Marks
	a) Work Related performance – Work Attitude/ Academic preparation/ problem solving ability/ Adaptability / Overall Attendance / Progress towards learning goals	10
	b) Organizational skills – Time management skills / Planning skills/ communication skills	20
	c) Relationship with others – Willingness to cooperate with co-works/ Ability to work with supervisor / Acceptance of constructive comments / Ability to take direction	20
	Internship Report / Viva Voce Examination	25
	Total	75

* CIA Marks =25 marks (Internship Review 1, Review2 and Review 3)

Course Outcomes		Programme Outcomes
CO	On successful completion of this course , students will be able to	
1	Find their specific areas of interest , refine their skills and abilities	PO1, PO2, PO3, PO4, PO5, PO6

2	Show a greater sense of self-awareness and appreciation for others	PO1, PO2, PO3, PO4, PO5, PO6
3	Apply problem solving and critical thinking skills to solve real time problem	PO1, PO2, PO3, PO4, PO5, PO6
4	Design various solution approaches for addressing IT business needs.	PO1, PO2, PO3, PO4, PO5, PO6
5	Apply best practices of IT industries by working in the Product or service domain.	PO1, PO2, PO3, PO4, PO5, PO6

Mapping with Programme Outcomes:

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

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

Guidelines for internship

- Internship should be of 2 weeks duration.
- A student is expected to find internship by himself or herself. However, the institution should assist their students in getting internship in good organizations.
- The home institution cannot be taken as the place of internship.
- Internship can be on any topic covered in the syllabus mentioned in the syllabus, not restricted to the specialization.
- Internship can be done, in one of the following, but not restricted to, types of

organizations:

- Software development firms
- Hardware/ manufacturing firms
- Any small scale industries, service providers like banks
- Clinics/ NGOs/professional institutions like that of CA, Advocate etc
- Civic Depts like Ward office/post office/police station/ punchayat.

Guidelines for making Internship Report

A student is expected to make a report based on the internship he or she has done in an organization. It should contain the following:

- Certificate: A certificate in the prescribed Performa (given in appendix 1) from the organization where the internship done.
- Evaluation form: The form filled by the supervisor or to whom the intern was reporting, in the prescribed Performa (given in appendix 2).
- Title: A suitable title giving the idea about what work the student has performed during the internship.
- Description of the organization: A small description of 1 to 2 pages on the organization where the student has interned
- Description about the activities done by the section where the intern has worked: A description of 2 to 4 pages about the section or cell of the organization where the intern actually worked. This should give an idea about the type of activity a new employee is expected to do in that section of the organization.
- Description of work allotted and actually done by the intern: A detailed description of the work allotted and actual work performed by the intern during the internship period. Intern may give a weekly report of the work by him or her if needed. It shall be of around 7 to 10 pages.
- Self assessment: A self assessment by the intern on what he or she has learnt during the internship period. It shall contain both technical as well as interpersonal skills learned in the process. It shall be of around 2 to 3 pages.

The internship report may be around 20 to 30 pages and this needs to be submitted to the external examiner at the time of University examination.

Appendix 1

(Proforma for the certificate for internship in official letter head)

This is to certify that Mr/Ms _____ of _____ College/Institution worked as an intern as part of her B.Sc. course in Data Science of Thiruvalluvar University. The particulars of internship are given below:

Internship starting date:

Internship ending date:

Actual number of days worked:

Tentative number of hours worked: Hours

Broad area of work:

A small description of work done by the intern during the period:

Signature:

Name:

Designation:

Contact number:

Email:

(Seal of the organization)

Appendix 2

(Proforma for the Evaluation of the intern by the supervisor/to whom the intern was reporting
in the organization)

Professional Evaluation of intern

Name of intern:

College/institution:

[Note: Give a score in the 1-5 scale by putting √ in the respective cells]

S. No	Particular	Excellent	Very Good	Good	Moderate	Satisfactory
1	Attendance					
2	Punctuality					
3	Adaptability					
4	Ability to shoulder responsibility					
5	Ability to work in a team					
6	Written and oral communication skills					
7	Problem solving skills					
8	Ability to grasp new concepts					
9	Ability to complete task					
10	Quality of work done					

Comments:

Signature:

Name:

Designation:

Contact number:

Email:

(Seal of the organization)

SEMESTER –VI

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	IOT AND CLOUD TECHNOLOGIES	CC13	6	-	-	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.								18	
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.								18	
III	Virtual Machines Provisioning and Migration Services Introduction and Inspiration -Background and Related Work- Virtual Machines 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.								18	
IV	Data Security, Identity and Access Management Data security and storage:								18	

	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.	
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.	18
TOTAL HOURS		90
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	P.Rizwan Ahmed, Internet of Things, Margham Publications, Chennai, 2017	
3	Tim Mather, Subra Kumaraswamy, ShahedLatif (2010), Cloud Security and Privacy, OREILLY Media.	
4	Adrian McEwen, Designing the Internet of Things, Wiley, 2013.	
Reference Books		
1.	Ronald L. Krutz and Russell Dean Vines(2010), Cloud Security, Wiley – India	
2	RajkumarBuyya, James Broberg, AndrzejGoscinski(2011),CLOUD COMPUTING Principles and Paradigms, John Wiley & Sons, Inc., Hoboken, New Jersey	

Mapping with Programme Outcomes:

CO/PSO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6
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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
	IOT AND CLOUD TECHNOLOGIES LAB	CC 14	-	-	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.

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
	ARTIFICIAL INTELLIGENCE	CC1 5	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 Knowledge Representation									

LO4	Introduce the concept of Software Agents	
LO5	Understand about AI applications	
UNIT	Contents	No. Of. Hours
I	INTRODUCTION : Introduction–Definition – Future of Artificial Intelligence – Characteristics of Intelligent Agents– Typical Intelligent Agents – Problem Solving Approach to Typical AI problems.	15
II	PROBLEM SOLVING METHODS Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal Decisions in Games – Alpha – Beta Pruning – Stochastic Games	15
III	KNOWLEDGE REPRESENTATION First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information	15
IV	SOFTWARE AGENTS Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.	15
V	APPLICATIONS AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving	15
TOTAL HOURS		75
Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
CO1	Understand the basics of the theory and practice of Artificial Intelligence as a discipline and about intelligent agents.	PO1, PO2, PO3, PO4, PO5, PO6
CO2	Understand search techniques and gaming theory	PO1, PO2, PO3, PO4, PO5, PO6
CO3	The student will learn to apply knowledge representation techniques and problem solving strategies to common AI applications.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Student should be aware of techniques used for classification and clustering.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Student should aware of basics of pattern recognition and steps required for it.	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Elaine Rich, Kevin Knight (2008), Shivsankar B Nair, Artificial Intelligence, Third Edition, Tata McGraw Hill Publication	
2	P.Rizwan Ahmed, Artificial Intelligence, Margham Publications, Chennai, 2012	

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 Pvt 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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	INTRODUCTION TO LINEAR ALGEBRA	Elec.	5	-	-	VI	3	25	75	100
Learning Objectives										
<ul style="list-style-type: none"> Vector Spaces, linear dependence and independence of vectors . Dual spaces, Inner product and norm – orthogonalization process. Linear transformations. Various operators on vector spaces 										
UNIT	Contents									No. Of. Hours
I	Vector spaces – Subspaces – Linear Combinations and linear span - Systems of Linear equations – Homogenous Equations – Non-homogenous Equations – Elementary Matrices – Row reduced -Echelon form.									12
II	Linear Dependence and Linear independence – Bases – Dimensions									12
III	Linear transformations, null spaces and ranges – Matrix representation of a linear transformation –invertibility and isomorphisms – dual spaces									12
IV	Eigen values, eigen vectors, diagonalizability – invariant subspaces – Cayley– Hamilton theorem									12
V	Inner products and norms – Gram Schmidt Orthogonalization Process - Orthogonal complements									12

Recommended Text	
1	Linear Algebra - Stephen H Friedberg, Arnold J Insel and Lawrence E Spence, 5 th edition (2018) Pearson
Reference Books	
	<ol style="list-style-type: none"> 1. I.N.Herstein, Topics in Algebra, Wiley Eastern Ltd. Second Edition, 2006. 2. N.S.Gopalakrishnan, University Algebra, New Age International Publications, Wiley Eastern Ltd. 3. John B.Fraleigh, First course in Algebra, Addison Wesley. 4. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice Hall of India Pvt. Ltd., New Delhi, 2004. 5. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007. 6. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
Website and e-Learning Source	
1	https://nptel.ac.in

Course Learning Outcome (for Mapping with POs and PSOs)

Students will be able to

CLO 1: Acquire a detailed knowledge about vector spaces and subspaces

CLO 2: Explain the concepts of Linear Dependence, Linear Independence, Bases and Dimension of basis

CLO 3: Explain the concept of Linear Transformations, their Matrix representation and the notion of dual spaces

CLO 4: Find the Eigen values and Eigen vectors, to apply the concepts for diagonalisation

CLO5: Explain about Inner product and norms and to apply Gram Schmidt Orthogonalization Process to problems on inner product spaces

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

Subject	Subject Name	U	≡	L	T	P	S	U	:	Marks
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Code								CIA	External	Total
	ARTIFICIAL NEURAL NETWORK	Elect	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 Neo cognitron, 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
Weightage of course contributed to each PSO	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
	ANALYTICS FOR SERVICE INDUSTRY	Elect	4	-	-	-	3	25	75	100
Learning Objectives										
LO1	Recognize challenges in dealing with data sets in service industry.									
LO2	Identify and apply appropriate algorithms for analyzing the healthcare, Human resource, hospitality and tourism data.									
LO3	Make choices for a model for new machine learning tasks.									
LO4	To identify employees with high attrition risk.									
LO5	To Prioritizing various talent management initiatives for your organization.									
UNIT	Contents								No. Of. Hours	
I	Healthcare Analytics : Introduction to Healthcare Data Analytics- Electronic Health Records– Components of EHR- Coding Systems- Benefits of EHR- Barrier to Adopting HER Challenges-Phenotyping Algorithms. Biomedical Image Analysis and Signal Analysis- Genomic Data Analysis for Personalized Medicine. Review of Clinical Prediction Models.								12	
II	Healthcare Analytics Applications : Applications and Practical Systems for Healthcare– Data Analytics for Pervasive Health- Fraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer- Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.								12	
III	HR Analytics: Evolution of HR Analytics, HR information systems and data sources, HR Metric and HR Analytics, Evolution of HR Analytics; HR Metrics and HR Analytics; Intuition versus analytical thinking; HRMS/HRIS and data sources; Analytics frameworks like LAMP, HCM:21(r) Model.								12	
IV	Performance Analysis: 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
Weightage of course contributed to each PSO	14	15	14	15	15	14

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	COMPUTING INTELLIGENCE	Elect	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, Mc neill, 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
Weightage of course contributed to each PSO	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	Inst. Hours	Marks		
									CIA	External	Total
CC16	Data Analytics using R Programming	Elective	5	-	-	-	3	5	25	75	100
Course Objective											
C1	To understand the problem solving approaches										
C2	To learn the basic programming constructs in R Programming										
C3	To learn the basic programming constructs in R Programming										

C4	To use R Programming data structures - lists, tuples, and dictionaries.	
C5	To do input/output with files in R Programming.	
UNIT	Contents	No. of Hours
I	Evolution of Big data — Best Practices for Big data Analytics — Big data characteristics — Validating — The Promotion of the Value of Big Data — Big Data Use Cases- Characteristics of Big Data Applications — Perception and Quantification of Value -Understanding Big Data Storage — A General Overview of High-Performance Architecture — HDFS — MapReduce and YARN — Map Reduce Programming Model	15
II	CONTROL STRUCTURES AND VECTORS -Control structures, functions, scoping rules, dates and times, Introduction to Functions, preview of Some Important R Data Structures, Vectors, Character Strings, Matrices, Lists, Data Frames, Classes Vectors: Generating sequences, Vectors and subscripts, Extracting elements of a vector using subscripts, Working with logical subscripts, Scalars, Vectors, Arrays, and Matrices, Adding and Deleting Vector Elements, Obtaining the Length of a Vector, Matrices and Arrays as Vectors Vector Arithmetic and Logical Operations, Vector Indexing, Common Vector Operations	15
III	LISTS- Lists: Creating Lists, General List Operations, List Indexing Adding and Deleting List Elements, Getting the Size of a List, Extended Example: Text Concordance Accessing List Components and Values Applying Functions to Lists, Data Frames, Creating Data Frames, Accessing Data Frames, Other Matrix-Like Operations	15
IV	FACTORS AND TABLES - Factors and Levels, Common Functions Used with Factors, Working with Tables, Matrix/Array-Like Operations on Tables , Extracting a Sub table, Finding the Largest Cells in a Table, Math Functions, Calculating a Probability, Cumulative Sums and Products, Minima and Maxima, Calculus, Functions for Statistical Distributions R PROGRAMMING .	15
V	OBJECT-ORIENTED PROGRAMMING S Classes, S Generic Functions, Writing S Classes, Using Inheritance, S Classes, Writing S Classes,	15

	Implementing a Generic Function on an S Class, visualization, Simulation, code profiling, Statistical Analysis with R, data manipulation	
	Total	75
Course Outcomes		Programme Outcomes
CO	On completion of this course, students will	
1	Work with big data tools and its analysis techniques.	PO1
2	Analyze data by utilizing clustering and classification algorithms.	PO1, PO3
3	Learn and apply different mining algorithms and recommendation systems for large volumes of data.	PO2, PO6
4	Perform analytics on data streams.	PO4, PO5, PO6
5	Learn NoSQL databases and management.	PO5, PO6
Text Book		
1	Roger D. Peng," R Programming for Data Science ", 2012	
2	Norman Matloff,"The Art of R Programming- A Tour of Statistical Software Design", 2011	
Reference Books		
1.	Garrett Golemund, Hadley Wickham,"Hands-On Programming with R: Write Your Own Functions and Simulations", 1st Edition, 2014	
2.	Venables ,W.N.,andRipley,"S programming", Springer, 2000.	
Web Resources		
1.	https://www.simplilearn.com	

Mapping with Programme Outcomes:

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

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks			
								CIA	External	Total	
	NATURAL LANGUAGE PROCESSING	Elect	4	-	-	-	3	25	75	100	
Learning Objectives											
LO1	To understand approaches to syntax and semantics in NLP.										
LO2	To learn natural language processing and to learn how to apply basic algorithms in this field.										
LO3	To understand approaches to discourse, generation, dialogue and summarization within NLP.										
LO4	To get acquainted with the algorithmic description of the main language levels: morphology, syntax, semantics, pragmatics etc.										
LO5	To understand current methods for statistical approaches to machine translation.										
UNIT	Contents								No. Of. Hours		
I	Introduction : Natural Language Processing tasks in syntax, semantics, and pragmatics – Issue- Applications – The role of machine learning – Probability Basics –Information theory – Collocations -N-gram Language Models – Estimating parameters and smoothing – Evaluating language models.								12		
II	Word level and Syntactic Analysis: Word Level Analysis: Regular Expressions-Finite-State Automata-Morphological Parsing-Spelling Error Detection and correction-Words and Word classes-Part-of Speech Tagging. Syntactic Analysis: Context-free Grammar-Constituency- Parsing-Probabilistic Parsing.								12		
III	Semantic analysis and Discourse Processing: Semantic Analysis: Meaning Representation-Lexical Semantics- Ambiguity-Word Sense Disambiguation. Discourse Processing: cohesion-Reference Resolution- Discourse Coherence and Structure.								12		
IV	Natural Language Generation: Architecture of NLG Systems- Generation Tasks and Representations- Application of NLG. Machine Translation: Problems in Machine Translation. Characteristics of Indian Languages- Machine Translation Approaches-Translation involving Indian Languages.								12		
V	Information retrieval and lexical resources: Information Retrieval: Design features of Information Retrieval Systems-Classical, Non-classical, Alternative Models of Information Retrieval – valuation Lexical Resources: WorldNet-Frame Net Stemmers- POS Tagger- Research Corpora SSAS.								12		
Course Outcomes								Programme Outcomes			
CO	On completion of this course, students will										
CO1	Describe the fundamental concepts and techniques of natural language processing. Explain the advantages and disadvantages of different NLP technologies and their applicability in different business situations.								PO1, PO2, PO3, PO4, PO5, PO6		
CO2	Distinguish among the various techniques, taking into account the assumptions, strengths, and weaknesses of each Use NLP technologies to explore and gain a broad understanding								PO1, PO2, PO3, PO4, PO5, PO6		

	of text data.	
CO3	Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions. Use NLP methods to analyse sentiment of a text document.	PO1, PO2, PO3, PO4, PO5, PO6
CO4	Analyze large volume text data generated from a range of real-world applications. Use NLP methods to perform topic modelling.	PO1, PO2, PO3, PO4, PO5, PO6
CO5	Develop robotic process automation to manage business processes and to increase and monitor their efficiency and effectiveness. Determine the framework in which artificial intelligence and the Internet of things may function, including interactions with people, enterprise functions, and environments.	PO1, PO2, PO3, PO4, PO5, PO6
Textbooks		
1	Daniel Jurafsky, James H. Martin, “Speech & language processing”, Pearson publications.	
2	Allen, James. Natural language understanding. Pearson, 1995.	
Reference Books		
1.	Pierre M. Nugues, “An Introduction to Language Processing with Perl and Prolog”, Springer	
Web Resources		
1.	https://en.wikipedia.org/wiki/Natural_language_processing	
2.	https://www.techtarget.com/searchenterpriseai/definition/natural-language-processing-NLP	

Mapping with Programme Outcomes:

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

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

Subject Code	Subject Name	Category	L	T	P	S	Credits	Marks		
								CIA	External	Total
	CYBER FORENSICS	SEC8	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 data seizure.

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 Services,. Types of Computer Forensics Technology: Types of Business Computer Forensic, Technology–Types of Military Computer Forensic Technology–Types of Law Enforcement–Computer Forensic.	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.	6
III	Duplication and Preservation of Digital Evidence: Processing steps, Legal Aspects of collecting and Preserving Computer forensic Evidence. Computer image Verification and Authentication: Special needs of Evidential Authentication.	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	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.	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 Digital Crime", 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