SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603203.

(Approved by AICTE, Affiliated to Anna University, 'A' Grade Accredited by NAAC,NBA Accredited, ISO 9001:2015 Certified)

POST GRADUATE CURRICULA AND SYLLABI
MASTER OF COMPUTER APPLICATIONS

REGULATION 2024

PROGRAMME: MASTER OF COMPUTER APPLICATIONS (2 YEARS)

REGULATIONS – 2024 CHOICE-BASED CREDIT SYSTEM
MASTER OF COMPUTER APPLICATIONS (2 YEARS)

VISION OF THE DEPARTMENT

To create and apply knowledge by thinking and doing, preparing for tomorrow's innovators and conduct cutting-edge research to bring the transformative power of computing to society in a rapidly changing world.

MISSION OF THE DEPARTMENT

1. To bring the most brilliant students and faculty together to understand the strengths and limits of computation, invent next-generation computing systems, and create innovative solutions to real-world problems.

2. To provide conducive environment so as to achieve excellence in teaching-learning, and research and development activities.

3. Deliver knowledge among students through novel pedagogical methods in the varied areas of computer sciences with thrust on applications so as to enable students to undertake research.

4. To facilitate students to nurture skills to practice their professions competently to meet the ever-changing needs of society.

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REGULATIONS – 2024 CHOICE-BASED CREDIT SYSTEM
MASTER OF COMPUTER APPLICATIONS (2 YEARS)

1. PROGRAMME EDUCATIONAL COURSE OBJECTIVES (PEOs):

PEO 1: To equip students with a strong foundation to design and develop solutions in mathematical, scientific, data analytics and business applications.

PEO 2: To develop the ability to plan, analyze, design, code, test, implement and maintain the software product for real time systems.

PEO 3: To practice effectively as individuals and as team members in multidisciplinary projects involving technical, managerial, economic and social constraints.

PEO 4: To progress their career productively in software industry, academia, research, entrepreneurial pursuit, government, consulting firms and other Information Technology enabled services.

2. PROGRAMME COURSE OUTCOMES (POs):

After going through the two years of study, our master's in computer applications graduates will exhibit the ability to:

PO#	PROGRAMME COURSE OUTCOMES
1.	An ability to independently carry out research/investigation and development work to solve practical problems.
2.	An ability to write and present a substantial technical report/document.
3.	An ability to demonstrate the design and development of computer applications for any domains.
4.	An ability to create, select, adapt and apply appropriate innovative techniques, resources, and modern computing tools to complex computing activities with an understanding of the limitations.
5.	An ability to recognize the need and to engage in independent learning for continual development as a computing professional.
6.	An ability to function effectively as an individual and as a member/leader of a team in various technical environments.

3. PEO / PO Mapping:

PROGRAMME EDUCATIONAL COURSE OBJECTIVES	POs					
	PO1	PO2	PO3	PO4	PO5	PO6
I	3	1	3	3	3	3
II	2	1	3	3	3	3
III	3	3	2	3	2	2
IV	2	1	2	1	1	2

(3 – High, 2 – Medium, 1 – Low)

4. **Mapping of Course Outcome and Programme Outcome**

YEAR	SEM	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6
YEAR 1	SEMESTER 1	Applied Probability and Statistics	2.4	0.2	2.0	2	1.2	2
		Research Methods and Intellectual Property Rights	1	2	1	-	1	-
		Advanced Data Structures and Algorithms	2.4	0.2	2	2	1.2	2
		Advanced Database Technology	2	1	2.8	2	2.2	2.4
		Python Programming	2.2	1	3	3	2.2	2.6
		Computer Networks and Management	2.2	1	3	3	2.2	2.6
		Data Structures Laboratory	1.8	1	3	2.6	2	2.2
		Database Technologies Laboratory	2	1	2	2	2	2
		Python Programming Laboratory	1.8	1	3	2.6	2	2.2

	SEMESTER 2	Full Stack Web Development	1.8	1	2.6	2	2.6	2.4
		Cloud Computing and Mobile Application Development	2.6	1.4	2.6	3	2	2.6
		Advanced Data Science	1.2	-	0.6	0.4	1.4	0.4
		Cyber Security	2	1	2	2	2	2
		Object Oriented Software Engineering	2	1	3	2.8	2	2
		Professional Elective - I	-	-	-	-	-	-
		Full Stack Web Development Laboratory	2.2	1	2.4	2	2.6	2.6
		Mobile Application Development Laboratory	3	0.2	3	2.8	2	2
		Communication Skills Enhancement - I	0.8	2	1.8	0.8	0.8	0.8
		Mini Project	2	1	2	1	2	2
YEAR 2	SEMESTER 3	Machine Learning	1.6	1	2	2	2	2
		Internet of Things	2	1	2.4	2	2	2.4
		Professional Elective II	-	-	-	-	-	-
		Professional Elective III	-	-	-	-	-	-
		Professional Elective IV	-	-	-	-	-	-
		Professional Elective - V	-	-	-	-	-	-
		Machine Learning Laboratory	2	1	2	2	2	2
		Internet of Things Laboratory	2	1	2	2	2	2
		Communication Skills Enhancement- II	0.8	2	1.8	0.8	0.8	0.8
	SEMESTER 4	Project Work	-	-	-	-	-	-

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MASTER OF COMPUTER APPLICATIONS (2 YEARS)
I TO IV SEMESTERS CURRICULA AND SYLLABI

SEMESTER I

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MA4121	Applied Probability and Statistics	BSC	4	3	1	0	4
2	BA4171	Research Methods and Intellectual Property Rights	RMC	3	3	0	0	3
3	MC4161	Advanced Data Structures andAlgorithms	PCC	3	3	0	0	3
4	MC4162	Advanced Database Technology	PCC	3	3	0	0	3
5	MC4163	Python Programming	PCC	3	3	0	0	3
6	MC4164	Computer Networks and Management	PCC	3	3	0	0	3
7	Axxxxx	Audit Course *#	AC	2	2	0	0	0
PRACTICAL								
8	MC4165	Data Structures Laboratory #	PCC	2	0	0	2	1
9	MC4166	Database Technologies Laboratory	PCC	4	0	0	4	2
10	MC4167	Python Programming Laboratory	PCC	4	0	0	4	2
			TOTAL	31	20	1	10	24

*   Audit Course is optional
\#   No End Semester Examination is required for this course.

Sl. No	COURSE CODE	COURSE TITLE		CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY									
1	MC4261	Full Stack Web Development		PCC	3	3	0	0	3
2	MC4262	Cloud Computing and Mobile Application Development		PCC	3	3	0	0	3
3	MC4263	Advanced Data Science		PCC	3	3	0	0	3
4	MC4264	Cyber Security		PCC	3	3	0	0	3
5	MC4265	Object Oriented Software Engineering		PCC	3	3	0	0	3
6	PMC1xx	Professional Elective - I		PEC	3	3	0	0	3
PRACTICAL									
7	MC4266	Full Stack Web Development Laboratory		PCC	4	0	0	4	2
8	MC4267	Mobile Application Development Laboratory		PCC	4	0	0	4	2
9	EN4247	Communication Skills Enhancement - I #		EEC	2	0	0	2	1
10	MC4268	Mini Project #		EEC	2	0	0	2	1
				TOTAL	30	18	0	12	24

SEMESTER III

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	MC4361	Machine Learning	PCC	3	3	0	0	3
2	MC4362	Internet of Things	PCC	3	3	0	0	3
3	PMC2xx	Professional Elective II	PEC	3	3	0	0	3
4	PMC3xx	Professional Elective III	PEC	3	3	0	0	3
5	PMC4xx	Professional Elective IV	PEC	3	3	0	0	3
6	PMC5xx	Professional Elective V	PEC	3	3	0	0	3
PRACTICAL								
7	MC4363	Machine Learning Laboratory	PCC	4	0	0	4	2
8	MC4364	Internet of Things Laboratory	PCC	4	0	0	4	2
9	EN4348	Communication Skills Enhancement - II#	EEC	2	0	0	2	1
			TOTAL	28	18	0	10	23

No End Semester Examination is required for this course.

SEMESTER IV

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1.	MC4441	Project Work	EEC	24	0	0	24	12
			TOTAL	24	0	0	24	12

TOTAL NO. OF CREDITS: 83

BASIC SCIENCE COURSES (BSC)

Sl. No	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	PRACTICAL		
1	MA4121	Applied Probability and Statistics	3	1	0	4	I

PROFESSIONAL CORE COURSES (PCC)

S.NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	PRACTICAL		
1.	MC4161	Advanced Data Structures and Algorithms	3	0	0	3	I
2.	MC4162	Advanced Database Technology	3	0	0	3	I
3.	MC4163	Python Programming	3	0	0	3	I
4.	MC4164	Computer Networks and Management	3	0	0	3	I
5.	MC4165	Data Structures Laboratory	0	0	2	1	I
6.	MC4166	Database Technologies Laboratory	0	0	4	2	I
7.	MC4167	Python Programming Laboratory	0	0	4	2	I
8.	MC4261	Full Stack Web Development	3	0	0	3	II
9.	MC4262	Cloud Computing and Mobile Application Development	3	0	0	3	II
10.	MC4263	Advanced Data Science	3	0	0	3	II
11.	MC4264	Cyber Security	3	0	0	3	II

12.	MC4265	Object Oriented Software Engineering	3	0	0	3	II
13.	MC4266	Full Stack Web Development Laboratory	0	0	4	2	II
14.	MC4267	Mobile Application Development Laboratory	0	0	4	2	II
15.	MC4361	Machine Learning	3	0	0	3	III
16.	MC4362	Internet of Things	3	0	0	3	III
17.	MC4363	Machine Learning Laboratory	0	0	4	2	III
18.	MC4364	Internet of Things Laboratory	0	0	4	2	III
					TOTAL CREDITS	46	

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	PRACTICAL		
1	BA4171	Research Methods and Intellectual Property Rights	3	0	0	3	I
					TOTAL CREDITS	3	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			LECTURE	TUTORIAL	PRACTICAL		
1	MC4268	Mini Project	0	0	2	1	II
2	EN4247	Communication Skills Enhancement – I	0	0	2	1	II
3	EN4348	Communication Skills Enhancement – II	0	0	2	1	III
4	MC4441	Project Work	0	0	24	12	IV
					TOTAL CREDITS	15	

PROFESSIONAL ELECTIVE COURSES: VERTICALS

AI	SOFTWARE ENGINEERING	DATA SCIENCE	AI & ML	CYBER SECURITY	CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES
Artificial Intelligence for Social Good	Software Requirements Engineering	Machine Learning for Data Science	Natural Language Processing	Database Management Systems and Security	Virtualization
Neural Network and Deep Learning	Software Industrialization	Data Visualization	Predictive Modeling	Operating Systems and Security	Cloud Services Management
Data Analytics and Computing	Business Intelligence	Data Security and Privacy	Smart Convergent Technologies	Cryptography and Cyber Security	Storage Technologies
Image Processing and Machine Vision	Integrated Software Project Management	Big Data Analytics	Web Analytics	Engineering Secure Software Systems	Software Defined Networks
Introduction to Blockchain Technology	Software Security	Exploratory Data Analysis	Machine Learning and Deep Learning	Cyber Forensics	Stream Processing

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I: ARTIFICIAL INTELLIGENCE

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	PMC101	Artificial Intelligence for Social Good	PEC	3	3	0	0	3
2	PMC102	Neural Network and Deep Learning	PEC	3	3	0	0	3
3	PMC103	Data Analytics and Computing	PEC	3	3	0	0	3
4	PMC104	Image processing and Machine Vision	PEC	3	3	0	0	3
5	PMC105	Introduction to Blockchain Technology	PEC	3	3	0	0	3

VERTICAL II: SOFTWARE ENGINEERING

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	PMC201	Software Requirements Engineering	PEC	3	3	0	0	3
2	PMC202	Software Industrialization	PEC	3	3	0	0	3
3	PMC203	Business Intelligence	PEC	3	3	0	0	3
4	PMC204	Integrated Software Project Management	PEC	3	3	0	0	3
5	PMC205	Software Security	PEC	3	3	0	0	3

VERTICAL III: DATA SCIENCE

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	PMC301	Machine Learning for Data Science	PEC	3	3	0	0	3
2	PMC302	Data Visualization	PEC	3	3	0	0	3
3	PMC303	Data Security and Privacy	PEC	3	3	0	0	3
4	PMC304	Big Data Analytics	PEC	3	3	0	0	3
5	PMC305	Exploratory Data Analysis	PEC	3	3	0	0	3

VERTICAL IV: ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	PMC401	Natural Language Processing	PEC	4	2	0	2	3
2	PMC402	Predictive Modeling	PEC	3	3	0	0	3
3	PMC403	Smart Convergent Technologies	PEC	3	3	0	0	3
4	PMC404	Web Analytics	PEC	3	3	0	0	3
5	PMC405	Machine Learning and DeepLearning	PEC	3	3	0	0	3

VERTICAL V: CYBER SECURITY

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	PMC501	Database Management Systems and Security	PEC	3	3	0	0	3
2	PMC502	Operating Systems and Security	PEC	4	2	0	2	3
3	PMC503	Cryptography and Cyber Security	PEC	3	3	0	0	3
4	PMC504	Engineering Secure Software Systems	PEC	4	2	0	2	3
5	PMC505	Cyber Forensics	PEC	4	2	0	2	3

VERTICAL VI: CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES

Sl. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	PMC601	Virtualization	PEC	4	2	0	2	3
2	PMC602	Cloud Services Management	PEC	4	2	0	2	3
3	PMC603	Storage Technologies	PEC	3	3	0	0	3
4	PMC604	Software Defined Networks	PEC	4	2	0	2	3
5	PMC605	Stream Processing	PEC	4	2	0	2	3

AUDIT COURSES (AC)
Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	AEN401	English for Research Paper Writing	2	0	0	0
2.	ACE402	Disaster Management	2	0	0	0
3.	ABA403	Constitution of India	2	0	0	0
4.	ABA404	Entrepreneurship Essentials	2	0	0	0

BRIDGE COURSES
(For the M.C.A students admitted under non-computer-science background category)

SL. NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C
Classes are to be conducted and completed before the start of the class of first semester,							
1.	BC4101	Data Structures and Algorithms	5	3	0	2	0
Classes are to be conducted and completed before the start of the class of second semester,							
2.	BC4201	Introduction to Computer Organization and Operating Systems	3	3	0	0	0
Classes are to be conducted and completed before the start of the class of third semester,							
3.	BC4301	Mathematical Foundations of Computer Science	3	3	0	0	0

ABBREVIATIONS

BSC   - BASIC SCIENCE COURSES

PCC   - PROFESSIONAL CORE COURSES

PEC   - PROFESSIONAL ELECTIVE COURSES

RMC   - RESEARCH METHODOLOGY AND IPR COURSES

EEC   - EMPLOYABILITY ENHANCEMENT COURSES

SUMMARY

S.NO.	SUBJECT AREA	NAME OF THE PROGRAMME : M.C.A.				
		CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	-
1.	BSC	4	-	-	-	4
2.	PCC	17	19	10	-	46
3.	PEC	-	3	12	-	15
4.	RMC	3	-	-	-	3
5.	EEC	-	2	1	12	15
	TOTAL CREDITS	24	24	23	12	83

An MCA, student shall select a professional elective courses (15 credits) from semester II Onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

A student shall select a professional elective courses (15 credits) from semester II onwards. All these courses have to be in a particular vertical or across the verticals. Moreover, if the student can register in any one of the following verticals then he/ she can become an expert in the particular domain.

MA4121   **APPLIED PROBABILITY AND STATISTICS**   **L T P C**
                                                                    3 1 0 4

COURSE OBJECTIVES:

- To encourage students to develop a working knowledge of the central ideas of Linear Algebra.
- To enable students to understand the concepts of Probability and Random Variables.
- To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables and the significanceof the central limit theorem.
- To apply the small / large sample tests through Tests of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution andprincipal components analysis.

UNIT I   LINEAR ALGEBRA   12

Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – QR factorization - generalized eigenvectors – Canonical forms - singular value decomposition and applications – pseudo inverse – least square approximations.

UNIT II   PROBABILITY AND RANDOM VARIABLES   12

Probability – Axioms of probability – Conditional probability – Bayes theorem – Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson , Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT III   TWO DIMENSIONAL RANDOM VARIABLES   12

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT IV   TESTING OF HYPOTHESIS   12

Sampling distributions – Type I and Type II errors – Small and Large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT V   MULTIVARIATE ANALYSIS   12

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Population principal components – Principal components from standardized variables

TOTAL: 60 PERIODS

REFERENCES:

1. Dallas E Johnson, "Applied multivariate methods for data Analysis", Thomson and Duxburypress, Singapore, 1998.
2. Richard A. Johnson and Dean W. Wichern, "Applied multivariate statistical Analysis", Pearson Education, Fifth Edition, 6th Edition, New Delhi, 2013.
3. Bronson, R.,"Matrix Operation" Schaum's outline series, Tata McGrawHill, New York, 2011.
4. Oliver C. Ibe, "Fundamentals of Applied probability and Random Processes", Academic Press, Boston, 2014.
5. Johnson R. A. and Gupta C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson India Education, Asia, 9th Edition, New Delhi, 2017.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Apply the concepts of Linear Algebra to solve practical problems.

CO2: Use the ideas of probability and random variables in solving engineering problems.

CO3: Be familiar with some of the commonly encountered two dimension random variables and be equipped for a possible extension to multivariate analysis.

CO4: Use statistical tests in testing hypothesis on data.

CO5: Develop critical thinking based on empirical evidence and the scientific approach to knowledge development.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	-	2	2	1	2
CO2	2	-	2	2	1	1
CO3	2	-	2	1	1	2
CO4	3	1	2	2	1	2
CO5	3	-	2	3	2	3
AVG	2.4	0.2	2	2	1.2	2

BA4171	RESEARCH METHODS AND INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To familiarize the students with the scientific methodology involved in research process.
- To comprehend different methods on data collection.
- To understand techniques to code and analyze data using various statistical techniques.
- To know the concept of IPR and ethics in research.
- To understand about patent drafting and filing process.

UNIT I   INTRODUCTION   9

Introduction – Sources of Research Problem, Research Process - Criteria of Good Research - Scope and importance, Approaches – Qualitative – Quantitative, Research Design and Types, Types of Variables, Ethics in Research.

UNIT II   DATA COLLECTION AND ANALYSIS   9

Sources of Data – Primary – Secondary, Data Collection Methods, Measurement and Scaling, Validity of Findings- Internal and External Validity

UNIT III   DATA PREPARATION AND DATA CLEANING   9

Sampling Techniques, Editing – Coding – Tabulation of Data, Validity of data – Qualitative Vs Quantitative, Data analysis – Univariate - Bivariate and Multivariate statistical techniques – Cluster analysis – Multiple regression.

UNIT IV   INTELLECTUAL PROPERTY RIGHTS AND PATENTS   9

Introduction to Intellectual Property (IP) - Role of IP in the Economic and Cultural Development of the Society – IP Governance - IP as a Global Indicator of Innovation - Major Amendments in IP Laws and Acts in India, Trademark and secrets - Types and features of IPR, Patents - Conditions for Obtaining a Patent Protection - National Bodies Dealing with Patent Affairs - Registration procedure.

UNIT V   DOCUMENTATION AND REPORT WRITING   9

Research report – Report format - Title of the report - Contents of report - Different types, Report Presentation - Oral Presentation - Written Presentation, IPR Document – Forms of IPR – IPR Guidelines

TOTAL: 45 PERIODS

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", Sep 2013.
5. C.R. Kothari,"Research Methodology: Methods and Trends", New Age International,2015
6. Dipankar Deb Rajeeb Dey, Valentina E. Balas "Engineering Research Methodology", ISSN 1868-4394 ISSN 1868-4408 (electronic), Intelligent Systems Reference Library, ISBN 978-981-13-2946-3 ISBN 978-981-13- 2947-0 (eBook), https://doi.org/10.1007/978-981-13-2947-0
7. Intellectual Property A Primer for Academia by Prof. Rupinder Tewari Ms. Mamta Bhardwa
8. David V. Thiel "Research Methods for Engineers" Cambridge University Press, 978-1- 107-03488- 4
9. Intellectual Property Rights by N.K.Acharya Asia Law House 6th Edition. ISBN: 978-93- 81849-30-9

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Formulate and design research problem.

CO2: Understand and comprehend the data collection methods.

CO3: Perform data analysis and acquire Insights.

CO4: Understand IPR and follow research ethics.

CO5: Understand and practice drafting and filing a Patent in research and development.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	-	-	-	-	-
CO2	-	2	-	-	-	-
CO3	-	-	1	-	-	-
CO4	-	-	1	-	-	-
CO5	-	-	-	-	1	-
AVG	1	2	1	-	1	-

MC4161   **ADVANCED DATA STRUCTURES AND ALGORITHMS**   **L   T   P   C**
                                                                        3   0   0   3

COURSE OBJECTIVES:

- To learn the concepts of linear data structures and its applications.
- To understand the concepts of non-linear data structures like trees and graphs.
- To learn the usage of sorting techniques.
- To familiarize the concepts of hashing.
- To understand about algorithm analysis and design techniques.

UNIT I   LINEAR DATA STRUCTURES   9

Abstract Data Types (ADTs) – List ADT – Array-Based Implementation – Linked List Implementation Doubly-Linked Lists – Circular Linked Lists – Stack ADT: Implementation of Stacks – Queue ADT: Implementation of Queues – Applications.

UNIT II   ALGORITHMS IN COMPUTING   9

Introductions to Algorithms – Iterative and Recursive Algorithms – Designing Algorithms – Analyzing Algorithms – Growth of Functions: Asymptotic Notations – Standard Notations and Common Functions – Recurrences: The Substitution Method – The Recursion – Tree Method.

UNIT III   HIERARCHICAL DATA STRUCTURES & HASHING   9

Trees: Preliminaries – Implementation of Trees – Tree Traversals with an Application – Binary Trees: Implementation – Expression Trees – Search Tree ADT – Binary Search Trees – Applications of Trees – Fundamentals of Hashing – Hash Function – Separate Chaining – Open Addressing.

UNIT IV   SORTING AND GRAPHS   9

Sorting Algorithms: Insertion Sort, Quick Sort, Heap Sort - Graphs: Representation of Graphs, Graph Traversals – Topological Sort – Shortest Path Algorithms: Dijkstra's Algorithm – Minimum Spanning Tree: Prim's and Kruskal's Algorithm.

UNIT V   ALGORITHM DESIGN TECHNIQUES   9

Greedy Algorithms: Huffman Codes – Divide and Conquer: Merge Sort – Dynamic Programming: Using a Table instead of Recursion – Ordering Matrix Multiplications – Introduction to NP Completeness.

TOTAL: 45 PERIODS

REFERENCES:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second Edition,Pearson Education, 1997.
2. V. Alfred, J. E. Hopcroft, J. D. Ullman, "Data Structures and Algorithms", Pearson education Asia, 1983.
3. Robert Kruse & Bruce Leung, "Data Structures & Program Design in C", Pearson Education, 2007.
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning, 2002.
5. S. Sridhar, "Design and Analysis of Algorithms", Oxford University Press, 2014.
6. Anany Levitin, "Introduction to Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Use abstract data types including stacks, queues and lists for any application.

CO2: Analyze of Algorithms in computing.

CO3: Design and implement tree data structures. Analyze and implement hashing techniques that solve in linear time.

CO4: Apply sorting algorithms for a given problem.

CO5: Design algorithms using graph structures to solve real life problems

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	-	2	2	1	2
CO2	2	-	2	2	1	1
CO3	2	-	2	1	1	2
CO4	3	1	2	2	1	2
CO5	3	-	2	3	2	3
AVG	2.4	0.2	2	2	1.2	2

MC4162   **ADVANCED DATABASE TECHNOLOGY**   L   T   P   C
                                                              3   0   0   3

COURSE OBJECTIVES:

- To understand the working principles and query processing of distributed databases.
- To understand the basics of spatial, temporal and mobile databases and their applications.
- To distinguish the different types of NoSQL databases.
- To understand the basics of XML and create well-formed and valid XML documents.
- To gain knowledge about information retrieval and web search.

UNIT I   DISTRIBUTED DATABASES   9

Distributed Systems – Introduction – Architecture – Distributed Database Concepts –
Distributed Data Storage – Distributed Transactions – Commit Protocols –
Concurrency Control – Distributed Query Processing

UNIT II   SPATIAL AND TEMPORAL DATABASES   9

Active Databases Model – Design and Implementation Issues - Temporal Databases – Temporal.
Querying - Spatial Databases: Spatial Data Types, Spatial Operators and Queries – Spatial
Indexing and Mining – Applications -- Mobile Databases: Location and Handoff Management,
Mobile Transaction Models – Deductive Databases - Multimedia Databases.

UNIT III   NOSQL DATABASES   9

NoSQL – CAP Theorem – Sharding - Document based – MongoDB Operation: Insert, Update,
Delete, Query, Indexing, Application, Replication, Sharding- Cassandra: Data Model, Key Space,
Table Operations, CRUD Operations, CQL Types - HIVE: Data types, Database Operations,
Partitioning – HiveQL – OrientDB Graph database – OrientDB Features.

UNIT IV   XML DATABASES   9

Structured, Semi structured, and Unstructured Data – XML Hierarchical Data Model – XML
Documents – Document Type Definition – XML Schema – XML Documents and Databases –XML
Querying – XPath – XQuery.

UNIT V   INFORMATION RETRIEVAL AND WEB SEARCH   9

IR concepts – Retrieval Models – Queries in IR system – Text Preprocessing – Inverted Indexing –
Evaluation Measures – Web Search and Analytics – Current trends.

TOTAL: 45 PERIODS

REFERENCES:

1. Abraham Silberschatz, Henry F Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, McGraw Hill, 2019.
2. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education/Addison Wesley, 2017.
3. Guy Harrison, "Next Generation Databases, NoSQL, NewSQL and Big Data", First Edition, Apress publishers, 2015
4. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining: Concepts and Techniques", Third Edition, Morgan Kaufmann, 2012.
5. Brad Dayley, "Teach Yourself NoSQL with MongoDB in 24 Hours", Sams Publishing, First Edition, 2014.
6. C. J. Date, A. Kannan, S. Swamynathan, "An Introduction to Database Systems",8th Edition, Pearson Education, 2006.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Design a distributed database system and execute distributed queries.

CO2: Manage Spatial and Temporal Database systems and implement it in corresponding applications.

CO3: Use NoSQL database systems and manipulate the data associated with it.

CO4: Design XML database systems and validate with XML schema.

CO5: Apply knowledge of information retrieval concepts on web databases.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	2	2	2
CO2	2	1	3	2	2	2
CO3	2	1	3	2	2	3
CO4	2	1	3	2	3	3
CO5	2	1	3	2	2	2
AVG	2	1	2.8	2	2.2	2.4

MC4163	PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop Python programs with conditionals, loops and functions.
- To use Python data structures – lists, tuples, dictionaries.
- To do input/output with files in Python.
- To use modules, packages and frameworks in python.
- To define a class with attributes and methods in python.

UNIT I BASICS OF PYTHON 9

Introduction to Python Programming – Python Interpreter and Interactive Mode– Variables and Identifiers – Arithmetic Operators – Values and Types – Statements. Operators – Boolean Values – Operator Precedence – Expression – Conditionals: If Else Constructs – Loop Structures/Iterative Statements – While Loop – For Loop – Break Statement-Continue statement – Function Call and Returning Values – Parameter Passing – Local and Global Scope – Recursive Functions

UNIT II DATA TYPES AND MODULES IN PYTHON 9

Lists, Tuples, Sets, Strings, Dictionary, Modules: Module Loading and Execution – Packages – Making Your Own Module – The Python Standard Libraries.

UNIT III FILE HANDLING AND EXCEPTION HANDLING 9

Files: Introduction – File Path – Opening and Closing Files – Reading and Writing Files –File Position –Exception: Errors and Exceptions, Exception Handling, Multiple Exception.

UNIT IV PACKAGES AND FRAMEWORKS 9

Introduction – The Python Libraries for data processing, data mining and visualization NUMPY, Pandas, Matplotlib, Plotly-Frameworks- -Django, Flask, Web2Py

UNIT V OBJECT ORIENTED PROGRAMMING IN PYTHON 9

Creating a Class, Class methods, Class Inheritance, Encapsulation, Polymorphism, class Method vs. static methods, Python object persistence.

TOTAL: 45 PERIODS

REFERENCES:

1. Reema Thareja, "Python Programming using Problem Solving Approach", Oxford University Press, First edition, 2017.
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, Shroff, O'Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/).
3. Guido van Rossum, Fred L. Drake Jr., "An Introduction to Python – Revised and Updated for Python 3.2, Network Theory Ltd., First edition, 2011.
4. John V Guttag, "Introduction to Computation and Programming Using Python", Revised and Expanded Edition, MIT Press, 2013.
5. Charles Dierbach, "Introduction to Computer Science using Python", Wiley India Edition, First Edition, 2016.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Develop algorithmic solutions to simple computational problems.

CO2: Represent compound data using Python lists, tuples and dictionaries.

CO3: Read and write data from/to files in Python Programs.

CO4: Structure simple Python programs using libraries, modules etc.

CO5: Structure a program by bundling related properties and behaviors into individual objects.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	3	1	3	3	2	3
CO2	1	1	3	3	1	2
CO3	2	1	3	3	2	2
CO4	3	1	3	3	3	3
CO5	2	1	3	3	3	3
AVG	2.2	1	3	3	2.2	2.6

MC4164   COMPUTER NETWORKS AND MANAGEMENT   L T P C
                                                             3 0 0 3

COURSE OBJECTIVES:

- To learn the fundamentals of networking, network security and network programming.
- To explore the end to end issues in data communication and possible secure solutions.
- To study about routing algorithms and protocols, IP and related protocols.
- To understand medium access control and LANs.
- To learn about networking devices and the techniques required to monitor and manage them.

UNIT I   ARCHITECTURE AND APPLICATION   9

Data networks -Network Architecture - ISO/OSI and TCP/IP reference models – HTTP and HTTPS, FTP, E-mail and DNS.

UNIT II   SOCKET PROGRAMMING   9

System calls and socket programming, Elementary TCP and UDP socket - Developing client/server applications -Socket Options - Advanced Socket IP options for IPv6 server and client's interoperability- Raw Sockets.

UNIT III   SECURE COMMUNICATION   9

Secured Data Networks – CIA triangle - Encryption and Decryption – Symmetric and Asymmetric Cryptosystems -End to end issues – Transport layer protocols – TCP extensions -IPSec – SSL and TLS protocols.

UNIT IV   L2 AND L3 PROTOCOLS AND DEVICES   9

Medium Access Control - Ethernet - CSMA/CD - IEEE 802.11 WLAN CSMA/CA - IPv4 - Addressing, VLSM, CIDR - IPv6 – Network devices – Hubs, Bridges, Switches, Routers, L3 Switches.

UNIT V   DEVICES, MONITORING AND MANAGEMENT   9

Edge and Core Networks – Introduction to SDN- data plane- control plane Honeypots – Firewalls – Network monitoring - IDS – Network Management System – SNMP and its variants

TOTAL: 45 PERIODS

REFERENCES:

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", Seventh Edition, Pearson Education, 2016.
2. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Fifth Edition, Morgan Kaufmann Publishers Inc., 2011.
3. William Stallings, "Data and Computer Communications", Eighth Edition, Pearson Education, 2011.
4. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, " Computer Networks: An Open Source Approach", First Edition, McGraw Hill, 2011.
5. W. Richard Stevens, "TCP/IP illustrated-The Protocols", Volume 1, Pearson Education, 2012.
6. W. Richard Stevens, Bill Fenner, Andrew M Rudoff "UNIX Network Programming: The Sockets Networking API", Volume 1, Third Edition, Pearson Education, 2015.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Different network layers and the architecture.

CO2: Design and implement simple client/server programs using socket options.

CO3: Design and implement simple cryptosystems.

CO4: To configure various transport layer level parameters in setting up a network.

CO5: Design a network as per the given specifications, monitor and manage the networks

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	3	1	3	3	2	3
CO2	1	1	3	3	1	2
CO3	2	1	3	3	2	2
CO4	3	1	3	3	3	3
CO5	2	1	3	3	3	3
AVG	2.2	1	3	3	2.2	2.6

MC4165   DATA STRUCTURES LABORATORY   L T P C
                                                                           0 0 2 1

COURSE OBJECTIVES:

- To understand the usage of advanced tree structures.
- To familiarize the usage of heap structures.
- To learn the usage of graph data structures and spanning trees.
- To learn how to analyze the complexities of algorithms.
- To explore the various design strategies of algorithms.

LIST OF EXPERIMENTS:

1. Implementation of Stack ADT and Queue ADT
2. Implementation of Binary Search tree and its operations.
3. Implementation of AVL tree and its operations.
4. Implementation of Hashing techniques such as separate chaining.
5. Implementation of representation of graphs and topological sort.
6. Implementation of a spanning tree for a given graph using Prim's algorithm.
7. Implementation of shortest path algorithms such as Dijkstra's algorithm.
8. Implementation of iterative and recursive algorithms with its complexity analysis.
9. Implementation of Merge sort algorithm analysis using divide and conquer approach.
10. Implementation of matrix chain multiplication using dynamic programming approach.
11. Implementation of Huffman coding using greedy approach

TOTAL: 30 PERIODS

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Implement basic and advanced data structures extensively.

CO2: Choose and apply suitable hierarchical data structures for real time problems.

CO3: Apply suitable heap data structures based on the problem requirements.

CO4: Design and apply algorithms using graph structures and Design and implement iterative and recursive algorithms with minimum complexity.

CO5: Design and develop efficient algorithms by adopting suitable algorithm design strategies.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	3	3	2	2
CO2	2	1	3	3	2	2
CO3	1	1	3	2	2	2
CO4	2	1	3	2	2	2
CO5	2	1	3	3	2	3
AVG	1.8	1	3	2.6	2	2.2

MC4166   **DATABASE TECHNOLOGIES LABORATORY**   L   T   P   C
                                                         0   0   4   2

COURSE OBJECTIVES:

- To understand the process of distributing tables across multiple systems.
- To understand the process of storing, retrieving spatial and temporal data.
- To understand the process of storing, retrieving objects in a database.
- To understand the process of storing and retrieving data from a XML Database.
- To use the open source database for building a mobile application.

LIST OF EXPERIMENTS:

1. NOSQL Exercises

    a) MongoDB – CRUD operations, Indexing, Sharding

    b) Cassandra: Table Operations, CRUD Operations, CQL Types

    c) HIVE: Data types, Database Operations, Partitioning – HiveQL

    d) OrientDB Graph database – OrientDB Features

2. MySQL Database Creation, Table Creation, Query

3. MySQL Replication – Distributed Databases

4. Spatial data storage and retrieval in MySQL

5. Temporal data storage and retrieval in MySQL

6. Object storage and retrieval in MySQL

7. XML Databases , XML table creation, XQuery FLWOR expression

8. Mobile Database Query Processing using open source DB (MongoDB/MySQL etc)

                                                              TOTAL: 60 PERIODS

SOFTWARE REQUIREMENTS

1. Java / Python / R / Scala

2. Oracle, MySQL, MongoDB, Casandra, Hive, OrientDB

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

 CO1: Design and implement advanced databases.

CO2: Use big data frameworks and tools.

CO3: Formulate complex queries using SQL.

CO4: Create an XML document and perform Xquery.

CO5: Query processing in Mobile databases using open source tools.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	2	2	2
CO2	2	1	2	2	2	2
CO3	2	1	2	2	2	2
CO4	2	1	2	2	2	2
CO5	2	1	2	2	2	2
AVG	2	1	2	2	2	2

MC4167	PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To Implement python program with conditionals and loops
- Use of functions for structures python programs
- Able to know the compound data using python lists, tuples and dictionaries
- Understand about how to read and write data using files
- Knowing about Object Oriented Concepts

LIST OF EXPERIMENTS:

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines.

1. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
2. Scientific problems using Conditionals and Iterative loops.
3. Linear search and Binary search
4. Selection sort, Insertion sort
5. Merge sort, Quick Sort
6. Implementing applications using Lists, Tuples.
7. Implementing applications using Sets, Dictionaries.
8. Implementing programs using Functions.
9. Implementing programs using Strings.
10. Implementing programs using written modules and Python Standard Libraries (pandas,numpy, Matplotlib, scipy)
11. Implementing real-time/technical applications using File handling.
12. Implementing real-time/technical applications using Exception handling.
13. Creating and Instantiating classes

TOTAL: 60 PERIODS

HARDWARE/SOFTWARE REQUIREMENTS

1. Processors: Intel Atom® processor Intel®Core™i3 processor
2. Disk space: 1GB.
3. Operating systems: Windows 7,macOS and Linux
4. Python versions:2.7, 3.6, 3.8

REFERENCE:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.
2. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
3. David M.Beazley "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009.
4. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1,2013).
5. http://www.edx.org/

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Apply the Python language syntax including control statements, loops and functions to solve a wide variety of problems in mathematics and science.

CO2: Use the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data.

CO3: Create files and perform read and write operations.

CO4: Illustrate the application of python libraries.

CO5: Handle exceptions and create classes and objects for any real time applications.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	3	3	2	2
CO2	2	1	3	3	2	2
CO3	1	1	3	2	2	2
CO4	2	1	3	2	2	2
CO5	2	1	3	3	2	3
AVG	1.8	1	3	2.6	2	2.2

MC4261	FULL-STACK WEB DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of web programming and client-side scripting.
- To learn server-side development using NodeJS.
- To understand and architect databases using NoSQL and SQL databases.
- To learn the advanced client-side scripting and ReactJS framework.
- To understand DevOps and Deployment of Web Applications.

UNIT I   INTRODUCTION TO CSS and JAVASCRIPT   9

Introduction to Web: Server - Client - Communication Protocol (HTTP) – Structure of HTML Documents – Basic Markup tags – Working with Text and Images with CSS– CSS Selectors – CSS Flexbox - JavaScript: Data Types and Variables - Functions - Events – AJAX: GET and POST

UNIT II   SERVER-SIDE PROGRAMMING WITH NODE JS   9

Introduction to Web Servers – JavaScript in the Desktop with NodeJS – NPM – Serving files with the http module – Introduction to the Express framework – Server-side rendering with Templating Engines – Static Files - async/await - Fetching JSON from Express

UNIT III   ADVANCED NODE JS AND DATABASE   9

Introduction to NoSQL databases – MongoDB system overview - Basic querying with MongoDB shell – Request body parsing in Express – NodeJS MongoDB connection – Adding and retrieving data to MongoDB from NodeJS – Handling SQL databases from NodeJS – Handling Cookies in NodeJS – Handling User Authentication with NodeJS

UNIT IV   ADVANCED CLIENT-SIDE PROGRAMMING   9

React JS: React DOM - JSX - Components - Properties – Fetch API - State and Lifecycle -JS Local storage - Events - Lifting State Up - Composition and Inheritance

UNIT V   APP IMPLEMENTATION IN CLOUD   9

Cloud providers Overview – Virtual Private Cloud – Scaling (Horizontal and Vertical) –Virtual Machines, Ethernet and Switches – Docker Container – Kubernetes – DevOps and Deployment - Deploying MEAN stack applications to hosting platforms.

TOTAL: 45 PERIODS

Text Book

1. Greg Lim, Beginning MERN Stack Development, Amazon Digital Services LLC - Kdp, 2021,ISBN,9798523625503
2. MERN Quick Start Guide: Build web applications with MongoDB, Express.js, React, and Node 1st Edition, Eddy Wilson Iriarte Koroliova, Packt Publishing,2018

REFERENCES:

1. Philip Ackermann, "JavaScript: The Comprehensive Guide", Sap Pr America, 2022, ISBN-13: 978-1493222865.
2. Craig Buckler , "Node.js: Novice to Ninja", SitePoint, 2022, 9781925836523.
3. Mayur Patil, "React.js For Beginners", Notion Press, 2023, ISBN-13 : 979-8889355106.
4. Marc Wandschneider, "Learning Node", Addison-Wesley Professional, 2nd Edition, 2016.
5. Joe Beda, Kelsey Hightower, Brendan Burns, "Kubernetes: Up and Running", O'ReillyMedia, 1st edition, 2017.
6. Joe Paul Zikopoulos, Christopher Bienko, Chris Backer, Chris Konarski, Sai Vennam, "Cloud Paul Without Compromise", O'Reilly Media, 1st edition, 2021.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Write client-side scripting HTML, CSS and JS.

CO2: Implement and architect the server side of the web application.

CO3: Implement Web Application using NodeJS.

CO4: Architect NoSQL databases with MongoDB.

CO5: Implement a full-stack Single Page Application using React, NodeJS and MongoDB and deploy on Cloud.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	1	2	2	2	2
CO2	2	1	2	2	2	2
CO3	2	1	3	2	3	2
CO4	2	1	3	2	3	3
CO5	2	1	3	2	3	3
AVG	1.8	1	2.6	2	2.6	2.4

MC4262	CLOUD COMPUTING AND MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To gain the fundamental concepts, key technologies, strengths, and limitations of cloud computing, and deploy applications on commercial cloud infrastructures.
- To acquire knowledge about cloud computing and virtualization, including the process of migration to the cloud.
- To select appropriate technologies, algorithms, and approaches for implementing a cloud environment using OpenStack, AWS, and Google App Engine.
- To design mobile applications that are mindful of the resource constraints of mobile devices.
- To understand the complexities of deploying cellular networks and developing mobile applications using resilient programming practices.

UNIT I   INTRODUCTION TO CLOUD COMPUTING   9

Introduction- Evolution-Characteristics -Elasticity in Cloud – On-demand Provisioning – NIST Reference Architecture -Architectural Design Challenges – Cloud Deployment Models –Cloud Service Models- Benefits of Cloud Computing – Overview of Cloud Standards.

UNIT II   CLOUD ENABLING TECHNOLOGIES   9

Basics of Virtualization – Full and Para Virtualization- Implementation Levels of Virtualization – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Desktop Virtualization – Server Virtualization – Application and Database Virtualization with Multitenancy – Virtual Desktop Infrastructure – Docker Containers.

UNIT III   CLOUD SOFTWARE AND COMPUTING PLATFORMS   9

Google App Engine (GAE) – Programming Environment for GAE – Google Cloud Platform – AWS– OpenStack – VMWARE.

UNIT IV   APPLICATION DESIGN   9

Mobile Memory Management – Design Patterns for Limited Memory – Work Flow for Application Development – Techniques for Composing Applications – Dynamic Linking – Plug-ins and Rule of Thumb for Using DLLs – Concurrency and Resource Management.

UNIT V   APPLICATION DEVELOPMENT   9

Android Application Architecture – Event Based Programming – iOS Platform -Event Handling and Graphics Services – Layer Animation – Location Based Services – Resilient Programming Practices – Packaging and Deployment – Security And Hacking.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kai Hwang, Geofrey C. Fox and Jack J. Dongarra, Distributed and Cloud Computing, Morgan Kaufmann, First Edition, 2012. [Unit 1,2,3 eBook Available]
2. Tommi Mikkonen, Programming Mobile Devices an introduction for practitioners, John Wiley and Sons Ltd, 2007 - [Unit 4 eBook Available]
3. Reto Meier, PROFESSIONAL Android™ 4 Application Development , John Wiley and Sons Ltd,2012- [Unit 5 eBook Available]
4. Rajkumar Buyya, Christian Vacchiola, S.ThamaraiSelvi, Mastering Cloud Computing, MCGrawHill Education (India) Pvt. Ltd., 2013.

REFERENCES:

1. Bernard Golden, Amazon Web Service for Dummies, John Wiley & Sons, 2013.
2. Raoul Alongi, AWS: The Most Complete Guide to Amazon Web Service from Beginner to Advanced Level, Amazon Asia- Pacific Holdings Private Limited, 2019.
3. Sriram Krishnan, Programming: Windows Azure, O'Reilly, 2010.
4. Danielle Ruest, Nelson Ruest, ¯Virtualization: A Beginner"s Guide, McGraw-Hill Osborne Media, 2009.
5. John W.Ritting house and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Articulate the main concepts, key technologies, strengths and limitations of cloud computing and deploy applications over commercial cloud computing infrastructures.

CO2: Gain knowledge about cloud & virtualization along with how one can migrate over it.

CO3: Choose the appropriate technologies, algorithms and approaches for Implementation of cloud environment using Openstack, AWS and Google App engine.

CO4: Design the mobile applications that are aware of the resource constraints of mobile devices.

CO5: Understand the intricacies in deploying cellular networks and developing mobile applications based on resilient programming practices.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	3	1	2	3	2	3
CO2	2	1	2	3	2	3
CO3	2	1	3	3	2	3
CO4	3	1	3	3	3	1
CO5	3	3	3	2	3	3
AVG	2.6	1.4	2.6	2.8	2.4	2.6

MC4263　　　　　　　　**ADVANCED DATA SCIENCE**　　　　　L　T　P　C
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3　0　0　3

COURSE OBJECTIVES:

- Be exposed to basic introduction of big data.
- To impart necessary knowledge of the mathematical foundations.
- Be familiar with basic concepts on Machine Learning.
- Learn the different classification algorithm for appropriate decision making.
- To learn the tools to implement Data science and its application.

UNIT I　　　INTRODUCTION TO DATA SCIENCE　　　　　　　　　　9

Introduction to Data Science-Concept of Data Science-Traits of Big data-Web Scraping - Analysis vs reporting

UNIT II　　　MATHEMATICAL FOUNDATIONS　　　　　　　　　　　9

Linear Algebra: Vectors, Matrices- Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox-Correlation and Causation- Probability: Dependence and Independence, Conditional Probability, Bayes's-Theorem, Random Variables-Continuous Distributions- the Normal Distribution the Central Limit Theorem.

UNIT III　　　MACHINE LEARNING　　　　　　　　　　　　　　　9

Overview of Machine learning concepts –Types of Machine learning - Linear Regression model assumptions-Classification and Regression algorithms- Naïve Bayes, K-Nearest Neighbors, logistic regression- support vector machines (SVM), decision trees, and random forest.

UNIT IV　　　PROGRAMMING TOOLS FOR DATA SCIENCE　　　　　9

Introduction to Programming Tools for Data Science-Toolkits using Python: Matplotlib, NumPy, Scikit- learn, Visualizing Data: Bar Charts, Line Charts and Scatterplots - Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs).

UNIT V　　　CASE STUDIES OF DATA SCIENCE APPLICATION　　　9

Weather forecasting-Stock market prediction-Object recognition- Real Time Sentiment Analysis

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media First edition(April 30, 2015) [eBook available]
2. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn and Tensor Flow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, 2017, O'Reilly Media.

REFERENCES:

1. Stephen Marsland, Machine learning: An Algorithmic Perspective‖, CRC Press, Second Edition, 2009.
2. G. Strang (2016) Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA.
3. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press, First Edition (November 18, 2016)
4. Montgomery, D. C. and G. C. Runger (2011). Applied Statistics and Probability for Engineers.5th Edition. John Wiley & Sons, Inc., NY, USA.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Basic foundations of Big Data.

CO2: Demonstrate understanding of the mathematical foundations needed for data science.

CO3: Implement models such as k-nearest Neighbors, Naive Bayes, linear and logistic Regression, decision trees.

CO4: Build data science applications using Python based toolkits.

CO5: Familiar in Data science applications and implementation.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	-	-	-	-	2	-
CO2	3	-	3	-	-	-
CO3	-	-	-	2	-	-
CO4	3	-	-	-	3	-
CO5	-	-	-	-	2	2
AVG	1.2	-	0.6	0.4	1.4	0.4

MC4264   CYBER SECURITY   L   T   P   C
                                                                            3   0   0   3

COURSE OBJECTIVES:

- To learn the principles of cyber security and to identify threats and risks.
- To learn how to secure physical assets and develop system security controls.
- To understand how to apply security for Business applications and Network Communications.
- To learn the technical means to achieve security.
- To learn to monitor and audit security measures.

UNIT I   PLANNING FOR CYBER SECURITY   9

Best Practices-Standards and a plan of Action-Security Governance Principles, components and Approach-Information Risk Management-Asset Identification-Threat Identification-Vulnerability Identification-Risk Assessment Approaches-Likelihood and Impact Assessment-Risk Determination, Evaluation and Treatment-Security Management Function-Security Policy-Acceptable Use Policy- Security Management Best Practices - Security Models: Bell La Padula model, Biba Integrity Model - Chinese Wall model

UNIT II   SECURITY CONTROLS   9

People Management-Human Resource Security-Security Awareness and Education - Information Management- Information Classification and handling-Privacy-Documents and Record Management- Physical Asset Management-Office Equipment-Industrial Control Systems-Mobile Device Security- System Development-Incorporating Security into SDLC - Disaster management and Incident response planning.

UNIT III   CYBER SECURITY FOR BUSINESS APPLICATIONS AND NETWORKS   9

Business Application Management-Corporate Business Application Security-End user Developed Applications-System Access- Authentication Mechanisms-Access Control System Management- Virtual Servers-Network Storage Systems-Network Management Concepts-Firewall-IP Security- Electronic Communications - Case study on OWASP Vulnerabilities using OWASP ZAP tool.

UNIT IV   TECHNICAL SECURITY   9

Supply Chain Management-Cloud Security-Security Architecture-Malware Protection - Intrusion Detection-Digital Rights Management-Cryptographic Techniques-Threat and Incident Management- Vulnerability Management-Security Event Management-Forensic Investigations-Local Environment Management-Business Continuity.

UNIT V   SECURITY ASSESSMENT   9

Security Monitoring and Improvement-Security Audit-Security Performance-Information Risk Reporting-Information Security Compliance Monitoring- Securing cloud-based resources and services. Tokenization - Security Protocols - Security Monitoring and Improvement Best practices.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Jason Edwards, Griffin Weaver "The Cybersecurity Guide to Governance, Risk, and Compliance" Released May 2024, Publisher(s): Wiley, ISBN: 9781394250196.
2. David Sutton , "Cyber Security: The complete guide to cyber threats and protection", Released 2022 , Second Edition, Publisher(s): BCS, The Chartered Institute for IT.

REFERENCES

1. William Stallings, "Effective Cyber Security - A guide to using Best Practices and Standards", Addison-Wesley Professional, First Edition, 2019.
2. Raef Meeuwisse, "Cyber Security for Beginners", Second Edition, Cyber Simplicity Ltd, 2017.
3. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, 2015

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Develop a set of risk and security requirements to ensure that there are no gaps in an Organization's security practices.

CO2: Achieve management, operational and technical means for effective cyber security.

CO3: Audit and monitor the performance of cyber security controls.

CO4: Spot gaps in the system and devise improvements.

CO5: Identify and report vulnerabilities in the system.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	2	2	2
CO2	2	1	2	2	2	2
CO3	2	1	2	2	2	2
CO4	2	1	2	2	2	2
CO5	2	1	2	2	2	2
AVG	2	1	2	2	2	2

MC4265   **OBJECT ORIENTED SOFTWARE ENGINEERING**   L   T   P   C
                                                                       3   0   0   3

COURSE OBJECTIVES:

- To understand the phases in object oriented software development.
- To gain fundamental concepts of requirements engineering and analysis.
- To know about the different approach for object oriented design and its methods.
- To learn about how to perform object oriented testing and how to maintain software.
- To provide various quality metrics and to ensure risk management.

UNIT I   SOFTWARE DEVELOPMENT AND PROCESS MODELS   9

Introduction to Software Development – Challenges – An Engineering Perspective – Object Orientation – Software Development Process – Iterative Development Process – Process Models– Life Cycle Models – Unified Process – Iterative and Incremental – Agile Processes.

UNIT II   MODELING OO SYSTEMS   9

Object Oriented Analysis (OOA / Coad-Yourdon), Object Oriented Design (OOD/Booch), Hierarchical Object Oriented Design (HOOD), Object Modeling Technique (OMT) – Requirement Elicitation – Use Cases – SRS Document – OOA - Identification of Classes and Relationships, Identifying State and Behavior – OOD - Interaction Diagrams – Sequence Diagram – Collaboration Diagrams – Unified Modeling Language and Tools.

UNIT III   DESIGN PATTERNS   9

Design Principles – Design Patterns – GRASP – GoF – Dynamic Object Modeling –
Static Object Modeling.

UNIT IV   SYSTEM TESTING   9

Software testing: Software Verification Techniques – Object Oriented Checklist:- Functional Testing – Structural Testing – Class Testing – Mutation Testing – Levels of Testing – Static and Dynamic Testing Tools - Software Maintenance – Categories – Challenges of Software Maintenance – Maintenance of Object Oriented Software – Regression Testing

UNIT V   SOFTWARE QUALITY AND METRICS   9

Need of Object Oriented Software Estimation – Lorenz and Kidd Estimation – Use Case Points Method – Class Point Method – Object Oriented Function Point – Risk Management – Software Quality Models – Analyzing the Metric Data – Metrics for Measuring Size and Structure – Measuring Software Quality - Object Oriented Metrics

                                                    TOTAL: 45 PERIODS

REFERENCES:

1. Yogesh Singh, Ruchika Malhotra, " Object – Oriented Software Engineering", PHI Learning Private Limited ,First edition,2012
2. Ivar Jacobson. Magnus Christerson, PatrikJonsson, Gunnar Overgaard, "Object Oriented Software Engineering, A Use Case Driven Approach", Pearson Education, Seventh Impression, 2009
3. Craig Larman, "Applying UML and Patterns, an Introduction to Object-Oriented Analysis and Design and Iterative Development", Pearson Education, Third Edition, 2008.
4. Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Jim Conallen Kelli A. Houston, "Object Oriented Analysis & Design with Applications, Third Edition, Pearson Education, 2010
5. Roger S. Pressman, "Software Engineering: A Practitioner's Approach, Tata McGrawHill Education, 8th Edition, 2015

COURSE OUTCOMES (COs):

On completion of the course the student would be able to :

CO1: Design object oriented software using appropriate process models. Differentiate software process1es under waterfall and agile methodology.

CO2: Design and Develop UML diagrams for software projects and object orient analysis.

CO3: Apply Design Patterns for a software process.

CO4: Categorize testing methods and compare different testing tools for software processes.

CO5: Analyze object oriented metrics and quality for software engineering processes.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	3	3	2	2
CO2	2	1	3	2	2	2
CO3	2	1	3	3	2	2
CO4	2	1	3	3	1	2
CO5	2	1	3	3	3	2
AVG	2	1	3	2.8	2	2

MC4266   FULL STACK WEB DEVELOPMENT LABORATORY   L   T   P   C
                                                          0   0   4   2

COURSE OBJECTIVES:

- To implement the client side of the web application using javascript.
- To understand Javascript on the desktop using NodeJS.
- To develop a web application using NodeJS and Express.
- To implement a SPA using React.
- To develop a full stack single page application using React, NodeJS, and a Database (MongoDB or SQL).

LIST OF EXPERIMENTS:

1. Create a form and validate the contents of the form using JavaScript.
2. Get data using Fetch API from an open-source endpoint and display the contents in the form of a card.
3. Create a NodeJS server that serves static HTML and CSS files to the user without using express.
4. Create a NodeJS server using Express that stores data from a form as a JSON file and displays it in another page. The redirect page should be prepared using Handlebars.
5. Create a NodeJS server using Express that creates, reads, updates and deletes students' details and stores them in MongoDB database. The information about the user should be obtained from a HTML form.
6. Create a NodeJS server that creates, reads, updates and deletes event details and stores them in a MySQL database. The information about the user should be obtained from a HTML form.
7. Create a counter using ReactJS
8. Create a to do application using ReactJS. Store the data to a JSON file using a simple NodeJS server and retrieve the information from the same during page reloads.
9. Create a simple Sign up and Login mechanism and authenticate the user using cookies.The user information can be stored in either MongoDB or MySQL and the server should be built using NodeJS and Express Framework.
10. Create and deploy a virtual machine using a virtual box that can be accessed from the host computer using SSH.
11. Create a docker container that will deploy a NodeJS ping server using the NodeJS image.

TOTAL: 60 PERIODS

SOFTWARE REQUIREMENTS

1. NodeJS/Express JS, ReactJS, Docker any IDE like NOTEPAD++/visualstudio code/ sublime text etc.,
2. MySQL, MongoDB

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: To implement and deploy the client side of the web application.

CO2: To develop and deploy server side applications using NodeJS.

CO3: To use Express framework in web development.

CO4: To implement and architect database systems in both NoSQL and SQL environments.

CO5: To develop a full stack single page application using React, NodeJS, and a Database and deploy using containers.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	3	1	3	2	3	3
CO2	2	1	2	2	3	3
CO3	2	1	2	2	3	2
CO4	2	1	3	2	2	3
CO5	2	1	2	2	2	2
AVG	2.2	1	2.4	2	2.6	2.6

MC4267   MOBILE APPLICATION DEVELOPMENT LABORATORY   L   T   P   C
**   0   0   4   2**

COURSE OBJECTIVES:

Students will able to know the

- Installation and configuration of Android sdk
- Application development using Android -layout and event handling
- Application using SQL Lite and Fire base database
- Knowledge about Google play services and geolocation using GPS tracking

LIST OF EXPERIMENTS:

1. Install and configure Java Development Kit (JDK), android studio and android SDK.
2. Develop an application that uses GUI components, fonts and colours.
3. Design an application that uses Layout Managers, Event listeners, Event handling and push notification in Android.
4. Build a simple native calculator application to do simple arithmetic operations.
5. Create animations and graphical primitives in Android environment.
6. Develop an application that makes use of SQL Lite mobile database.
7. Develop an application that makes use of internet for communication using Firebase to send SMS and E-Mail services.
8. Implement an android application that writes data into the SD card and makes use of Notification Manager.
9. Develop a native application that uses Location based services such as GPS tracking, Geo fencing and activity recognition using Google play services.
10. Implement simple gaming application using open-source tools like flutter or Unity.
11. Creating and Executing Your First Container Using Docker
12. Install Google App Engine. Create "hello world" app and other simple web applications using python.

TOTAL: 60 PERIODS

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

    CO1: Design the right user interface for mobile application.

    CO2: Implement mobile application using UI toolkits and frameworks.

    CO3: Design mobile applications that are aware of the resource constraints of mobile devices.

    CO4: Develop web based mobile application that accesses internet and location data.

    CO5: Implement android application with multimedia support.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3		3	2	2	2
CO2	3		3	3	2	2
CO3	3		3	3	2	2
CO4	3	1	3	3	2	2
CO5	3		3	3	2	2
AVG	3	0.2	3	2.8	2	2

EN4247   **COMMUNICATION SKILLS ENHANCEMENT – I**   **L   T   P   C**
                                                                0   0   2   1

COURSE OBJECTIVES:

- To provide opportunities to learners to practice English and thereby make them proficient users of the language.
- To enable learners to fine-tune their linguistic skills (LSRW) with the help of technology.
- To improve the performance of students' listening, speaking, reading and writing skills and thereby enhance their career opportunities.

LIST OF ACTIVITIES:

1. Listening:
   - Listening and practicing neutral accents
   - Listening to short talks and lectures and completing listening comprehension exercises
   - Listening to TED Talks

2. Speaking:
   - Giving one minute talks
   - Participating in small Group Discussions
   - Making Presentations

3. Reading:
   - Reading Comprehension
   - Reading subject specific material
   - Technical Vocabulary

4. Writing:
   - Formal vs Informal Writing
   - Paragraph Writing
   - Essay Writing
   - Email Writing

TOTAL: 30 PERIODS

REFERENCES / MANUALS / SOFTWARE: Open Sources / websites

COURSE OUTCOMES (COs):

On completion of the course, the students will be able to:

   CO1: Listen and comprehend lectures in English.

   CO2: Articulate well and give presentations clearly.

   CO3: Communicate effectively in formal and informal reading.

   CO4: Write proficient essays and emails.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	2	2	1	1	1
CO2	1	3	2	1	1	1
CO3	1	2	3	1	1	1
CO4	1	3	2	1	1	1
AVG	0.8	2	1.8	0.8	0.8	0.8

MC4361   **MACHINE LEARNING**   L   T   P   C
                                                                    3   0   0   3

COURSE OBJECTIVES:

- To gain knowledge on foundations of machine learning and apply suitable.
- Dimensionality reduction techniques for an application.
- To select the appropriate model and use feature engineering techniques.
- To gain knowledge on Probability and Bayesian Learning to solve the given problem.
- To design and implement the machine learning techniques for real world problems.
- To analyze, learn and classify complex data without predefined models.

UNIT I   INTRODUCTION   9

Human Learning - Types – Machine Learning - Types - Problems not to be solved - Applications - Languages/Tools- Issues. Preparing to Model: Introduction – Machine Learning Activities - Types of data - Exploring structure of data - Data quality and remediation - Data Pre-processing

UNIT II   MODEL EVALUATION AND FEATURE ENGINEERING   9

Model Selection - Training Model - Model Representation and Interpretability – Evaluating Performance of a Model - Improving Performance of a Model - Feature Engineering: Feature Transformation - Feature Subset Selection

UNIT III   BAYESIAN LEARNING   9

Basic Probability Notation- Inference – Independence - Bayes' Rule. Bayesian Learning: Maximum Likelihood and Least Squared error hypothesis-Maximum Likelihood hypotheses for predicting probabilities- Minimum description Length principle -Bayes optimal classifier - Naïve Bayes classifier - Bayesian Belief networks -EM algorithm.

UNIT IV   PARAMETRIC MACHINE LEARNING   9

Logistic Regression: Classification and representation – Cost function - Gradient descent – Advanced optimization – Regularization - Solving the problems on overfitting. Perceptron – Neural Networks – Multi - class Classification - Backpropagation – Nonlinearity with activation functions (Tanh, Sigmoid, Relu, PRelu) - Dropout as regularization

UNIT V   NON PARAMETRIC MACHINE LEARNING   9

k- Nearest Neighbors- Decision Trees – Branching – Greedy Algorithm – Multiple Branches – Continuous attributes – Pruning. Random Forests: ensemble learning. Boosting – Adaboost algorithm. Support Vector Machines – Large Margin Intuition – Loss Function - Hinge Loss – SVM Kernels

                                                              TOTAL: 45 PERIODS

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", Third Edition, MIT Press, 2014
2. Tom M. Mitchell, "Machine Learning", India Edition, 1st Edition, McGraw-Hill Education Private Limited, 2013
3. Saikat Dutt, Subramanian Chandramouli and Amit Kumar Das, "Machine Learning", 1st Edition, Pearson Education, 2019
4. Christopher M. Bishop, "Pattern Recognition and Machine Learning", Revised Edition, Springer, 2016.
5. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow",2nd Edition, O"Reilly, 2019
6. Stephen Marsland, "Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Understand about Data Preprocessing, Dimensionality reduction.

CO2: Apply proper model for the given problem and use feature engineering techniques.

CO3: Make use of Probability Technique to solve the given problem.

CO4: Analyze the working model and features of Decision tree.

CO5: Choose and apply appropriate algorithm to learn and classify the data.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	1	2	2	2	2
CO2	1	1	2	2	2	2
CO3	2	1	2	2	2	2
CO4	2	1	2	2	2	2
CO5	2	1	2	2	2	2
AVG	1.6	1	2	2	2	2

MC4362   **INTERNET OF THINGS**   L T P C
                                                                       3 0 0 3

COURSE OBJECTIVES:

- To understand the concepts of IoT and its working models
- To know the various IoT protocols
- To understand about various IoT Physical devices and Endpoints
- To know the security and privacy issues connected with IoT
- To apply the concept of Internet of Things in a real world scenario

UNIT I   FUNDAMENTALS OF IOT   9

Definition and Characteristics of IoT, Sensors, Actuators, Physical Design of IoT – IoT Protocols, IoT communication models, IoT Communication APIs, IoT enabled Technologies – Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture and Industry.

UNIT II   IOT PROTOCOLS   9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4-BACNet Protocol- Modbus – KNX – Zigbee- Network layer – APS layer – Security

UNIT III   IOT PHYSICAL DEVICES AND ENDPOINTS   9

Introduction to Arduino and Raspberry Pi - Installation, Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, and reading input from pins.

UNIT IV   INTERNET OF THINGS PRIVACY, SECURITY AND   9
GOVERNANCE

Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

UNIT V   APPLICATIONS   9

IOT APPLICATIONS - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra

SUGGESTED ACTIVITIES:

1: Study of 5 different types of sensors and actuators available in Market
2: Study of commercial IoT available in any one domain
3: Study the recent developments in IoT Protocol
4: Implement simple Python programs for IoT
5: Study on the latest government policies on IoT security and Privacy
6: A study on how to use IoT to solve some problems in your neighborhood

TOTAL: 45 PERIODS

REFERENCES:

1. Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012. .
3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, "IoT Fundamentals, Networking Technologies, Protocols, and Use cases for the Internet of Things", Cisco Press, First Edition, 2017.
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet Of Things", Springer, 2011
5. Raspberry Pi Cookbook, Software and Hardware Problems and solutions, Simon Monk,O'Reilly (SPD), 2016, ISBN 7989352133895
6. Peter Friess,'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Define the infrastructure for supporting IoT deployments.

CO2: Understand the usage of IoT protocols for communication between various IoT Devices.

CO3: Design portable IoT using Arduino/Raspberry Pi /equivalent boards.

CO4: Understand the basic concepts of security and governance as applied to IoT.

CO5: Analyze and illustrate applications of IoT in real time scenarios.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	2	2	2
CO2	2	1	2	2	2	2
CO3	2	1	3	2	2	3
CO4	2	1	2	2	2	2
CO5	2	1	3	2	2	3
AVG	2	1	2.4	2	2	2.4

MC4363   **MACHINE LEARNING LABORATORY**   L   T   P   C
                                                          0   0   4   2

COURSE OBJECTIVES:

- To understand about data cleaning and data preprocessing.
- To familiarize with the Supervised Learning algorithms and implement them in practical situations.
- To familiarize with unsupervised Learning algorithms and carry on the implementation part.
- To involve the students to practice ML algorithms and techniques.
- Learn to use algorithms for real time data sets.

LIST OF EXPERIMENTS:

1. Demonstrate how do you structure data in Machine Learning
2. Implement data preprocessing techniques on real time dataset
3. Implement Feature subset selection techniques
4. Demonstrate how will you measure the performance of a machine learning model
5. Write a program to implement the naïve Bayesian classifier for a sample training data set. Compute the accuracy of the classifier, considering few test data sets.
6. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using the standard Heart Disease Data Set.
7. Apply EM algorithm to cluster a set of data stored in a .CSV file.
8. Write a program to implement k-Nearest Neighbor algorithm to classify the dataset.
9. Apply the technique of pruning for a noisy data monk2 data, and derive the decision tree from this data. Analyze the results by comparing the structure of pruned and unpruned tree.
10. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
11. Implement Support Vector Classification for linear kernels.
12. Implement Logistic Regression to classify problems such as spam detection. Diabetes predictions and so on.

TOTAL: 60 PERIODS

LAB SOFTWARE REQUIREMENTS:

Python or any ML tools like R

COURSE OUTCOMES (COs):

On completion of the laboratory course, the student should be able to

    CO1: Apply data preprocessing technique and explore the structure of data to prepare for
        predictive modeling.

    CO2: Understand how to select and train a model and measure the performance.

    CO3: Apply feature selection techniques in Machine Learning.

    CO4: Construct Bayesian Network for appropriate problem.

    CO5: Learn about parametric and non-parametric machine Learning algorithms and
        implement to practical situations.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	2	2	2
CO2	2	1	2	2	2	2
CO3	2	1	2	2	2	2
CO4	2	1	2	2	2	2
CO5	2	1	2	2	2	2
AVG	2	1	2	2	2	2

MC4364   **INTERNET OF THINGS LABORATORY**   L   T   P   C
                                                               0   0   4   2

COURSE OBJECTIVES:
- To design applications to interact with sensors.
- To design and develop IoT application Arduino/Raspberry pi for real world scenario.
- To enable communication between IoT and cloud platforms.
- To develop applications using Django Framework.

LIST OF EXPERIMENTS:

1. To study various IoT protocols – 6LowPAN, IPv4/IPv6, Wifi, Bluetooth, MQTT.
2. IoT Application Development Using sensors and actuators (temperature sensor, light sensor, infrared sensor)
3. To study Raspberry Pi development board and to implement LED blinking applications.
4. To develop an application to send and receive data with Arduino using HTTP request
5. To develop an application that measures the room temperature and posts the temperature value on the cloud platform.
6. To develop an application that measures the moisture of soil and post the sensed data over Google Firebase cloud platform.
7. To develop an application for measuring the distance using ultrasonic sensor and post distance value on Google Cloud IoT platform
8. Develop a simple application based on sensors.
9. Develop IoT applications using Django Framework and Firebase/ Bluemix platform.
10. Develop a commercial IoT application.

TOTAL: 60 PERIODS

HARDWARE/SOFTWARE REQUIREMENTS:

1. The universal microcontroller development board
2. 8051 Daughter Board
3. Raspberry Pi 3B+ Original
4. Arduino Daughter Board
5. Humidity + IR Sensor Interface
6. Ultrasonic Sensors
7. Open source software's Django Framework
8. Open cloud architectures like Bluemix, Development platforms like Firebase

COURSE OUTCOMES (COs):

On completion of the laboratory course, the student should be able to

CO1: To understand the various IoT protocols.

CO2: Test and experiment different sensors for application development.

CO3: To develop applications using Arduino/Raspberry Pi/ Equivalent boards.

CO4: To develop applications that would read the sensor data and post it in Cloud.

CO5: Develop IOT applications with different platforms and frameworks.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	2	2	2
CO2	2	1	2	2	2	2
CO3	2	1	2	2	2	2
CO4	2	1	2	2	2	2
CO5	2	1	2	2	2	2
AVG	2	1	2	2	2	2

EN4348   **COMMUNICATION SKILLS ENHANCEMENT – II**   **L   T   P   C**
                                                                   0   0   2   1

COURSE OBJECTIVES:

- To provide opportunities to learners to practice their communication skills to make them become proficient users of English.
- To enable learners to fine-tune their linguistic skills (LSRW) with the help of Technology to communicate globally.
- To enhance the performance of learners at placement interviews and group discussions and other recruitment procedures.

LIST OF ACTIVITIES:

1. SOFT SKILLS
   - People skills
   - Interpersonal skills
   - Team building skills
   - Leadership skills
   - Problem solving skills

2. PRESENTATION SKILLS
   - Preparing slides with animation related to the topic
   - Introducing oneself to the audience
   - Introducing the topic
   - Presenting the visuals effectively – 5 minute presentation

3. GROUP DISCUSSION SKILLS
   - Participating in group discussions
   - Brainstorming the topic
   - Activities to improve GD skills.

4. INTERVIEW SKILLS
   - Interview etiquette – dress code – body language
   - Attending job interviews
   - Answering questions confidently
   - Technical interview – telephone/Skype interview
   - Emotional and cultural intelligence
   - Stress Interview

TOTAL: 30 PERIODS

REFERENCES / MANUALS / SOFTWARE:

Open Sources / websites

COURSE OUTCOMES (COs):

On completion of the laboratory course, the student should be able to

CO1: Students will be able to improve the problem solving skills.

CO2: Students will make effective presentations.

CO3: Students will be able to participate in Group discussions with confidence.

CO4: Students will be able to perform well in the interviews.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	2	1	1	1
CO2	1	3	2	1	1	1
CO3	1	2	3	1	1	1
CO4	1	3	2	1	1	1
AVG	1	2.5	2.25	1	1	1

PMC101   **ARTIFICIAL INTELLIGENCE FOR SOCIAL GOOD**   L T P C
                                                                  3 0 0 3

COURSE OBJECTIVES:

- To understand the fundamental concepts and principles of artificial intelligence.
- To explore the applications of AI in addressing social, environmental, and humanitarian challenges.
- To learn how to design and implement AI solutions that promote social good.
- To investigate case studies where AI has been successfully applied for social impact.
- To evaluate the potential benefits and risks associated with AI technologies in societal contexts.
- To encourage critical thinking and problem-solving skills in the context of AI for social betterment.

UNIT I   INTRODUCTION   9

Introduction, Logistics, Course Project, Basics of Optimization, Convex optimization, Linear Programming (LP) and Mixed Integer Linear Programming (MILP), Conservation Planning, Wild life corridor design, Basics of Regression and Classification, Linear and Logistic Regression, Kernel Regression, Decision Trees, Data-based Prediction

UNIT II   BASICS OF REINFORCEMENT LEARNING   9

Food rescue, detecting social bots on Twitter, Basics of Game Theory, Cover: Equilibrium concepts, Security Games, Bayesian Persuasion and Security Games, Autonomous Driving, Basics of Reinforcement Learning, Markov Decision Process (MDP), Q-Learning, Policy Gradient, Reinforcement Learning for Bike Repositioning

UNIT III   BASICS OF DEEP LEARNING   9

AI and Ethics and Policy, Basics of Deep Learning, Feedforward Neural Networks, Convolutional Neural Networks, Learning from Remote Sensing Data, Poverty and crop yield prediction

UNIT IV   INFLUENCE MAXIMIZATION   9

Basics of Influence Maximization, Influence propagation models, submodular function optimization, Dynamic Influence Maximization under Uncertainty, AI/ML/DS for social good: opportunities and challenges, Mixture Models and Probabilistic Graphical Models, Gaussian Mixture Models (GMMs),Dynamic Bayesian Networks (DBNs), Markov Random Fields (MRFs), Response to COVID-19

UNIT V   R-CNN   9

Cover: Object detection using Faster R-CNN, Detect human and wildlife from video data, Coordinate drone patrol and human patrol

TOTAL: 45 PERIODS

REFERENCES:

1. Artificial Intelligence and Social Work Edited by MilindTambe, Eric Rice, Cambridge University Press.
2. Artificial Intelligence and Conservation Edited by Fei Fang, MilindTambe, BistraDilkina, Andrew J.Plumptre, Cambridge University Press

Reference Link : http://www.andrew.cmu.edu/user/feif/08737S18/08737_S18_Syllabus.pdf

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: To understand artificial intelligence concepts and range of problems that can be handled by machine learning and deep learning.

CO2: To develop knowledge of decision making and learning methods.

CO3: To expose students to the frontiers of AI-intensive computing and information systems.

CO4: To describe and list the key aspects of planning in artificial intelligence.

CO5: To provide a sufficiently strong foundation to encourage further research.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	1	2	1
CO2	2	1	2	1	2	1
CO3	2	1	1	2	2	2
CO4	1	1	1	2	2	1
CO5	1	1	2	1	2	1
AVG	1.6	1	1.6	1.4	2	1.2

PMC102   NEURAL NETWORK AND DEEP LEARNING   L   T   P   C
**   3   0   0   3**

COURSE OBJECTIVES:

- To understand the basic concepts and working principles of artificial neurons.
- To explore various types of neural networks based on their architectures and learning rules.
- To grasp the fundamental concepts of Deep Neural Networks (DNN) and their different types, including their working principles.
- To analyze and implement advanced neural network architectures for complex tasks.
- To understand the applications of neural networks and deep learning in real-world scenarios.

UNIT I   INTRODUCTION   9

Biological Neuron, Idea of computational units, McCulloch-Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability, Convergence theorem for Perceptron Learning Algorithm, Type of network architecture, Activation functions, Basic Learning rules.

UNIT II   FEEDFORWARD NETWORKS   9

Multilayer Neural Network, Gradient Descent learning, Back propagation, Empirical Risk Minimization, regularization, Radial Basis Neural Network

UNIT III   RECURRENT NEURAL NETWORKS   9

Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs and Bidirectional RNNs.

UNIT IV   DEEP NEURAL NETWORKS   9

Introduction, Difficulty of training deep neural networks, Greedy layer wise training. Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines. Convolutional Neural Networks: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Back propagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks. Auto Encoders, Deep Reinforcement Learning, Deep Learning Tools: Caffe, Theano and Torch.

UNIT V   PARAMETER TUNING   9

Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Bishop, C., M., Pattern Recognition and Machine Learning, Springer, 2006.

REFERENCES:

1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.
2. Golub, G., H., and Van Loan, C., F., Matrix Computations, JHU Press, 2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: To understand basic concepts of artificial neuron and its working principle.

CO2: To understand the feedforward networks.

CO3: To understand different kinds of Neural Networks based on architectures and learning rules.

CO4: To understand the basic concepts of Deep Neural Networks (DNN) and its different kinds with working principle.

CO5: To understand the various parameter tuning and optimization methods.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	1	2	1	2	1
CO2	2	1	2	1	2	1
CO3	1	2	2	2	1	1
CO4	2	2	2	1	2	1
CO5	2	2	2	1	2	1
AVG	1.6	1.6	2	1.4	1.8	1

PMC103   **DATA ANALYTICS AND COMPUTING**   L   T   P   C
                                                             3   0   0   3

COURSE OBJECTIVES:
- To introduce the fundamental concepts of data analytics.
- To understand the underlying behavior of data through various data exploration and visualization techniques.
- To present various feature selection techniques for effective feature engineering.
- To introduce and evaluate different machine learning techniques and their corresponding metrics.
- To develop skills in deploying data analytics solutions using appropriate computational tools and platforms.

UNIT I   INTRODUCTION   9

Introduction to Data, Data types, Introduction to Stages of Data Processing: Data Pre Processing; Data Imputation; Data Cleaning; Data Transformation; Data Visualization; Data Analysis; Data Engineering, Data Management.

UNIT II   EXPLORATORY DATA ANALYSIS AND VISUALIZATION   9

Introduction to the Chicago Train Ridership data, Visualizations for Numeric Data: Exploring Train Ridership Data, Visualizations for Categorical Data: Exploring the OkCupid Data, Visualizing Relationships between Outcomes and Predictors, Exploring Relationships between Categorical Predictors, Post Modelling Exploratory Visualizations.

UNIT III   FEATURE SELECTION AND ENGINEERING   9

Feature Selection, Classes of Feature Selection Methodologies: intrinsic (or implicit) methods, filter methods, and wrapper methods, Feature Engineering, Feature Engineering techniques: Binning, Feature Hashing, Log Transforms, n-grams, Banalization, Bag-of words.

UNIT IV   MODEL SELECTION   9

Model Selection, Introduction to machine learning, Supervised and unsupervised learning, machine learning algorithms.

UNIT V   MODEL EVALUATION   9

Model Evaluation Approaches: Cross Validation, Confusion Matrix, Gain and Lift cgart, Kolmogorov-Smirnov Chart, Chi Square, ROC curve, Gini Coefficient, L^1 version of RSME.

TOTAL: 45 PERIODS

REFERENCES:

1. James, G., Witten, D., Hastie, T., Tibshirani, R. An introduction to statistical learning with applications in R. Springer, 2013.
2. Han, J., Kamber, M., Pei, J. Data mining concepts and techniques. Morgan Kaufmann, 2011.
3. Hastie, T., Tibshirani, R., Friedman, J. The Elements of Statistical Learning, 2nd edition. Springer, 2009.
4. Murphy, K. Machine Learning: A Probabilistic Perspective. - MIT Press, 2012.
5. Zumel, N. , Mount, J. Practical Data Science with R". Manning, 2014.
6. G. Strang (2016). Introduction to Linear Algebra, Wellesley-Cambridge Press, Fifth edition, USA.
7. Bendat, J. S. and A. G. Piersol (2010). Random Data: Analysis and Measurement Procedures. 4th Edition. John Wiley & Sons, Inc., NY, USA:
8. Montgomery, D. C. and G. C. Runger (2011). Applied Statistics and Probability for Engineers. 5th Edition. John Wiley & Sons, Inc., NY, USA.
9. David G. Luenberger (1969). Optimization by Vector Space Methods, John Wiley & Sons (NY)

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: To introduce basic concepts of Data Analytics.

CO2: To understand underlying behavior of data using different data exploration and data visualization techniques.

CO3: To introduce different feature selection techniques for feature engineering.

CO4: To introduce different kinds of ML techniques and model selection.

CO5: Will Learn different model evaluation approaches

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	1	2	1
CO2	2	1	2	2	2	1
CO3	1	1	2	2	2	1
CO4	2	1	2	1	2	2
CO5	1	1	2	1	2	1
AVG	1.6	1	2	1.4	2	1.4

PMC104   IMAGE PROCESSING AND MACHINE VISION   L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the fundamental principles and techniques of image processing and machine vision.
- To understand the mathematical foundations and algorithms used in image processing tasks such as filtering, segmentation, and feature extraction, image restoration, enhancement, and compression.
- To learn about the principles and algorithms for machine vision tasks such as object detection, recognition, and tracking.
- To develop practical skills in implementing image processing and machine vision algorithms using programming languages and software tools.
- To study the applications of image processing and machine vision in various fields such as medicine, surveillance, robotics, and autonomous systems.

UNIT I   INTRODUCTION   9

Background, definition, Digital Image Fundamentals, Origin of DIP, Digital image representation, fundamental steps in image processing, elements of digital image processing systems, image acquisition, storage, processing, communication and display, data structures for image analysis

UNIT II   IMAGE ENHANCEMENT   9

Image Enhancement in the spatial domain (Basic gray level transformations, histogram processing, Enhancement using arithmetic/logic operations, Basics of spatial filtering-comparison between smoothing and sharpening spatial filters),Image Enhancement in the frequency domain (1D Fourier transform-2D Fourier transform and its Inverse-Smoothing & sharpening frequency domain filters (Ideal, Butterworth, Gaussian), homomorphic filtering)

UNIT III   IMAGE COMPRESSION AND SEGMENTATION   9

Image compression (Fundamentals, Error-free compression, Huffman coding, block coding, constant area coding, variable length coding, bit-plane coding, lossless predictive coding-source and channel encoding-decoding- Lossy compression, lossy predictive coding, transform coding.), Image Segmentation (Thresholding, Edge Based Segmentation, Region Based Segmentation, Mean shift segmentation, Graph cut algorithm, Matching, Evaluation Issues in Segmentation, Watersheds)

UNIT IV   COLOR IMAGE PROCESSING   9

Color Fundamentals, Color Models, Pseudo color Image Processing, Basics of Full Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation, Noise in Color Images.

UNIT V   MACHINE VISION   9

Introduction, definition, Active vision system, Machine vision components, hardware's and algorithms, image function and characteristics, segmentation, data reduction, feature extraction, edge detection, image recognition and decisions, application of machine vision such as in inspection of parts, identification, industrial robot control, mobile robot application, Competing technologies, CCD line scan and area scan sensor, Videcon and other cameras, Triangulation geometry, resolution passive and active stereo imaging, laser scanner, data processing.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Rafael C.Gonzalez and Richard E. Woods,"Digital Image Processing", Richard E.Woods.
2. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing using MATLAB", Main purpose-Practical
3. Bershold Klaus, Paul Holm, "Robot vision", The MIT press.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: To understand the fundamentals of digital images and perform image related operations by image processing techniques.

CO2: To articulate the valuable information from images after pre-processing by using various image enhancement operations.

CO3: To learn and Implement the suitable compression and segmentation techniques on digital images and explore the methods to manipulate the color properties of digital images.

CO4: To discuss the applications of digital image processing concepts in the development and design of a computer vision system using digital images.

CO5: To learn and understand the machine vision and techniques.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	1	2	1
CO2	1	1	1	1	2	2
CO3	2	1	2	2	2	1
CO4	2	2	2	1	2	1
CO5	2	1	2	1	1	1
AVG	1.8	1.2	1.8	1.2	1.8	1.2

PMC105   **INTRODUCTION TO BLOCKCHAIN TECHNOLOGY**   **L   T   P   C**
                                                                                 3   0   0   3

COURSE OBJECTIVES:
- To introduce the fundamental concepts and principles of blockchain technology.
- To understand the architecture and components of a blockchain system.
- To explore different types of blockchains (public, private, permissioned) and their respective usecases.
- To learn about the cryptographic principles and mechanisms underlying blockchain technology.
- To develop practical skills in deploying and interacting with blockchain networks using relevant tools and platforms.

UNIT I   **INTRODUCTION**   **9**

Overview of Blockchain, History of Blockchain, Technical Concepts of Blockchain Technology, Blockchain Characteristics, Design Methodology for Blockchain Applications, Domain Specific Blockchain Applications, Research Aspects, Blockchain Benefits and Challenges.

UNIT II   **CRYPTO PRIMITIVES AND OVERVIEW OF**   **9**
                                   CRYPTOCURRENCIES

Cryptographic Hash Functions, Digital Signature; Hashchain to Blockchain; Overview of Crypto currencies, Bitcoin overview, Mining and Consensus, Mathematical analysis of properties of Bitcoin.

UNIT III   **BLOCKCHAIN COMPONENTS**   **9**

Ethereum, Ethereum Virtual Machine (EVM), Ethereum Languages, Smart Contracts, Structure of a Contract, Smart contracts Vulnerabilities, Development Tools and Frameworks- Metamask, Truffle, Decentralized Applications(Dapps).

UNIT IV   **INTEGRATION OF ARTIFICIAL INTELLIGENCE (AI) WITH**   **9**
                                   BLOCKCHAIN

How to adopt AI in Blockchain, Role of AI in Blockchain, Methods to implement AI in Blockchain, Concept of Internet of Things (IoT), Secure and Smart IoT, Blockchain enabled smart IoT with AI.

UNIT V   **BLCOKCHAIN USE-CASES**   **9**

Blockchain for Healthcare Informatics, Blockchain for Agricultural Supply chain Management, Blockchain for Financial Technology, Blockchain for Smart Applications, Blockchain for Government Applications.

                                                                      TOTAL: 45 PERIODS

REFERENCES:

1. Arshdeep Bahga and Vijay K. Madisetti, Blockchain Applications: A Hands-on Approach, ISBN:9780996025560, 2018.
2. Josh Thompsons, Blockchain: The Blockchain For Beginners Guide To Blockchain Technology And Leveraging Blockchain Programming, Kindle Edition, ISBN:1546772804
3. Arvind Narayanan, J. Bonneau, E Felten, A Miller, and S Goldfeder, Bitcoin and Cryptocurrency Technologies: A comprehensive Introduction, Princeton University Press, 2016.
4. Andreas M. Antonopoulos, Mastering Bitcoin: Programming The Open Blockchain, O'Reilly,ISBN: 9789352135745, 2017

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: To state concepts, benefits, and the challenges of Blockchain Technology.

CO2: To analyze and use some of the commonly used Crypto techniques for Blockchain.

CO3: To use different development platforms to build applications on Blockchain.

CO4: To integrate AI techniques, IoT with Blockchain.

CO5: To design and develop secure systems for different application domains.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	1	2	1
CO2	1	2	2	1	2	2
CO3	1	1	2	1	2	1
CO4	2	1	1	1	2	1
CO5	2	1	2	2	2	1
AVG	1.6	1.2	1.8	1.2	2	1.2

PMC201   **SOFTWARE REQUIREMENTS ENGINEERING**   **L   T   P   C**
                                                                    3   0   0   3

COURSE OBJECTIVES:

The student should be able to

- Understand the basics of requirements engineering.
- Learn different techniques used for requirements elicitation.
- Know the role played by requirements analysis in requirement integration.
- Appreciate the use of various methodologies for requirements development.
- Study the current trends in requirements prioritization and validation.

UNIT I   REQUIREMENTS ENGINEERING OVERVIEW   9

Software Requirement Overview – Software Development Roles –Software Development Process Kernels – Commercial Life Cycle Model – Vision Development – Stakeholders Needs & Analysis – Stakeholder needs –Stakeholder activities.

UNIT II   REQUIREMENTS ELICITATION   9

The Process of Requirements Elicitation – Requirements Elicitation Problems – Problems of Scope – Problems of Understanding – Problems of Volatility – Current Elicitation Techniques – Information Gathering – Requirements Expression and Analysis – Validation – An Elicitation Methodology Framework – A Requirements Elicitation Process Model – Methodology over Method – Integration of Techniques – Fact-Finding – Requirements Gathering – Evaluation and Rationalization – Prioritization– Integration and Validation.

UNIT III   REQUIREMENTS ANALYSIS   9

Identification of Functional and Non Functional Requirements – Identification of Performance Requirements – Identification of safety Requirements – Analysis – Feasibility and Internal Compatibility of System Requirements – Definition of Human Requirements Baseline.

UNIT IV   REQUIREMENTS DEVELOPMENT   9

Requirements analysis – Requirements Documentation – Requirements Development Workflow – Fundamentals of Requirements Development – Requirements Attributes Guidelines Document – Supplementary Specification Document – Use Case Specification Document – Methods for Software Prototyping – Evolutionary prototyping –Throwaway prototyping.

UNIT V   REQUIREMENTS VALIDATION   9

Validation objectives – Analysis of requirements validation – Activities – Properties – Requirement reviews – Requirements testing – Case tools for requirements Engineering.

TOTAL: 45 PERIODS

REFERENCES:

1. Dean Leffingwe, Don Widrig, Managing Software Requirements A Use Case Approach, Second Addition, Addison Wesley, 2003
2. Ian Graham, Requirements Engineering and Rapid Development‖, Addison Wesley,1998
3. Ian Sommerville, Pete Sawyer, Requirements Engineering: A Good Practice Guide, SixthEdition, Pearson Education, 2004
4. Karl Eugene Wiegers, Software Requirements‖, Word Power Publishers, 2000
5. Wiegers, Karl, Joy Beatty, ‖Software requirements‖, Pearson Education, 2013

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Prepare SRS including the details of requirements engineering.

CO2: To learn and understand the process of requirements elicitation.

CO3: Describe the stages of requirements analysis.

CO4: Analyze software requirements gathering.

CO5: To learn about the software validation and testing tools.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	1	2	1
CO2	2	1	2	1	2	1
CO3	1	1	2	1	1	1
CO4	2	1	2	2	2	1
CO5	1	1	1	1	2	2
AVG	1.6	1	1.8	1.2	1.8	1.2

PMC202 **SOFTWARE INDUSTRIALIZATION** L T P C

  3 0 0 3

COURSE OBJECTIVES:

The student should be able:

- To point out the need for industrialization in software development.
- To understand the non-functional requirements in software engineering.
- To carry out performance analyses.
- To study the various types of scalability.
- To acquire the art of capacity planning.
- To understand the techniques for infrastructure management.

UNIT I INDUSTRIALIZATION OF SOFTWARE DEVELOPMENT 9

The Fragile Hand Weaving - Features Vs Robustness - Components and Services Based Development – Agile and Dev Ops - Software Factory – Automation

UNIT II NON FUNCTIONAL REQUIREMENTS and ENGINEERING 9

NFRs - Cost of Quality - Business and System View - Industrialization Process in SDLC - Performance and Scalability – Capacity Planning –Production Operations

UNIT III PERFORMANCE and SCALABILITY ENGINEERING 9

Engineering for Performance and Scalability -Performance Modelling, Measurement and Testing - Workload Characterization - Latency and Throughput Requirements - Resource Usage Measurements Processor, Memory, Disk, Network - Performance Testing and Profiling - Bottleneck and Hotspot Identification - Vertical and Horizontal Scalability - Load, Space and Structural Scalability - Endurance Engineering - Analysis and Presenting Recommendations - Tools for Performance and Scalability

UNIT IV THE ART OF CAPACITY PLANNING 9

Capacity Planning Art Vs Science – Budgetary Capacity Planning - Utilization, Service Demand, The Forced Flow, Interactive Response Time, Little's Laws - Using Queuing Models - Markov Models - M/M/1 M/G/1 Single Queue Systems - Mean Value Analysis, Multi-Class Models - Priority Scheduling Fork/Join Queuing Networks - Production Capacity Forecasting With Regression and Time Series Models – Tools for Capacity Planning

UNIT V PRODUCTION SYSTEMS MANAGEMENT 9

Infrastructure Management and Support – Systems, Storage and Network Monitoring – High Availability Service Levels – Change and Configuration Management- Capacity Augmentation - Modernizing and Cloud Enablement - Automation

TOTAL: 45 PERIODS

REFERENCES:

1. Andre B. Bondi, Foundations of Software and System Performance Engineering, Addison Wesley, 2015
2. Daniel A. Menasce, Dowdy, Almeida, Computer Capacity Planning by Example, Prentice Hall, 2004
3. L. Chung, B. Nixon, E. Yu and J. Mylopoulos, Non-Functional Requirements in Software Engineering, Springer, 2000
4. Rich Schiesser, IT Systems Management, Pearson Education, 2010

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Understand SOA and DevOps.

CO2: Understand the non-functional requirements in software engineering.

CO3: Apply various performance analysis techniques and analyze software systems for scalability.

CO4: Apply capacity planning methods.

CO5: Apply infrastructure management techniques.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	1	2	1
CO2	1	1	2	1	2	1
CO3	2	1	1	1	1	2
CO4	2	1	1	1	2	1
CO5	1	1	2	1	2	1
AVG	1.6	1	1.6	1	1.8	1.2

PMC203	BUSINESS INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The student should be able to

- Identify the enormous opportunities that currently exists in providing business intelligence services.
- Gain a practical understanding of the key data mining methods of classification, prediction, data reduction and exploration.
- Understand and help develop the strategies of modern enterprise decision makers.
- Acquire knowledge in many scientific and technological fields including data warehouses, data mining, content analytics, business process management, and visual analytics.
- Gain competences in information systems, web science, decision science, software engineering, and innovation and entrepreneurship.

UNIT I INTRODUCTION 9

BI Basics – Meeting the BI challenge – BI user models – Basic reporting and querying – BI Markets - BI and Information Exploitation - Value of BI - BI cycle - Bridging the analysis gap – BI Technologies BI Decision Support Initiatives – BI Project Team.

UNIT II BI BIG PICTURE 9

Advanced Emerging BI Technologies – Human factors in BI implementations – BI design and development – OO Approach to BI - BI Environment – BI business process and information flow – Identifying BI opportunities – Evaluating Alternatives - BI solutions – BI Project Planning.

UNIT III BI ARCHITECTURE 9

Components of BI Architecture – BI Design and prototyping – Importance of Data in Decision Making- Data requirements Analysis - Using OLAP for BI – Data warehouse and Technical BI Architecture – Business Rules – Data Quality – Data Integration – High performance BI - BI 2.0 – Goo LAP Fact Retrieval Framework.

UNIT IV BI TECHNOLOGIES 9

Successful BI – LOFT Effect – Importance of BI Tools – BI standardization – Creating business value through location based intelligence – Technologies enabling BI – technologies for information integration - Building effective BI Systems - Strategic, Tactical, Operational and Financial Intelligence.

UNIT V FUTURE OF BI 9

Knowledge Discovery for BI – Markov Logic Networks – BI Search and Text Analytics – Advanced Visualization – Semantic Web Technologies for building BI - Service oriented BI – Collaborative BI -Evaluating BI – Stakeholder model of BI.

TOTAL: 45 PERIODS

REFERENCES:

1. CindiHowson,"Successful Business Intelligence, Tata McGraw-Hill Education, 2007
2. David Loshin, Business Intelligence: The Savvy Manager's Guide‖, Morgan Kaufmann, 2nd Edition, Newnes Publishers, 2012
3. Elizabeth Vitt, Michael Luckevich, Stacia Misner, Business Intelligence, O'Reilly Media, Inc.,2010.
4. Larissa Terpeluk Moss, S. Atre, Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications, Addison-Wesley Information Technology Series, illustrated edition, Addison-Wesley Professional, 2003
5. Marie - Aude Aufaure, Esteban Zimány, Business Intelligence, First European Summer School eBISS, 2011.
6. Murugan Anandarajan, Asokan Anandarajan, Cadambi A. Srinivasan, Business Intelligence Techniques: A Perspective from Accounting and Finance, illustrated Springer,2003
7. Rajiv Sabherwal, Irma Becerra-Fernandez, ‾Business Intelligence‖, illustrated Edition, John Wiley & Sons, 2010

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Assess the business intelligence potential of today's data rich environment.

CO2: Discuss the different approaches of BI technologies.

CO3: Importance of data and the components of BI Architecture.

CO4: Building the effective BI systems.

CO5: Gain the knowledge discovery of BI and advanced visualization.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	2	1	1	2	2
CO2	2	2	1	1	2	1
CO3	2	2	2	1	2	2
CO4	2	1	1	1	2	2
CO5	2	2	1	1	1	2
AVG	2	1.8	1.2	1	1.8	1.8

PMC204   INTEGRATED SOFTWARE PROJECT MANAGEMENT   L   T   P   C

                                                            3   0   0   3

COURSE OBJECTIVES:

- Understand the basic concept of project management.
- Learn the various costing and life cycle management.
- Understand the role played by risk in software project.
- Appreciate the use of metrics for software project management.
- Know the challenges in people management.

UNIT I   PROJECT MANAGEMENT & COSTING   9

Software Project Management approaches - Project Acquisition – Initiation – Planning – PERT-Execution and Control – CPM – Change Management – Project Closure – Agile SPM Problems in Software Estimation - Algorithmic Cost Estimation Process, Function Points, COCOMO II (Constructive Cost Model) – Estimating Web Application Development – Concepts of Finance, Activity Based Costing and Economic Value Added (EVA) – Balanced Score Card.

UNIT II   PROCESS MODELS & LIFECYCLE MANAGEMENT   9

Software Engineering Process Models - Adaptive Software Development (ASD) - DSDM – SCRUM –Crystal -Feature Driven Development (FDD) - ISO 9000: 2000 – SPICE – SIX SIGMA – CMMI. SLIM (Software Life cycle Management) – PLM (Product Lifecycle Management) – PDM (Product Data Management) - PLM, PDM Applications - Pre-PLM Environment - Change Management.

UNIT III   RISK MANAGEMENT   9

Perspectives of Risk Management - Risk Definition – Risk Categories – Risk Assessment: Approaches, techniques and good practices – Risk Identification / Analysis / Prioritization – Risk Control (Planning / Resolution / Monitoring) – Risk Retention – Risk Transfer – Failure Mode and Effects Analysis (FMEA) – Operational Risks – Supply Chain Risk Management.

UNIT IV   METRICS   9

Need for Software Metrics – scope – basics – framework for software measurement - Classification of Software Metrics: Product Metrics (Size Metrics, Complexity Metrics, Halsteads Product Metrics, Quality Metrics), and Process metrics (Empirical Models, Statistical Models, Theory-based Models, Composite Models, and Reliability Models) – measuring internal and external product attributes.

UNIT V   PEOPLE MANAGEMENT   9

Leadership styles – Developing Leadership skills – Leadership assessment – Motivating People – Organizational strategy – Management – Team building – Delegation – Art of Interviewing People - Team Management – Rewarding – Client Relationship Management.

TOTAL: 45 PERIODS

REFERENCES:

1. Antonio Borghesi, Barbara Gaudenzi, Risk Management: How to Assess, Transfer and Communicate Critical Risks: Perspectives in Business Culture, Illustrated Edition, Springer, 2012
2. Murali Chemuturi, Thomas M. Cagley, Mastering Software Project Management: Best Practices, Tools and Techniques, J. Ross Publishing, 2010
3. Norman Fenton, James Bieman, Software Metrics: A Rigorous and Practical Approach, 3rd edition, CRC Press, 2015.
4. Stark,John, Decision Engineering: Product Lifecycle Management:21st Century Paradigm for Product Realization, 2nd Edition.,Springer London,2011.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Identify the various elements of software management process framework.

CO2: Use available open source estimation tools for cost estimation.

CO3: Identify existing risk and perform risk assessment.

CO4: Design a software metric for software project management.

CO5: Modify the art of interviewing people for a given scenario.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	1	1	2	2
CO2	2	2	2	1	2	1
CO3	2	1	1	2	1	2
CO4	2	2	1	1	2	2
CO5	2	1	1	1	2	2
AVG	2	1.4	1.2	1.2	1.8	1.8

PMC205 **SOFTWARE SECURITY** L T P C

3 0 0 3

COURSE OBJECTIVES:

The student should be able to

- Know the importance and need of software security.
- Know about various attacks.
- Learn about secure software design.
- Understand risk management in secure software development.
- Know the working of tools related to software security.

UNIT I   INTRODUCTION   9

Need for software security – Memory based attacks – low level attacks against heap and stack – stack smashing – format string attacks – stale memory access attacks – ROP (Return oriented programming) – malicious computation without code injection. Defense against memory based attacks stack canaries – non-executable data - address space layout randomization (ASLR), memory- safety enforcement, control flow Integrity (CFI) – randomization

UNIT II   SECURE DESIGN   9

Isolating the effects of untrusted executable content - stack inspection – policy specification languages – vulnerability trends – buffer overflow - code injection - Generic network fault injection -local fault injection - SQL injection - Session hijacking. Secure design - threat modeling and security design principles - good and bad software design - Web security-browser security: cross-site scripting (XSS), cross-site forgery (CSRF) – database security – file security.

UNIT III   SECURITY RISK MANAGEMENT   9

Risk Management Life cycle – Risk Profiling – Risk exposure factors – Risk Evaluation and Mitigation - Risk Assessment Techniques – Threat and Vulnerability Management.

UNIT IV   SECURITY TESTING   9

Traditional software testing – comparison - secure software development life cycle – risk based security testing – prioritizing security testing with threat modeling – shades of analysis: white, grey and black box testing.

UNIT V   ADVANCED SOFTWARE SECURITY   9

Advanced penetration testing – planning and scoping – DNS groper – DIG (Domain Information Graph) -Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client side Attacks - Post Exploitation - Bypassing Firewalls and Avoiding Detection - Tools for penetration testing

TOTAL: 45 PERIODS

REFERENCES:

1. Bryan Sullivan and Vincent Liu, Web Application Security, A Beginner's Guide, Kindle Edition, McGraw Hill, 2012
2. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press), Addison-Wesley Professional, 2006
3. Evan Wheeler, Security Risk Management: Building an Information Security Risk Management Program from the Ground Up, First edition, Syngress Publishing, 2011
4. Lee Allen, Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled), Kindle Edition, Packt Publishing,2012
5. Mike Shema, Hacking Web Apps: Detecting and Preventing Web Application Security Problems, First edition, Syngress Publishing, 2012
6. Robert C. Seacord, Secure Coding in C and C++ (SEI Series in Software Engineering), Addison-Wesley Professional, 2005

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Use tools for securing software.

CO2: Create SQL injection and security design principles in software development.

CO3: Life cycle of security risk management and different techniques.

CO4: Involve selection of testing techniques related to software security in testing phase of software development.

CO5: Planning and scoping of advanced software security.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	1	2	1
CO2	2	2	2	1	2	2
CO3	1	1	2	1	2	1
CO4	2	1	2	2	2	2
CO5	2	1	2	1	2	1
AVG	1.8	1.2	2	1.2	2	1.4

PMC301   **MACHINE LEARNING FOR DATA SCIENCE**   L T P C
                                                        3 0 0 3

COURSE OBJECTIVES:

- To understand the basic concepts of machine learning.
- To understand and build supervised learning models.
- To understand neural network and learn combination of classifiers.
- To understand and build unsupervised learning models.
- To design and analysis of probabilistic graphical models.

UNIT I   INTRODUCTION TO MACHINE LEARNING   9

Machine Learning – Basic concepts – Types of Machine learning – Examples & Applications – Data Pre-processing - Noise Removal - Normalization - Bias & Variance, Review on Probability – Conditional probability – Bayesian conditional probability.

UNIT II   SUPERVISED LEARNING   9

Linear Regression Models: Multiple regression – Logistic regression, Naïve Bayes classifier, Nearest Neighbor and KNN Algorithm, Decision Trees, Support Vector Machines, Kernel functions.

UNIT III   NEURAL NETWORKS, ENSEMBLE TECHNIQUES   9

Artificial Neural Network(ANN), perceptron, multilayer perceptron, Back propagation network(BPN) activation functions, gradient descent optimization, error back propagation, Unit saturation (vanishing gradient problem) - ReLU, hyper parameter tuning, batch normalization, regularization, Ensemble Methods – Bagging, Boosting.

UNIT IV   UNSUPERVISORY & REINFORCEMENT LEARNING   9

Clustering - Distance Function, Minimum, maximum & average connection, Hierarchical Clustering, agglomerative – K Means clustering, Self-organizing Map, Reinforcement Learning overview.

UNIT V   GRAPHICAL MODELS & DIMENSION REDUCTION   9

Directed Graphical Models, Bayesian Networks, Markov Models, Hidden Markov Models, Inference-Learning Generalization, Dimension reduction-Curse of Dimensionality, PCA

TOTAL: 45 PERIODS

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
2. Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2014
3. Sridhar S & Vijayalakshmi M, "Machine Learning", Oxford University Press, 2021
4. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 1997.
5. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press. 2018.
6. Ian Goodfellow, Yoshua Bengio, Aaron Courville, "Deep Learning", MIT Press, 2016
7. Sebastain Raschka, Vahid Mirjalili, "Python Machine Learning", Packt publishing, 3rd Edition, 2019.
8. Francois Chollet, "Deep Learning with Python", Second Edition, Manning Publications,2021.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Explain the basic concepts of machine learning.

CO2: Construct supervised learning models.

CO3: Construct unsupervised learning algorithms.

CO4: Evaluate and compare different models.

CO5: Design of experiments using machine learning

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	1	2	2	2	1
CO2	1	2	2	1	2	2
CO3	2	1	2	2	2	1
CO4	1	1	2	2	1	1
CO5	1	1	2	2	2	1
AVG	1.2	1.2	2	1.8	1.8	1.2

PMC302   **DATA VISUALIZATION**   **L T P C**
                                                                         3 0 0 3

COURSE OBJECTIVES:
- To understand the fundamentals of data visualization.
- To know the working principles of various information visualization depth tools.
- To acquire knowledge about the issues in data representation.
- To visualize the Data using tools Tableau.
- To gain skill in designing real time interactive information visualization system.

UNIT I   INTRODUCTION   9

Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, and data visualization tools.

**UNIT II   VISUALIZATION TECHNIQUES FOR TIME-SERIES, TREES   9
               & GRAPHS**

Mapping – Time series - Connections and correlations – Indicator – Area chart-Pivot table- Scatter charts, Scatter maps – Tree maps, Space filling and non-space filling methods – Hierarchies and Recursion - Networks and Graphs-Displaying Arbitrary Graphs-node link graph-Matrix representation for graphs- Info graphics

UNIT III   TEXT AND DOCUMENT VISUALIZATION   9

Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders, Listing Files in a Folder, Asynchronous Image Downloads, Web Techniques, Parsing data - Levels of Effort, Tools for Gathering Clues, Text Markup Languages, Regular Expressions, Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.

UNIT IV   INTERACTIVE DATA VISUALIZATION   9

Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting, Framework – D3.js, Tableau Dashboards.

UNIT V   SECURITY IN DATAVISUALIZATION   9

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating secured visualization system.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Andy Kirk, Data Visualization: a successful design process, Packt Publishing Limited, 2012.
2. Ben Fry, "Visualizing Data: Exploring and Explaining Data with the Processing",O´Reilly, 2008.
3. Scott Murray, "Interactive data visualization for the web", O"Reilly Media, Inc.,2013
4. Greg Conti, "Security Data Visualization: Graphical Techniques for Network Analysis", No Starch Press Inc, 2007.

REFERENCES:

1. Robert Spence, "Information Visualization An Introduction", Third Edition, Pearson Education, 2014.
2. Colin Ware, "Information Visualization Perception for Design", Third edition, Margon Kaufmann Publishers, 2012.
3. Robert Spence, "Information Visualization Design for Interaction", Second Edition, Pearson Education, 2006.
4. Benjamin B. Bederson and Ben shneiderman, "The Craft of Information Visualization", Morgan Kaufmann Publishers, 2003.
5. Matthew O. Ward, George Grinstein, Daniel Keim, "Interactive Data Visualization: Foundation,Techniques and Applications", Second Edition, A.K.Peters/CRCPress,2015.
6. Joerg Osarek, "Virtual Reality Analytics", Gordon's Arcade, 2016.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Collect data and solve engineering problems in visualizing the information.

CO2: Mapping - Time series, Hierarchies and Recursion, Matrix representations of Graphs.

CO3: Analyze the text and document visualization and the web techniques.

CO4: Conduct experiments by applying various interactive data visualization tool and solve the space layout problem.

CO5: Creating secured visualization system.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	2	2	1	1	1
CO2	1	2	2	2	1	2
CO3	2	1	2	1	2	1
CO4	2	2	2	1	1	1
CO5	2	2	1	1	1	1
AVG	1.8	1.8	1.8	1.2	1.2	1.2

PMC303   **DATA SECURITY AND PRIVACY**   **L   T   P   C**
                                                                        3   0   0   3

COURSE OBJECTIVES:
- To understand the data security and attacks.
- Understand the encryption of data.
- Identify the data governance and privacy approaches.
- To learn the distributed data organization and federated data science.
- Analyze the internal policies and data protection.

UNIT I   ATTACKS AND PRIVACY   9

Attacks: Analyzing common attack vectors – Data Security – Probabilistic reasoning about attacks –Data security mitigations. Privacy aware Machine learning and Data Science: Privacy preserving techniques in ML - Open-source libraries for PPML Architecting privacy in Data and ML projects

UNIT II   ENCRYPTED COMPUTATION   9

Encrypted computation – Types of encrypted computation: Secure Multi-party computation – Homomorphic encryption. Real-world encrypted computation: Private set intersection – Private join and compute – Secure Aggregation – Encrypted Machine Learning. PSI and Moose.

UNIT III   DATA GOVERNANCE AND PRIVACY APPROACHES   9

Data Governance – Identifying sensitive data – Documenting data for use - Basic Privacy – Anonymization – Differential privacy – Privacy loss – Differential privacy with Laplace mechanism – Gaussian noise for differential privacy – Sensitivity and Privacy units – kAnonymity – Building Privacy into Data Pipelines.

UNIT IV   FEDERATED LEARNING AND DATA SCIENCE   9

Distributed data – Distributed Optimization - Federated learning – Architecting federated systems – Open-source federated libraries – Federated data science.

UNIT V   LEGALITY OF PRIVACY   9

GDPR – CCPA – HIPAA - LGPD - PIPL- Internal policies and contracts – Adhering to contract agreements and law – Interpreting Data protection regulations – Data governance 2.0 - Indian Data Protection Framework - Use case analysis.

TOTAL: 45 PERIODS

REFERENCES:

1. Katharine Jarmul, Practical Data Privacy, O'Reilly Media, Inc, 2023
2. David Evans, Vladimir Kolesnikov and Mike Rosulek, A Pragmatic Introduction to Secure Multi-Party Computation, NOW Publishers, 2022
   (Free access at https://securecomputation.org/)
3. William Stallings, Cryptography and Network Security - Principles and Practice, Seventh Edition, Pearson, 2017
4. Indian Data Protection Framework https://www.meity.gov.in/data-protection-framework

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Gain knowledge on the nature of attacks and threats and security management goals and framework.

CO2: Knowledge on the landscape of hacking and defense mechanisms.

CO3: Able to differentiate and integrate strategies for data security and protecting critical Infra-structure.

CO4: Able to understand policies to mitigate data security breaching.

CO5: Knowledge on IT Act, and amendments, copy rights, IPR and cyber law to deal with offenses.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	1	2	1
CO2	1	1	1	1	1	1
CO3	2	2	2	2	1	2
CO4	2	1	1	2	2	1
CO5	1	1	2	1	2	2
AVG	1.6	1.2	1.6	1.4	1.6	1.4

PMC304   BIG DATA ANALYTICS   L T P C
                                                                3 0 0 3

COURSE OBJECTIVES:

- To understand big data.
- To learn and use NoSQL big data management.
- To learn map reduce analytics using Hadoop and related tools.
- To work with map reduce applications.
- To understand the usage of Hadoop related tools for Big Data Analytics.

UNIT I   UNDERSTANDING BIG DATA   9

Introduction to big data – convergence of key trends – unstructured data – industry Examples of bigdata – web analytics – big data applications – big data technologies – introduction to Hadoop – open source technologies – cloud and big data – mobile business intelligence – Crowd sourcing analytics inter and trans firewall analytics.

UNIT II   NOSQL DATA MANAGEMENT   9

Introduction to NoSQL – aggregate data models – key-value and document data models – relationships graph databases – schema less databases – materialized views – distribution models – master-slave replication – consistency – Cassandra – Cassandra data model – Cassandra examples – Cassandra clients.

UNIT III   MAP REDUCE APPLICATIONS   9

MapReduce workflows – unit tests with MRUnit – test data and local tests – anatomy of Map Reduce job run – classic Map-reduce – YARN – failures in classic Mapreduce and YARN – job scheduling -shuffle and sort – task execution – MapReduce types – input formats – output formats.

UNIT IV   BASICS OF HADOOP   9

Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Haddop pipes design of Haddop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression – serialization – Avro – file- based data structures – Cassandra – Hadoop integration.

UNIT V   HADOOP RELATED TOOLS   9

Hbase – data model and implementations – Hbase clients – Hbase examples – praxis. Pig – Grunt -pig data model – Pig Latin – developing and testing Pig Latin scripts.Hive – data types and file formats – HiveQL data definition – HiveQL data manipulation- HiveQL queries.

TOTAL: 45 PERIODS

REFERENCES:

1. Michael Minelli, Michael Chambers, and AmbigDhiraj, "Big Data, Big Analytics: EmergingBusiness Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. Sadalage, Pramod J. "NoSQL distilled", 2013
4. E. Capriolo, D. Wrampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
5. Lars George, "HBase: The Definitive Guide: O'Reilley, 2011.
6. Eben Hewitt, "Cassandra: The Definitive Guide: O'Reilley, 2010.
7. Alan Gates, "Programming Pig", O'Reilley, 2011.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Describe the big data and use cases from selected business domains.

CO2: Explain NoSQL big data management.

CO3: Install, configure and run Hadoop and HDFS.

CO4: Perform map-reduce analytics using Hadoop.

CO5: Use Hadoop-related tools such as HBase, Cassandra, Pig and Hive for big data analytics.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	1	1	2	1
CO2	2	1	1	1	2	1
CO3	2	1	1	1	2	1
CO4	2	1	1	1	2	1
CO5	2	1	1	1	2	1
AVG	2	1	1	1	2	1

PMC305   **EXPLORATORY DATA ANALYSIS**   **L   T   P   C**
                                                                     3   0   0   3

COURSE OBJECTIVES:

- To outline an overview of exploratory data analysis.
- To implement data visualization using Matplotlib.
- To perform univariate data exploration and analysis.
- To apply bivariate data exploration and analysis.
- To use Data exploration and visualization techniques for multivariate and time series data.

UNIT I   EXPLORATORY DATA ANALYSIS   9

EDA fundamentals – Understanding data science - Significance of EDA – Making sense of data – Comparing EDA with classical and Bayesian analysis – Software tools for EDA – Visual Aids for EDA -Data transformation techniques-merging database, reshaping and pivoting, Transformation techniques.

UNIT II   EDA USING PYTHON   9

Data Manipulation using Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data – Handling Missing Data – Hierarchical Indexing – Combining datasets – Concat, Append, Merge and Join – Aggregation and grouping – Pivot Tables – Vectorized String Operations.

UNIT III   UNIVARIATE ANALYSIS   9

Introduction to Single Variable: Distribution Variables - Numerical Summaries of Level and Spread -Scaling and Standardizing – Inequality

UNIT IV   BIVARIATE ANALYSIS   9

Relationships between Two Variables – Percentage Tables – Analysis Contingency Tables – Handling Several Batches – Scatterplots and Resistant Lines.

UNIT V   MULTIVARIATE AND TIME SERIES ANALYSIS   9

Introducing a Third Variable – Causal Explanations – Three-Variable Contingency Tables and Beyond – Fundamentals of TSA – Characteristics of time series data – Data Cleaning -Time-based indexing – Visualizing – Grouping – Resampling.

TOTAL: 45 PERIODS

REFERENCES:

1. Suresh Kumar Mukhiya, Usman Ahmed, "Hands-On Exploratory Data Analysis with Python", Packt Publishing, 2020. (Unit 1)
2. Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data". First Edition, O Reilly, 2017. (Unit 2)
3. Catherine Mars, Jane Elliott, "Exploring Data: An Introduction to Data Analysis for Social Scientists", Wiley Publications, 2nd Edition, 2008. (Unit 3,4,5)
4. Eric Pimpler, Data Visualization and Exploration with R, GeoSpatial Training service, 2017.
5. Claus O. Wilke, "Fundamentals of Data Visualization", O'reilly Publications, 2019.
6. Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Understand the fundamentals of exploratory data analysis.

CO2: Implement the data Visualization using Matplotlib.

CO3: Perform univariate data exploration and analysis.

CO4: Apply bivariate data exploration and analysis.

CO5: Use Data exploration and visualization techniques for multivariate and time series data.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	2	2	1	2	1
CO2	2	2	2	1	2	1
CO3	2	2	2	1	2	1
CO4	2	2	2	1	2	1
CO5	2	2	2	1	2	1
AVG	2	2	2	1	2	1

PMC401   **NATURAL LANGUAGE PROCESSING**   L   T   P   C
                                                          2   0   2   3

COURSE OBJECTIVES:

- To understand basics of linguistics, probability and statistics.
- To study statistical approaches to NLP and understand sequence labeling.
- To outline different parsing techniques associated with NLP.
- To explore semantics of words and semantic role labeling of sentences.
- To understand discourse analysis, question answering and chatbots.

UNIT I   INTRODUCTION   6

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

UNIT II   STATISTICAL NLP AND SEQUENCE LABELING   6

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

UNIT III   CONTEXTUAL EMBEDDING   6

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

UNIT IV   COMPUTATIONAL SEMANTICS   6

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

UNIT V   DISCOURSE ANALYSIS AND SPEECH PROCESSING   6

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

SUGGESTED ACTIVITIES:

1. Probability and Statistics for NLP Problems
2. Carry out Morphological Tagging and Part-of-Speech Tagging for a sample text
3. Design a Finite State Automata for more Grammatical Categories
4. Problems associated with Vector Space Model
5. Hand Simulate the working of a HMM model
6. Examples for different types of work sense disambiguation
7. Give the design of a Chatbot

PRACTICAL EXERCISES: 15 PERIODS

1. Download nltk and packages. Use it to print the tokens in a document and the sentences from it.
2. Include custom stop words and remove them and all stop words from a given document using nltk or spaCY package
3. Implement a stemmer and a lemmatizer program.
4. Implement a simple Part-of-Speech Tagger
5. Write a program to calculate TFIDF of documents and find the cosine similarity between any two documents.
6. Use nltk to implement a dependency parser.
7. Implement a semantic language processor that uses WordNet for semantic tagging.
8. Project - (in Pairs) your project must use NLP concepts and apply them to some data.
   a. Your project may be a comparison of several existing systems, or it may propose a new system in which case you still must compare it to at least one other approach.
   b. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
   c. You must properly provide references to any work that is not your own in the write-up.
   d. Project proposal you must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

List of Possible Projects

1. Sentiment Analysis of Product Reviews
2. Information extraction from News articles
3. Customer support bot
4. Language identifier
5. Media Monitor
6. Paraphrase Detector
7. Identification of Toxic Comment
8. Spam Mail Identification

                                                   TOTAL: 45 PERIODS

REFERENCES:

1. Daniel Jurafsky and James H.Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition"(Prentice Hall Series in Artificial Intelligence), 2020
2. Jacob Eisenstein. "Natural Language Processing ", MIT Press, 2019
3. Samuel Burns "Natural Language Processing: A Quick Introduction to NLP with Python and NLTK, 2019
4. Christopher Manning, "Foundations of Statistical Natural Language Processing", MIT Press, 2009.
5. Nitin Indurkhya, Fred J. Damerau, "Handbook of Natural Language Processing", Second edition, Chapman & Hall/CRC: Machine Learning & Pattern Recognition, Hardcover,2010
6. Deepti Chopra, Nisheeth Joshi, "Mastering Natural Language Processing with Python",Packt Publishing Limited, 2016
7. Mohamed Zakaria Kurdi "Natural Language Processing and Computational Linguistics: Speech, Morphology and Syntax (Cognitive Science)", ISTE Ltd., 2016
8. Atefeh Farzindar, Diana Inkpen, "Natural Language Processing for Social Media (Synthesis Lectures on Human Language Technologies)", Morgan and Claypool Life Sciences, 2015

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Understand basics of linguistics, probability and statistics associated with NLP.

CO2: Implement a Part-of-Speech Tagger.

CO3: Design and implement a sequence labeling problem for a given domain.

CO4: Implement semantic processing tasks and simple document indexing and searching system using the concepts of NLP.

CO5: Implement a simple chatbot using dialogue system concepts.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	3	-	2	1	-
CO2	-	1	3	2	-	3
CO3	3	2	1	-	-	2
CO4	1	-	3	-	2	-
CO5	2	3	-	1	3	1
AVG	1.6	1.8	1.4	1	1.2	1.2

PMC402   **PREDICTIVE MODELING**   L   T   P   C
                                                       3   0   0   3

COURSE OBJECTIVES:
- To understand the terms and terminologies of predictive modeling.
- To study the various predictive models, their merits, demerits and application.
- To get exposure to various analytical tools available for predictive modeling.
- To learn the predictive modeling markup language.
- To get familiar with the technologies in predictive modeling.

UNIT I   INTRODUCTION TO PREDICTIVE MODELING   9

Core ideas in data mining - Supervised and unsupervised learning - Classification vs. Prediction - Steps in data mining- SEMMA Approach - Sampling -Pre-processing – Data cleaning - Data Partitioning - Building a model - Statistical models - Statistical models for predictive analytics.

UNIT II   PREDICTIVE MODELING BASICS   9

Data splitting – Balancing- Over fitting –Oversampling –Multiple Regression Artificial neural networks (MLP) - Variable importance- Profit/loss/prior probabilities – Model specification - Model selection - Multivariate Analysis.

UNIT III   PREDICTIVE MODELS   9

Association Rules-Clustering Models –Decision Trees- Ruleset Models- KNearest Neighbors – Naive Bayes - Neural Network Model – Regression Models – Regression Trees – Classification & Regression Trees (CART) – Logistic Regression – Multiple Linear Regression Scorecards – Support Vector Machines – Time Series Models - Comparison between models - Lift chart Assessment of a single model.

UNIT IV   PREDICTIVE MODELING MARKUP LANGUAGE   9

Introduction to PMML – PMML Converter - PMML Structure – Data Manipulation in PMML – PMML Modeling Techniques - Multiple Model Support – Model Verification.

UNIT V   TECHNOLOGIES AND CASE STUDIES   9

Weka – Rapid Miner – IBM SPSS Statistics- IBM SPSS Modeler – SAS Enterprise Miner – Apache Mahout – R Programming Language.-Real time case study with modeling and analysis.

TOTAL: 45 PERIODS

REFERENCES:

1. Kattamuri S. Sarma, "Predictive Modeling with SAS Enterprise Miner: Practical Solutions for Business Applications", 3rd Edition, SAS Publishing, 2017.
2. Alex Guazzelli, Wen-Ching Lin, Tridivesh Jena, James Taylor, "PMML in Action Unleashing the Power of Open Standards for Data Mining and Predictive Analytics", 2nd Edition, Create Space Independent Publishing Platform, 2012.
3. Ian H. Witten, Eibe Frank, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann Series in Data Management Systems, Morgan Kaufmann, 3rd Edition, 2011.
4. Eric Siegel, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", 2nd Edition, Wiley, 2016.
5. Conrad Carlberg, "Predictive Analytics: Microsoft Excel", 1st Edition, Que Publishing, 2012.
6. Jeremy Howard, Margit Zwemer, Mike Loukides, "Designing Great Data Products Inside the Drivetrain train Approach, a Four-Step Process for Building Data Products – Ebook", 1st Edition, O'Reilly Media, March 2012.

WEB REFERENCES:

1. https://nptel.ac.in/courses/108108111/
2. https://www.coursera.org/learn/predictive-modeling-analytics

ONLINE RESOURCES:

1. https://bookdown.org/egarpor/PM-UC3M/
2. https://cics.nd.edu/research/applications/materials/

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Design and analyze appropriate predictive models.

CO2: Define the predictive models using PMML.

CO3: Apply statistical tools for analysis.

CO4: Use various analytical tools available for predictive modeling.

CO5: Apply predictive modeling markup language in data manipulation.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	2	3	3	2	2
CO2	1	2	3	3	2	2
CO3	3	2	2	2	2	2
CO4	2	3	3	1	2	2
CO5	2	3	2	1	3	3
AVG	2	2.4	2.6	2	2.2	2.2

PMC403   SMART CONVERGENT TECHNOLOGIES   L T P C
                                                        3 0 0 3

COURSE OBJECTIVES:

- To learn about Fundamentals of IoT and Security.
- To know about IoT applications in Industry.
- To learn about RFID Pervasive networks.
- To gain fundamental concepts in 5G and Next Gen networks.
- To know about IoT implementation.

UNIT I   TOWARDS THE IOT UNIVERSE   9

Internet of Things Vision - IoT Strategic Research and Innovation Directions – IoT Applications - Internet of Things and Related Future Internet Technologies -Infrastructure - Networks and Communication - Processes - Data Management, Security, Privacy & Trust - Device Level Energy Issues.

UNIT II   IOT APPLICATIONS – VALUE CREATION FOR INDUSTRY   9

Introduction - IoT Applications for Industry – Value Creation and Challenges - Future Factory Concepts - Brownfield IoT: Technologies for Retrofitting - Smart Objects, Smart Applications – Four Aspects in your Business to Master IoT - Value Creation from Big Data and Serialization in the Pharmaceutical Industry - IoT for Retailing Industry- IoT for Oil and Gas Industry - Opinions on IoT Application and Value for Industry- Data Aggregation for the IoT in Smart Cities.

UNIT III   RFID PERVASIVE NETWORKS   9

RFID Tags- RFID Automatic Identification and Data Capture RFID Data Warehousing and analysis- RFID Data Management Issues, Solutions, and Directions- RFID Security: Threats and Solutions- RFIG Geometric Context of Wireless Tags- RFID Application in Animal Monitoring- RFID Enabled Logistics Services - Location Tracking in an Office Environment: The Nationwide Case Study- Pervasive Computing Security: Bluetooth's Example- Internet of Things: A Context-Awareness Perspective - Index.

UNIT IV   INTRODUCTION TO INDUSTRIAL INTERNET OF THINGS   9

Industrial Internet- Key IIoT Technologies- Innovation and the IIoT - Key Opportunities and Benefits the Digital and Human Workforce - Logistics and the Industrial Internet- IOT Innovations in Retail Cyber Physical Systems (CPS) – IP Mobility - Network Virtualization - SDN (Software Defined Networks)- The Cloud and Fog.

| UNIT V | IIOT ARCHITECTURE AND DESIGNING INDUSTRIAL INTERNET SYSTEMS | 9 |

Industrial Internet Architecture Framework (IIAF) - Industrial Internet Viewpoints - Architectural Topology: The Three-Tier Topology - Wireless Communication Technologies- Proximity Network Communication Protocols-Gateways: industrial gateways - CoAP (Constrained Application Protocol) – NFC

TOTAL: 45 PERIODS

REFERENCES:

1. Ovidiu Vermesan, Peter Friess, "Internet of Things - From Research and Innovation to Market Deployment"', River Publishers, 2014(unit I)
2. Ovidiu Vermesan, Peter Friess, "The Internet of Things: From RFID to the Next Generation Pervasive Networked Systems", River Publications, 2013.(Unit II)
3. Lu Yan, Yan Zhang, Laurence T. Yang and Huansheng Ning "The Internet of Things: From RFID to the Next-Generation Pervasive Networked Systems",. Auerbach Publications, 2019.(Unit III)
4. Gilchrist, Alasdair, "Industry 4.0 the Industrial Internet of Things", Apress, 2017. (Unit IV and Unit V)

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Describe the core principles of IoT Network Management.
CO2: Identify the applications of IoT in Industry.
CO3: Explain the basic concepts in RFID and Pervasive Networks.
CO4: Discuss the fundamental concepts in IIoT, CPS and Network Virtualization.
CO5: Design Industrial Internet Systems.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	2	2	2	2	2
CO2	1	1	1	3	3	3
CO3	1	3	2	3	2	1
CO4	1	1	2	2	3	3
CO5	2	1	2	2	3	3
AVG	1.2	1.6	1.8	2.4	2.6	2.4

PMC404   WEB ANALYTICS   L   T   P   C
                                                                   3   0   0   3

COURSE OBJECTIVES:

- To understand the Web analytics platform, and their evolution.
- To learn about the various Data Streams Data.
- To learn about the benefits of surveys and capturing of data.
- To understand Common metrics of web as well as KPI related concepts.
- To learn about the various Web analytics versions.

UNIT I   INTRODUCTION   9

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

UNIT II   DATA COLLECTION   9

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

UNIT III   QUALITATIVE ANALYSIS   9

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

UNIT IV   WEB METRICS   9

Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization (e-commerce, none-commerce sites): Improving bounce rates, Optimizing adwords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI. Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext Transfer Protocol), Server Log Files &Cookies, Web Bugs.

UNIT V   WEB ANALYTICS 2.0   9

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

TOTAL: 45 PERIODS

REFERENCES:

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

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Understand the Web analytics platform, and their evolution.

CO2: Use the various Data Streams Data.

CO3: Know how the survey of capturing of data will benefit.

CO4: Understand Common metrics of web as well as KPI related concepts.

CO5: Apply various Web analytics versions in existence.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	1	2	3	1	1
CO2	1	1	1	1	1	1
CO3	3	1	2	2	1	1
CO4	1	2	2	3	1	1
CO5	2	1	1	1	2	2
AVG	1.6	1.2	1.6	2	1.2	1.2

PMC405　　　　MACHINE LEARNING AND DEEP LEARNING　　　L　T　P　C
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3　0　0　3

COURSE OBJECTIVES:

The course is aimed at

- Understanding about the learning problem and algorithms.
- Providing insight about neural networks.
- Introducing the machine learning fundamentals and significance.
- Enabling the students to acquire knowledge about pattern recognition.
- Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I　　　LEARNING PROBLEMS AND ALGORITHMS　　　　　　　9

Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II　　　NEURAL NETWORKS　　　　　　　　　　　　　9

Differences between Biological and Artificial Neural Networks – Typical Architecture, Common Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron, Adaline, Standard Back propagation Training Algorithms for Pattern Association - Hebb rule and Delta rule, Hetero associative, Auto associative, Kohonen Self Organizing Maps, Examples of Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning.

UNIT III　　MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS　　　　　　　　　　9

Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV　　DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS　　　9

Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V　　　DEEP LEARNING: RNNS, AUTOENCODERS AND GANS　　　9

State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Auto encoders: Convolutional Auto encoders, Denoising auto encoders, Variational auto encoders, GANs: The discriminator, generator, DCGANs.

TOTAL: 45 PERIODS

REFERENCES:

1. J. S. R. Jang, C. T. Sun, E. Mizutani, Neuro Fuzzy and Soft Computing – A Computational Approach to Learning and Machine Intelligence, 2012, PHI learning
2. Deep Learning, Ian Good fellow, YoshuaBengio and Aaron Courville, MIT Press, ISBN:9780262035613, 2016.
3. The Elements of Statistical Learning. Trevor Hastie, Robert Tibshirani and Jerome Friedman. Second Edition. 2009.
4. Pattern Recognition and Machine Learning. Christopher Bishop. Springer. 2006.
5. Understanding Machine Learning. Shai Shalev-Shwartz and Shai Ben-David. Cambridge University Press. 2017.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Illustrate the categorization of machine learning algorithms.

CO2: Compare and contrast the types of neural network architectures, activation Functions.

CO3: Acquaint with the pattern association using neural networks.

CO4: Elaborate various terminologies related with pattern recognition and architectures of Convolutional neural networks.

CO5: Construct different feature selection and classification techniques and advanced Neural network architectures such as RNN, Auto encoders, and GANs.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	1	2	3	1	1
CO2	1	1	1	1	1	1
CO3	3	1	2	2	1	1
CO4	1	2	2	3	1	1
CO5	2	1	1	1	2	2
AVG	1.6	1.2	1.6	2	1.2	1.2

PMC501 DATABASE MANAGEMENT SYSTEMS AND SECURITY L T P C
                                                    3 0 0 3

COURSE OBJECTIVES:

- To learn the fundamentals of data models, conceptualize and depict a database system using ER diagram.
- To study the principles to be followed to create an effective relational database and write SQL queries to store/retrieve data to/from database systems.
- To know the fundamental concepts of transaction processing, concurrency control techniques and recovery procedure.
- To understand the need of security in Database Management systems.
- To learn how to secure Database Management systems.

UNIT I   RELATIONAL DATABASES   9

Data Models – Relational Data Models – Relational Algebra – Structured Query Language – Entity-Relationship Model - Mapping ER Models to Relations - Distributed Databases - Data Fragmentation – Replication.

UNIT II   DATABASE DESIGN   9

ER Diagrams – Functional Dependencies – Non-Loss Decomposition Functional Dependencies – First Normal Form – Second Normal Form – Third Normal Form – Dependency Preservation – Boyce/Codd Normal Form – Multi-Valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form.

UNIT III   TRANSACTION MANAGEMENT   9

Transaction Concepts – ACID Properties – Serializability – Transaction Isolation Levels – Concurrency Control – Need for Concurrency – Lock-Based Protocols – Deadlock Handling – Recovery System – Failure Classification – Recovery Algorithm.

UNIT IV   DATABASE SECURITY   9

Need for database security – SQL Injection Attacks – The Injection Technique – SQLi Attack Avenues and Types

UNIT V   ACCESS CONTROL AND ENCRYPTION   9

Database Access Control – SQL based access definition – Cascading Authorizations – Role-based access control – Inference – Database encryption

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, "Database System Concepts", Seventh Edition, Tata McGraw Hill, 2021.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", Seventh Edition, Pearson Education, 2016.
3. William Stallings, Lawrie Brown, "Computer Security: Principles and Practice", Fourth Edition, Pearson, 2019.

REFERENCES:

1. C.J. Date, A. Kannan and S. Swamynathan, "An Introduction to Database Systems", Pearson Education, Eighth Edition, 2006.
2. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", Third Edition, McGraw Hill, 2014.
3. Narain Gehani and Melliyal Annamalai, "The Database Book: Principles and Practice Using the Oracle Database System", Universities Press, 2012.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Model an application's data requirements using conceptual modeling and design
database schemas based on the conceptual model.

CO2: Formulate solutions to a broad range of query problems using relational algebra
SQL.

CO3: Demonstrate an understanding of normalization theory and apply such knowledge to
the normalization of a database.

CO4: Run transactions and estimate the procedures for controlling the consequences of
concurrent data access.

CO5: Understand and handle security issues in database management systems

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	2	2	1	1	-
CO2	1	2	2	1	1	-
CO3	2	1	2	1	2	-
CO4	2	2	3	2	1	-
CO5	2	2	3	2	2	-
AVG	1.6	1.8	2.4	1.4	1.4	-

PMC502   **OPERATING SYSTEMS AND SECURITY**   **L T P C**
                                                                2 0 2 3

COURSE OBJECTIVES:

- To understand the basic concepts of Operating Systems.
- To explore the process management concepts including scheduling, synchronization, threads and deadlock.
- To understand the memory, file and I/O management activities of OS.
- To understand the requirements of a trust model.
- To learn how security is implemented in various operating systems.

UNIT I   OPERATING SYSTEM OVERVIEW   6

Computer-System Organization – Architecture – Operating-System Operations – Resource Management – Security and Protection – Distributed Systems – Operating-System Services. Operating System Design and Implementation – Building and Booting an Operating System.

UNIT II   PROCESS MANAGEMENT   6

Process Concept – Process Scheduling – Operation on Processes, Inter process Communication– Threads – Overview – Multithreading models – Threading issues; CPU Scheduling – Scheduling criteria, Scheduling algorithms; Process Synchronization – critical- section problem. Deadlock – System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Detection, Recovery.

UNIT III   MEMORY MANAGEMENT AND FILE SYSTEMS   6

Main Memory – Background, Swapping, Contiguous Memory Allocation, Paging, Segmentation – Virtual Memory – Demand Paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory. Mass Storage system - HDD Scheduling – File System Structure, Directory implementation, Allocation Methods, Free Space Management.

UNIT IV   SECURE SYSTEMS AND VERIFIABLE SECURITY GOALS   6

Security Goals – Trust and Threat Model – Access Control Fundamentals – Protection System Reference Monitor – Secure Operating System Definition – Assessment Criteria – Information Flow – Information Flow Secrecy Models – Denning's Lattice Model – Bell LaPadula Model.

UNIT V   SECURITY IN OPERATING SYSTEMS   6

UNIX Security – UNIX Protection System – UNIX Authorization – UNIX Security Analysis – UNIX Vulnerabilities – Windows Security – Windows Protection System – Windows Authorization – Windows Security Analysis – Windows Vulnerabilities.

30 PERIODS

PRACTICAL EXERCISES

1. Basics of UNIX commands, Understand and practice Linux Permissions, special permissions and authentication (various options of chmod, setuid, setgid)
2. Write programs using the following system calls of UNIX operating systemfork, exec, getpid, exit, wait, close, stat, opendir, readdir
3. Write C programs to implement the various CPU Scheduling Algorithms
4. Implementation of Semaphores
5. Implementation of Shared memory
6. Bankers Algorithm for Deadlock Detection &Avoidance
7. Implementation of the following Memory Allocation Methods for fixed partition
     a) First Fit   b) Worst Fit   c) Best Fit
8. Implementation of the following Page Replacement Algorithms
     a) FIFO   b) LRU   c) LFU
9. Program to demonstrate the working of Bell LaPadula Model and Biba Integrity Model
10. Setting up access control lists of files and directories and testing the lists in Linux
11. Learn to enable and disable address space layout randomization

TOTAL: 45 PERIODS

TEXT BOOK:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", John Wiley & Sons, Inc., 10th Edition, 2021.
2. Trent Jaeger, Operating System Security, Morgan & Claypool Publishers series, 2008.

REFERENCES:

1. Morrie Gasser, "Building A Secure Computer System", Van Nostrand Reinhold, New York, 1988.
2. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.
3. William Stallings, "Operating Systems - Internals and Design Principles", 9th Edition, Pearson, 2017.
4. Michael Palmer, "Guide to Operating Systems Security", Course Technology – Cengage Learning, New Delhi, 2008.
5. Introduction to Hardware, Security and Trust, book by Mohammad Tehranipoor, CliffWang, Springer, 2012.
6. Gary McGraw, Software Security: Building Security In, Addison Wesley software Security series, 2005.
7. Gerardus Blokdyk, Security Focused Operating System A Complete Guide -2020 Edition, 5STARCooks, ISBN: 9781867373353, 2020.

COURSE OUTCOMES (COs):

On completion of the laboratory course, the student should be able to

CO1: To gain understanding on the concepts of Operating Systems.

CO2: To acquire knowledge on process management concepts including scheduling,
Synchronization, threads and deadlock.

CO3: To have understanding on memory, file and I/O management activities of OS.

CO4: To understand security issues in operating systems and appreciate the need
for security models

CO5: To gain exposure to the operating systems security models of WINDOWS and
UNIX OS.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	2	1
CO3	3	3	3	3	2	2
CO4	3	3	3	3	1	1
CO5	3	3	3	3	1	2
AVG	3	3	3	3	1.8	1.6

PMC503   **CRYPTOGRAPHY AND CYBER SECURITY**   L   T   P   C
                                                                               3   0   0   3

COURSE OBJECTIVES:

- Learn to analyze the security of in-built cryptosystems.
- Know the fundamental mathematical concepts related to security.
- Develop cryptographic algorithms for information security.
- Comprehend the various types of data integrity and authentication schemes.
- Understand cybercrimes and cyber security.

UNIT I   INTRODUCTION TO SECURITY   9

Computer Security Concepts – The OSI Security Architecture – Security Attacks – Security Services and Mechanisms – A Model for Network Security – Classical encryption techniques: Substitution techniques, Transposition techniques, Steganography – Foundations of modern cryptography: Perfect security – Information Theory – Product Cryptosystem – Cryptanalysis.

UNIT II   SYMMETRIC CIPHERS   9

Number theory – Algebraic Structures – Modular Arithmetic - Euclid's algorithm – Congruence and matrices – Group, Rings, Fields, Finite Fields SYMMETRIC KEY CIPHERS: SDES - Block Ciphers – DES, Strength of DES – Differential and linear cryptanalysis - Block cipher design principles – Block cipher mode of operation – Evaluation criteria for AES – Pseudo random Number Generators – RC4 – Key distribution.

UNIT III   ASYMMETRIC CRYPTOGRAPHY   9

MATHEMATICS OF ASYMMETRIC KEY CRYPTOGRAPHY: Primes – Primality Testing – Factorization – Euler's totient function, Fermat's and Euler's Theorem – Chinese Remainder Theorem – Exponentiation and logarithm ASYMMETRIC KEY CIPHERS: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange –- Elliptic curve arithmetic – Elliptic curve cryptography.

UNIT IV   INTEGRITY AND AUTHENTICATION ALGORITHMS   9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function: HMAC, CMAC – SHA – Digital signature and authentication protocols – DSS – Schnorr Digital Signature Scheme – ElGamal cryptosystem – Entity Authentication: Biometrics, Passwords, Challenge Response protocols – Authentication applications – Kerberos MUTUAL TRUST: Key management and distribution – Symmetric key distribution using symmetric and asymmetric encryption – Distribution of public keys – X.509 Certificates

UNIT V   CYBER CRIMES AND CYBER SECURITY   9

Cyber Crime and Information Security – classifications of Cyber Crimes – Tools and Methods – Password Cracking, Keyloggers, Spywares, SQL Injection – Network Access Control – Cloud Security – Web Security – Wireless Security

TOTAL: 45 PERIODS

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security - Principles and Practice", Seventh Edition, Pearson Education, 2017.
2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cybercrimes, Computer Forensics and Legal Perspectives", First Edition, Wiley India, 2011.

REFERENCES:

1. Behrouz A. Ferouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security",3rd Edition, Tata Mc Graw Hill, 2015.
2. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Understand the fundamentals of networks security, security architecture, threats and vulnerabilities.

CO2: Apply the different cryptographic operations of symmetric cryptographic algorithms.

CO3: Apply the different cryptographic operations of public key cryptography.

CO4: Apply the various Authentication schemes to simulate different applications.

CO5: Understand various cybercrimes and cyber security.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	3	2	1	2	2	-
CO2	3	3	3	3	3	-
CO3	3	3	3	3	3	-
CO4	3	3	3	3	3	-
CO5	3	2	3	2	3	-
AVG	3	2.6	2.6	2.6	2.8	-

PMC504   **ENGINEERING SECURE SOFTWARE SYSTEMS**   **L   T   P   C**
                                                             2   0   2   3

COURSE OBJECTIVES:

- Know the importance and need for software security.
- Know about various attacks.
- Learn about secure software design.
- Understand risk management in secure software development.
- Know the working of tools related to software security.

UNIT I   NEED OF SOFTWARE SECURITY AND LOW-LEVEL ATTACKS   6

Software Assurance and Software Security - Threats to software security - Sources of software insecurity - Benefits of Detecting Software Security - Properties of Secure Software – Memory-Based Attacks: Low-Level Attacks against Heap and Stack - Defense Against Memory-Based Attacks.

UNIT II   SECURE SOFTWARE DESIGN   7

Requirements engineering for secure software - SQUARE process Model – Requirements elicitation and prioritization- Isolating the Effects of Untrusted Executable Content – Stack Inspection – Policy Specification Languages – Vulnerability Trends – Buffer Overflow – Code Injection - Session Hijacking. Secure Design - Threat Modeling and Security Design Principles.

UNIT III   SECURITY RISK MANAGEMENT   5

Risk Management Life Cycle – Risk Profiling – Risk Exposure Factors – Risk Evaluation and Mitigation – Risk Assessment Techniques – Threat and Vulnerability Management.

UNIT IV   SECURITY TESTING   8

Traditional Software Testing – Comparison - Secure Software Development Life Cycle - Risk Based Security Testing – Prioritizing Security Testing With Threat Modeling – Penetration Testing-Planning and Scoping - Enumeration – Remote Exploitation – Web Application Exploitation - Exploits and Client Side Attacks – Post Exploitation – Bypassing Firewalls and Avoiding Detection-Tools for Penetration Testing.

UNIT V   SECURE PROJECT MANAGEMENT   4

Governance and security - Adopting an enterprise software security framework - Security and project management - Maturity of Practice.

30 PERIODS

PRACTICAL EXERCISES :   15 PERIODS

1. Implement the SQL injection attack.
2. Implement the Buffer Overflow attack.
3. Implement Cross Site Scripting and Prevent XSS.
4. Perform Penetration testing on a web application to gather information about the system, then initiate XSS and SQL injection attacks using tools like Kali Linux.
5. Develop and test the secure test cases
6. Penetration test using kali Linux

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Julia H. Allen, "Software Security Engineering", Pearson Education, 2008
2. Evan Wheeler, "Security Risk Management: Building an Information Security Risk Management Program from the Ground Up", First edition, Syngress Publishing, 2011
3. Chris Wysopal, Lucas Nelson, Dino Dai Zovi, and Elfriede Dustin, "The Art of Software Security Testing: Identifying Software Security Flaws (Symantec Press)", Addison Wesley Professional, 2006

REFERENCES:

1. Robert C. Seacord, "Secure Coding in C and C++ (SEI Series in Software Engineering)", Addison-Wesley Professional, 2005.
2. Jon Erickson, "Hacking: The Art of Exploitation", 2nd Edition, No Starch Press, 2008.
3. Mike Shema, "Hacking Web Apps: Detecting and Preventing Web Application Security Problems", First edition, Syngress Publishing, 2012
4. Bryan Sullivan and Vincent Liu, "Web Application Security, A Beginner's Guide", Kindle Edition,McGraw Hill, 2012
5. Lee Allen, "Advanced Penetration Testing for Highly-Secured Environments: The Ultimate Security Guide (Open Source: Community Experience Distilled)", Kindle Edition, Packt Publishing,2012
6. Jason Grembi, "Developing Secure Software"

COURSE OUTCOMES (COs):

On completion of the laboratory course, the student should be able to

CO1: Identify various vulnerabilities related to memory attacks.

CO2: Apply security principles in software development.

CO3: Evaluate the extent of risks.

CO4: Involve selection of testing techniques related to software security in the testing phase of software development.

CO5: Use tools for securing software.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	3	2	3	2	-
CO2	2	2	2	3	3	-
CO3	1	2	2	2	1	-
CO4	2	3	2	2	2	-
CO5	2	1	2	2	3	-
AVG	1.8	2.2	2	2.4	2.2	-

CYBER FORENSICS   L   T   P   C
                                                                      2   0   2   3

COURSE OBJECTIVES:

- To learn cybercrime and forensics.
- To become familiar with forensics tools.
- To learn to analyze and validate forensics data.
- To understand cyber laws and the admissibility of evidence with case studies.
- To learn the vulnerabilities in network infrastructure with ethical hacking.

UNIT I   INTRODUCTION TO CYBER CRIME AND FORENSICS   6

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Role of ECD and ICT in Cybercrime - Classification of Cyber Crime. The Present and future of Cybercrime - Cyber Forensics -Steps in Forensic Investigation - Forensic Examination Process - Types of CF techniques - Forensic duplication and investigation - Forensics Technology and Systems - Understanding Computer Investigation – Data Acquisition.

UNIT II   EVIDENCE COLLECTION AND FORENSICS TOOLS   6

Processing Crime and Incident Scenes – Digital Evidence - Sources of Evidence - Working with File Systems. - Registry - Artifacts - Current Computer Forensics Tools: Software/ Hardware Tools - Forensic Suite - Acquisition and Seizure of Evidence from Computers and Mobile Devices - Chain of Custody- Forensic Tools

UNIT III   ANALYSIS AND VALIDATION   6

Validating Forensics Data – Data Hiding Techniques – Performing Remote Acquisition – Network Forensics – Email Investigations – Cell Phone and Mobile Devices Forensics - Analysis of Digital Evidence - Admissibility of Evidence - Cyber Laws in India – Case Studies

UNIT IV   ETHICAL HACKING   6

Introduction to Ethical Hacking – Foot printing and Reconnaissance – Scanning Networks - Enumeration - System Hacking - Malware Threats – Sniffing – Email Tracking

UNIT V   ETHICAL HACKING IN WEB   6

Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications – SQL Injection - Hacking Wireless Networks – Hacking Mobile Platforms.

30 PERIODS

PRACTICAL EXERCISES:

1. Study and Explore the following forensic tools:
   a. FTK Imager
   b. Autopsy
   c. EnCase Forensic Imager
   d. LastActivityView
   e. USBDeview
2. Recover deleted files using FTKImager
3. Acquire forensic image of hard disk using EnCase Forensics Imager and also perform Integrity checking/validation
4. Restore the Evidence Image using En Case Forensics Imager.
5. Study the following:
   a. Collect Email Evidence in Victim PC.
   b. Extract Browser Artifacts (Chrome History view for Google Chrome)
6. Use USB Device to find the last connected USB to the system
7. Perform Live Forensics Case Investigation using Autopsy
8. Study Email Tracking and Email Tracing and write a report on them.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Bill Nelson, Amelia Phillips, Christopher Steuart, ‾Guide to Computer Forensics and Investigations‖, Cengage Learning, India Sixth Edition, 2019.
2. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, Version 11, 2021.
3. Dejey, S. Murugan - Cyber Forensics, Oxford University Press, India, 2018

REFERENCES:

1. John R.Vacca, "Computer Forensics ", Cengage Learning, 2005
2. MarjieT.Britz, "Computer Forensics and Cyber Crime: An Introduction 3rd Edition, PrenticeHall, 2013.
3. AnkitFadia " Ethical Hacking, Second Edition, Macmillan India Ltd, 2006
4. Kenneth C.Brancik "Insider Computer Fraud Auerbach Publications Taylor & Francis Group-2008.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Understand the basics of cybercrime and computer forensics.

CO2: Apply a number of different computer forensic tools to a given scenario.

CO3: Analyze and validate forensics data and understand admissibility of evidence in India with Cyber laws and Case Studies.

CO4: Identify the vulnerabilities in a given network infrastructure.

CO5: Implement real-world hacking techniques to test system security.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	-	-	-	-	-	-
CO2	2	1	1	2	-	-
CO3	2	2	1	1	2	-
CO4	-	-	-	-	-	-
CO5	-	3	-	2	-	-
AVG	0.8	1.2	0.6	1	0.4	-

PMC601	VIRTUALIZATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- ▪ To learn the basics and types of Virtualization.
- ▪ To understand the Hypervisors and its types.
- ▪ To explore the Virtualization Solutions.
- ▪ To experiment the virtualization platforms.

UNIT I   INTRODUCTION TO VIRTUALIZATION   7

Virtualization and cloud computing - Need of virtualization – cost, administration, fast deployment, reduce infrastructure cost – limitations- Types of hardware virtualization: Full virtualization - partial virtualization – Para virtualization-Types of Hypervisors

UNIT II   SERVER AND DESKTOP VIRTUALIZATION   6

Virtual machine basics- Types of virtual machines- Understanding Server Virtualization- types of server virtualization- Business Cases for Server Virtualization – Uses of Virtual Server Consolidation – Selecting Server Virtualization Platform-Desktop Virtualization-Types of Desktop Virtualization

UNIT III   NETWORK VIRTUALIZATION   6

Introduction to Network Virtualization-Advantages- Functions-Tools for Network Virtualization VLAN-WAN Architecture-WAN Virtualization

UNIT IV   STORAGE VIRTUALIZATION   5

Memory Virtualization-Types of Storage Virtualization-Block, File-Address space Remapping Risks of Storage Virtualization-SAN-NAS-RAID

UNIT V   VIRTUALIZATION TOOLS   6

VMWare-Amazon AWS-Microsoft HyperV- Oracle VM Virtual Box - IBM PowerVM- Google Virtualization- Case study.

30 PERIODS

PRACTICAL EXERCISES: **15 PERIODS**

1. Create type 2 virtualization in VMWARE or any equivalent Open Source Tool. Allocate memory and storage space as per requirement. Install Guest OS on that VMWARE.
2. a. Shrink and extend virtual disk
   b. Create, Manage, Configure and schedule snapshots
   c. Create Spanned, Mirrored and Striped volume
   d. Create RAID 5 volume
3. a. Desktop Virtualization using VNC
   b. Desktop Virtualization using Chrome Remote Desktop
4. Create type 2 virtualization on ESXI 6.5 server
5. Create a VLAN in CISCO packet tracer
6. Install KVM in Linux
7. Create Nested Virtual Machine(VM under another VM)

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010
2. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011
3. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach
4. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", APress,2005.
5. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
6. David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Auerbach Publications, 2006.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Analyze the virtualization concepts and Hypervisor.

CO2: Understanding the server virtualization and the types.

CO3: Analyze the tools for network virtualization.

CO4: Memory and storage virtualization.

CO5: Experiment with the VM with various software.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	-	-	-	-	-	-
CO2	2	1	1	2	-	-
CO3	2	2	1	1	2	-
CO4	-	-	-	-	-	-
CO5	-	3	-	2	-	-
AVG	0.8	1.2	0.6	1	0.4	-

PMC602 CLOUD SERVICES MANAGEMENT   **L T P C**
                                        2 0 2 3

COURSE OBJECTIVES:

- Introduce Cloud Service Management terminology, definition & concepts.
- Compare and contrast cloud service management with traditional IT service management.
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services.
- Select appropriate structures for designing, deploying and running cloud-based services in a business environment.
- Illustrate the benefits and drive the adoption of cloud-based services to solve real world problems.

UNIT I   CLOUD SERVICE MANAGEMENT FUNDAMENTALS   6

Cloud Ecosystem, the Essential Characteristics, Basics of Information Technology Service Management and Cloud Service Management, Service Perspectives, Cloud Service Models, Cloud service Deployment Models

UNIT II   CLOUD SERVICES STRATEGY   6

Cloud Strategy Fundamentals, Cloud Strategy Management Framework, Cloud Policy, Key Driver for Adoption, Risk Management, IT Capacity and Utilization, Demand and Capacity matching, Demand Queueing, Change Management, Cloud Service Architecture.

UNIT III   CLOUD SERVICE MANAGEMENT   6

Cloud Service Reference Model, Cloud Service LifeCycle, Basics of Cloud Service Design, Dealing with Legacy Systems and Services, Benchmarking of Cloud Services, Cloud Service Capacity Planning, Cloud Service Deployment and Migration, Cloud Marketplace, Cloud Service Operations Management.

UNIT IV   CLOUD SERVICE ECONOMICS   6

Pricing models for Cloud Services, Freemium, Pay Per Reservation, Pay per User, Subscription based Charging, Procurement of Cloud-based Services, Capex vs Opex Shift, Cloud service Charging, Cloud Cost Models.

UNIT V   CLOUD SERVICE GOVERNANCE & VALUE   6

IT Governance Definition, Cloud Governance Definition, Cloud Governance Framework, Cloud Governance Structure, Cloud Governance Considerations, Cloud Service Model Risk Matrix, Understanding Value of Cloud Services, Measuring the value of Cloud Services, Balanced Scorecard, Total Cost of Ownership.

30 PERIODS

PRACTICAL EXERCISES: **15 PERIODS**

1. Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud software's like Openstack, Eucalyptus, OpenNebula with Role-based access control
2. Create a Cost-model for a web application using various services and do Cost-benefit analysis
3. Create alerts for usage of Cloud resources
4. Create Billing alerts for your Cloud Organization
5. Compare Cloud cost for a simple web application across AWS, Azure and GCP and Suggest the best one

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Cloud Service Management and Governance: Smart Service Management in Cloud Era by Enamul Haque, Enel Publications
2. Cloud Computing: Concepts, Technology & Architecture by Thomas Erl, Ricardo Puttini, Zaigham Mohammad 2013
3. Cloud Computing Design Patterns by Thomas Erl, Robert Cope, Amin Naserpour

REFERENCES:

1. Economics of Cloud Computing by Praveen Ayyappa, LAP Lambert Academic Publishing
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya, Christian Vechhiola, S. Thamarai Selvi

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Exhibit cloud-design skills to build and automate business solutions using cloud technologies.

CO2: Discuss the cloud strategy fundamentals and framework.

CO3: Possess Strong theoretical foundation leading to excellence and excitement towards adoption of cloud-based services.

CO4: Analyze the price model for the cloud services.

CO5: Solve the real world problems using Cloud services and technologies.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	3	3	1	1	1	-
CO2	3	1	2	3	2	-
CO3	1	1	3	1	3	-
CO4	1	1	1	2	3	-
CO5	1	3	3	2	2	-
AVG	1.8	1.8	2	1.8	2.2	-

PMC603   **STORAGE TECHNOLOGIES**   L T P C

                                                                                     3 0 0 3

COURSE OBJECTIVES:

- Characterize the functionalities of logical and physical components of storage.
- Describe various storage networking technologies.
- Identify different storage virtualization technologies.
- Discuss the different backup and recovery strategies.
- Understand common storage management activities and solutions.

UNIT I   STORAGE SYSTEMS   9

Introduction to Information Storage: Digital data and its types, Information storage, Key characteristics of data center and Evolution of computing platforms. Information Lifecycle Management. Third Platform Technologies: Cloud computing and its essential characteristics, Cloud services and cloud deployment models, Big data analytics, Social networking and mobile computing, Characteristics of third platform infrastructure and Imperatives for third platform transformation. DataCenter Environment: Building blocks of a data center, Compute systems and compute virtualization and Software-defined data center.

UNIT II   INTELLIGENT STORAGE SYSTEMS AND RAID   5

Components of an intelligent storage system, Components, addressing, and performance of hard disk drives and solid-state drives, RAID, Types of intelligent storage systems, Scale-up and scale- out storage Architecture

UNIT III   STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION   13

Block-Based Storage System, File-Based Storage System, Object-Based and Unified Storage. Fibre Channel SAN: Software-defined networking, FC SAN components and architecture, FC SAN topologies, link aggregation, and zoning, Virtualization in FC SAN environment. Internet Protocol SAN: iSCSI protocol, network components, and connectivity, Link aggregation, switch aggregation, and VLAN, FCIP protocol, connectivity, and configuration. Fibre Channel over Ethernet SAN: Components of FCoE SAN, FCoE SAN connectivity, Converged Enhanced Ethernet, FCoE architecture

UNIT IV   BACKUP, ARCHIVE AND REPLICATION   12

Introduction to Business Continuity, Backup architecture, Backup targets and methods, Data deduplication, Cloud-based and mobile device backup, Data archive, Uses of replication and its characteristics, Compute based, storage-based, and network-based replication, Data migration, Disaster Recovery as a Service (DRaaS).

UNIT V   SECURING STORAGE INFRASTRUCTURE   6

Information security goals, Storage security domains, Threats to a storage infrastructure, Security controls to protect a storage infrastructure, Governance, risk, and compliance, Storage infrastructure management functions, Storage infrastructure management processes

TOTAL: 45 PERIODS

TEXT BOOKS:

1. EMC Corporation, Information Storage and Management, Wiley, India
2. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas,Introduction to Storage Area Networks, Ninth Edition, IBM - Redbooks, December 2017
3. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, Storage Networks Explained, Second Edition, Wiley, 2009

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Demonstrate the fundamentals of information storage management and various models of Cloud infrastructure services and deployment.

CO2: Illustrate the usage of advanced intelligent storage systems and RAID.

CO3: Interpret various storage networking architectures - SAN, including storage sub systems and virtualization.

CO4: Examine the different role in providing disaster recovery and remote replication technologies.

CO5: Infer the security needs and security measures to be employed in information storage management.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	2	1	3	3	-
CO2	3	1	2	3	3	-
CO3	1	1	3	2	2	-
CO4	3	2	1	2	2	-
CO5	1	3	2	1	2	-
AVG	1.8	1.8	1.8	2.2	2.4	-

PMC604   **SOFTWARE DEFINED NETWORKS**   **L   T   P   C**
                                                                 2   0   2   3

COURSE OBJECTIVES:

- ▪ To understand the need for SDN and its data plane operations.
- ▪ To understand the functions of control plane.
- ▪ To comprehend the migration of networking functions to SDN environment.
- ▪ To explore various techniques of network function virtualization.
- ▪ To comprehend the concepts behind network virtualization.

UNIT I   SDN: INTRODUCTION   6

Evolving Network Requirements – The SDN Approach – SDN architecture – SDN Data Plane, Control plane and Application Plane

UNIT II   SDN DATA PLANE AND CONTROL PLAN   6

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

UNIT III   SDN APPLICATIONS   6

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking

UNIT IV   NETWORK FUNCTION VIRTUALIZATION   6

Network Virtualization - Virtual LANs – OpenFlow VLAN Support - NFV Concepts – Benefits and requirements – Reference Architecture

UNIT V   NFV FUNCTIONALITY   6

NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use cases – SDN and NFV

30 PERIODS

PRACTICAL EXERCISES: **15 PERIODS**

1. Setup your own virtual SDN lab
   i. Virtualbox / Mininet Environment for SDN - http://mininet.org
   ii. https://www.kathara.org
   iii. GNS3
2. Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN and PACKET OUT etc.

3. Create a SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc.
4. Create a simple end-to-end network service with two VNFs using vim-emu https://github.com/containernet/vim-emu
5. Install OSM and onboard and orchestrate network service.

TOTAL: 45 PERIODS

TEXTBOOKS:

1. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud",Pearson Education, 1st Edition, 2015.

REFERENCES:

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

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Describe the motivation behind SDN.

CO2: Identify the functions of the data plane and control plane.

CO3: Design and develop network applications using SDN.

CO4: Orchestrate network services using NFV.

CO5: Explain various use cases of SDN and NFV.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	2	3	1	3	-
CO2	2	1	2	2	3	-
CO3	2	2	2	3	3	-
CO4	2	2	2	3	1	-
CO5	3	3	1	1	3	-
AVG	2	2	2	2	2.6	-

PMC605	STREAM PROCESSING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Introduce Data Processing terminology, definition & concepts.
- Define different types of Data Processing.
- Explain the concepts of Real-time Data processing.
- Select appropriate structures for designing and running real-time data services in a business environment.
- Illustrate the benefits and drive the adoption of real-time data services to solve real world problems.

UNIT I FOUNDATIONS OF DATA SYSTEMS 6

Introduction to Data Processing, Stages of Data processing, Data Analytics, Batch Processing, Stream processing, Data Migration, Transactional Data processing, Data Mining, Data Management Strategy, Storage, Processing, Integration, Analytics, Benefits of Data as a Service, Challenges

UNIT II REAL-TIME DATA PROCESSING 6

Introduction to Big data, Big data infrastructure, Real-time Analytics, Near real-time solution, Lambda architecture, Kappa Architecture, Stream Processing, Understanding Data Streams, Message Broker, Stream Processor, Batch & Real-time ETL tools, Streaming Data Storage

UNIT III DATA MODELS AND QUERY LANGUAGES 6

Relational Model, Document Model, Key-Value Pairs, NoSQL, Object-Relational Mismatch, Many- to-One and Many-to-Many Relationships, Network data models, Schema Flexibility, Structured Query Language, Data Locality for Queries, Declarative Queries, Graph Data models, Cypher Query Language, Graph Queries in SQL, The Semantic Web, CODASYL, SPARQL

UNIT IV EVENT PROCESSING WITH APACHE KAFKA 6

Apache Kafka, Kafka as Event Streaming platform, Events, Producers, Consumers, Topics, Partitions, Brokers, Kafka APIs, Admin API, Producer API, Consumer API, Kafka Streams API, Kafka Connect API

UNIT V REAL-TIME PROCESSING USING SPARK STREAMING 6

Structured Streaming, Basic Concepts, Handling Event-time and Late Data, Fault tolerant Semantics, Exactly-once Semantics, Creating Streaming Datasets, Schema Inference, Partitioning of Streaming datasets, Operations on Streaming Data, Selection, Aggregation, Projection, Watermarking, Window operations, Types of Time windows, Join Operations, Deduplication

30 PERIODS

PRACTICAL EXERCISES: **15 PERIODS**

1. Install MongoDB
2. Design and Implement Simple application using MongoDB
3. Query the designed system using MongoDB
4. Create a Event Stream with Apache Kafka
5. Create a Real-time Stream processing application using Spark Streaming
6. Build a Micro-batch application
7. Real-time Fraud and Anomaly Detection
8. Real-time personalization, Marketing, Advertising

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Streaming Systems: The What, Where, When and How of Large-Scale Data Processing by Tyler Akidau, Slava Chemyak, Reuven Lax, O'Reilly publication
2. Designing Data-Intensive Applications by Martin Kleppmann, O'Reilly Media Practical Real-time Data Processing and Analytics : Distributed Computing and Event Processing using Apache Spark, Flink, Storm and Kafka, Packt Publishing

REFERENCES:

1. https://spark.apache.org/docs/latest/streaming-programming-guide.html
2. Kafka.apache.org

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Understand the applicability and utility of different streaming algorithms.

CO2: Describe and apply current research trends in data-stream processing.

CO3: Analyze the suitability of stream mining algorithms for data stream systems.

CO4: Program and build stream processing systems, services and applications.

CO5: Solve problems in real-world applications that process data streams.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	2	3	1	-
CO2	2	1	1	2	2	-
CO3	3	1	2	3	3	-
CO4	2	1	3	3	3	-
CO5	3	3	1	2	2	-
AVG	2.6	1.8	1.8	2.6	2.2	-

AUDIT COURSES (AC)

AEN401   **ENGLISH FOR RESEARCH PAPER WRITING**   L   T   P   C
                                                               2   0   0   0

COURSE OBJECTIVES:

- Demonstrate writing meaningful sentences and coherent paragraphs
- Show conciseness, clarity and avoid redundancy in writing
- Summarize, evaluate literature, and write methodology, results and conclusion
- Describe how to develop title, write abstract and introduction
- Apply correct style of referencing and use punctuation appropriately

UNIT I   INTRODUCTION TO RESEARCH PAPER WRITING   6

Planning and preparation, word order & breaking up long sentences, structuring sentences and paragraphs. Presenting concisely and briefly. Outline ideas, simplify long sentences, and write coherent paragraphs with strong topic sentences and transitions, improving clarity and flow in academic, professional, and creative writing.

UNIT II   ENGAGING AND PERSUASIVE WRITING   6

Crafting clear arguments, using evidence effectively, adapting tone and style for different audiences, and applying rhetorical strategies to persuade. Exploring techniques for writing captivating opening statements and strong conclusions, developing coherence and flow. Checking for plagiarism.

UNIT III   KEY COMPONENTS OF WRITING A RESEARCH PAPER   6

Title, Abstract, Introduction, Literature Review, Methods/Methodology, Results, Discussion, Conclusion, References/Bibliography, Appendices.

UNIT IV   CRITICAL ANALYSIS OF RESEARCH PAPER   6

Identifying the research question, Examining the hypothesis, Assessing the study design, Reviewing and analysing data collection methods

UNIT V   CITING SOURCES AND POLISHING LANGUAGE   6

Useful phrases and punctuation, Integrating in-text citation and bibliography. Using clear and formal language, employing useful academic phrases, applying correct punctuation, paraphrasing effectively and maintaining consistency in citation.

TOTAL: 30 PERIODS

REFERENCES:

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book1998.

COURSE OUTCOMES (COs):

On completion of the course, the students will be able to

CO1: Write clear, meaningful sentences and coherent paragraphs that effectively convey ideas in a structured manner.

CO2: Demonstrate the ability to produce concise and clear written content eliminating redundancy while maintaining meaning and impact.

CO3: Summarize and evaluate literature and compose well-organized methodology, results and conclusion sections for academic or research writing.

CO4: Develop appropriate titles and write compelling abstracts and introductions that set the context and purpose of their work.

CO5: apply appropriate referencing styles and use punctuation correctly to enhance the clarity and professionalism of their writing.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	3	1	1	1	1
CO2	1	3	1	1	1	1
CO3	1	3	1	1	1	1
CO4	1	3	1	1	1	1
CO5	1	3	1	1	1	1
AVG	1	3	1	1	1	1

ACE402   DISASTER MANAGEMENT   L   T   P   C
                                                                     2   0   0   0

COURSE OBJECTIVES:

- Summarize basics of disaster.
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple Perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches.

UNIT I   INTRODUCTION   6

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II   REPERCUSSIONS OF DISASTERS AND HAZARDS   6

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks of Disease And Epidemics, War And Conflicts.

UNIT III   DISASTER PRONE AREAS IN INDIA   6

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV   DISASTER PREPAREDNESS AND MANAGEMENT   6

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V   RISK ASSESSMENT   6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL: 30 PERIODS

REFERENCES:

1. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal book Company, 2007.
3. Sahni, Pardeep Et.Al. ," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi, 2001.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Ability to summarize basics of disaster.

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5:Ability to develop the strengths and weaknesses of disaster management approaches.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	2	1	1	1	1
CO2	1	2	1	1	1	1
CO3	1	2	1	1	1	1
CO4	1	2	1	1	1	1
CO5	1	1	1	1	1	1
AVG	1	1.8	1	1	1	1

ABA403   **CONSTITUTION OF INDIA**   L   T   P   C

                                                                     2   0   0   0

COURSE OBJECTIVES:

Students will be able to:

- ▪ Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- ▪ To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional. Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- ▪ To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I   HISTORY AND PHILOSOPHY OF THE INDIAN CONSTITUTION   6

History - Constituent Assembly Govt. of India Act 1935 and India Independence Act 1947 – Why Tamilnadu's "Sengol" in Parliament (1947 & 2023)- Samvidhan Divas - The Preamble. The Constitutional amendments in India - National Emergency, President Rule, - Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT II   THE CENTRE: EXECUTIVE, LEGISLATIVE AND JUDICIARY   6

Meaning of Indian Flag & Ashoka Chakra - Indian Parliament, RS, LS, "The President" & "The Vice President", "The Prime Minister" - Central Ministry Cabinet. Supreme Court - Power & Functions, Appointment of Supreme & High Courts Judges (Collegium) - NRC & CAA (Illegal Migrants) - Abrogation of Article 370 in J & K – Need of Uniform Civil Code (UCC).

UNIT III   THE STATE GOVERNMENT, UNION TERRITORIES & STATE   6
                  LEGISLATURE

Madras Presidency to Tamil Nadu – Tamil Nadu Emblem. "The Governor" – Chief Minister - State Cabinet, MLA – Role & Power & Functions. Union Territories, Power & Functions – Central & State Relations. High Court & Subordinate Courts.

UNIT IV   LOCAL ADMINISTRATION   6

Corporation – Mayor – Role & Importance, Chairman District Administration Head - Role and Importance, Role of Elected Representative. Panchayati Raj: Functions PRI – Grama Sabha.
Block level Organizational Hierarchy, Village level - Role of Elected and Appointed officials - Importance of grass-root democracy.

UNIT V   ELECTION COMMISION AND E-GOVERNANCE   6

Role of Chief Election Commissioner - State Election Commission – One India One Election. National Good Governance Day - Governance and role of Engineers in E-Governance, Need for reformed engineering serving at the Centre and State, E- Courts, Role of I.T. professionals in Judiciary, Problem of Alienation and Secessionism in few states creating hurdles in Industrial development.

                                                             TOTAL: 30 PERIODS

TEXT BOOKS:

T1: Laxmikanth, M. (2024). Indian Polity (7th ed.). McGraw Hill Education.

T2: Singh, M. P. (Ed.). (2024). EBC's V. N. Shukla's Constitution of India (14th ed., reprint 2024). Eastern Book Company.

REFERENCES:

R1: BR. Ambedkar, Rupa Publications. (2024). The Constitution of India. Rupa Publications.

R2: Bakshi, P. M. (2023). The Constitution of India (19th ed.). Universal Law Publishing (LexisNexis).

R3: Babu, D. D. (2024). Introduction to the Constitution of India (27th ed.). LexisNexis.

R4: Kohli Atul (ed.), The Success of India's Democracy, Cambridge University Press, latest edition.

R5: Sharma, B. K. (2024). Introduction to the Constitution of India (11th ed.). PHI Learning.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: To interpret the philosophy of the Indian constitution.

CO3: Discuss the intellectual constitutional rights and duties.

CO4: Understand the organs of governance and the qualifications.

CO5: To analyze the Indian political system, the power and role of the elected officials identifies the organizational hierarchy.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	1	1	1	1	1
CO2	1	1	1	1	1	1
CO3	1	1	1	1	1	1
CO4	1	1	1	1	1	1
CO5	1	1	1	1	1	1
AVG	1	1	1	1	1	1

ABA404　　　　　　**ENTREPRENEURSHIP ESSENTIALS**　　　　　　**L　T　P　C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　2　0　0　0

COURSE OBJECTIVES:
- To understand the fundamental principles and concepts of entrepreneurship.
- To explore the entrepreneurial mindset and skills required for identifying and evaluating business opportunities.
- To learn about the process of starting and managing a new venture, including business planning and strategy development.
- To develop knowledge of key aspects of entrepreneurship such as marketing, finance, and operations management.
- To study successful entrepreneurial ventures and case studies to understand factors contributing to their success.

UNIT I　　　INTRODUCTION　　　　　　　　　　　　　　　　　　　　　6

Entrepreneurship - meaning, elements, determinants and importance of entrepreneurship and creative behavior- Dimensions of entrepreneurship-Qualities of an Entrepreneur, factors influencing entrepreneurship.

UNIT II　　　AGENCIES　　　　　　　　　　　　　　　　　　　　　　6

Agencies - commercial banks -district industries center- national small industries corporation – Small industries development organization -small industries service institutions -All India institutions -IDBI- IFCI-ICIIC-IRCBI.

UNIT III　　　ROLE OF INDUSTRIES / ENTREPRENEUR'S　　　　　　　6

Funding new venture - requirement -availability and access to finance -marketing - technology and industrial accommodation-Role of industries/entrepreneur's associations and self-help group's concept-business incubators-angel investors- venture capital and private equity fund.

UNIT IV　　　DESIGN OF BUSINESS PROCESSES　　　　　　　　　　6

Significance of writing the business plan/ project proposal - Contents of business plan/ project proposal - Designing business processes – location - layout – operation - planning & control- preparation of project report - Project submission/ presentation and appraisal by external agencies - financial/non-financial institutions.

UNIT V　　　MOBILIZING　　　　　　　　　　　　　　　　　　　　　6

Mobilizing resources to start -up Accommodation and utilities - preliminary contracts with the vendors-suppliers-bankers-principal customers-contract management.

TOTAL: 30 PERIODS

TEXT BOOKS:

1. Bhatia .R.C.,Entrepreneurship: Business and Management,
2. Khanka. S.S., "Entrepreneurial Development" Sultan Chand & Sons (2020).
3. Donald F Kuratko, "Entrepreneurship - Theory, Process and Practice", 10th Edition, Cengage Learning, 2017.

REFERENCE BOOKS:

1. David Taylor, Entrepreneurship Essentials: Launching and Scaling Your Business, Cheryl Eyes; PublishDrive edition (2024).
2. Dr. Bliven, Entrepreneurship Essentials You Always Wanted To Know, Vibrant Publishers (2023).
3. Harvard Business Review Entrepreneur's H: Everything You Need to Launch and Grow Your New Business (HBR Handbooks), Harvard Business Review Press (2018).
4. Hisrich R D, Peters M P, "Entrepreneurship" 10th Edition, Tata McGraw-Hill, (2017).
5. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, (2011).

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Students will demonstrate an understanding of fundamental entrepreneurship principles and concepts.

CO2: Students will be able to identify and evaluate business opportunities using entrepreneurial skills and mindset.

CO3: Students will develop proficiency in creating business plans and strategies for new ventures.

CO4: Students will acquire knowledge of key functional areas in entrepreneurship including marketing, finance, and operations management.

CO5: Students will analyze and learn from case studies of successful entrepreneurial ventures.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	1	1	1	1	1	1
CO2	1	1	1	1	1	1
CO3	1	1	1	1	1	1
CO4	1	1	1	1	1	1
CO5	1	1	1	1	1	1
AVG	1	1	1	1	1	1

BC4101   DATA STRUCTURES AND ALGORITHMS   L   T   P   C
                                                                          3   0   2   0

COURSE OBJECTIVES:

- Be familiar with basic techniques of algorithm analysis.
- Be exposed to the concept of ADTs. Learn linear data structures-List, Stack and Queue.
- Learn nonlinear data structures-Tree and Graphs.
- Be exposed to sorting, searching and hashing algorithms.

UNIT I   INTRODUCTION   3 + 2

Introduction - Abstract Data Types (ADT) - Arrays and its representation -Structures – Fundamentals of algorithmic problem solving – Important problem types – Fundamentals of the analysis of algorithm – analysis framework – Asymptotic notations, Properties, Recurrence Relation.

Lab Experiments:

1. Develop a program to perform various array operations
2. Write a program to find running time complexity by considering each statement in the program for a given set of numbers.

UNIT II   LINEAR DATA STRUCTURES - STACK, QUEUE   3 + 2

Stack ADT – Operations on Stack - Applications of stack – Infix to postfix conversion – evaluation of expression - Queue ADT – Operations on Queue - Circular Queue - Applications of Queue.

Lab Experiments:

1. Write a program to convert infix to postfix using stack data structure
2. Develop a program to perform circular queue operations

UNIT III   LINEAR DATA STRUCTURES – LIST   3 + 2

List ADT - Array-based Implementation - Linked list implementation - Singly Linked Lists – Circularly linked lists – Doubly Linked Lists - Applications of linked list – Polynomial Addition.

Lab Experiments:

1. Perform Polynomial Manipulation using Single Linked List.
2. Implement the various operations in double linked list.

UNIT IV   SEARCHING, SORTING AND HASH TECHNIQUES   3 + 2

Searching: Linear search – Binary Search- comparison of linear search and binary search, Sorting algorithms: Insertion sort - Bubble sort – selection sort - Hashing: Hash Functions – Separate Chaining –Open Addressing – Rehashing.

Lab Experiments:

1. Write a program to perform binary search
2. Write a program to sort a given set of numbers and compare among Bubble Sort, Selection Sort and Insertion Sort with respect to computational complexity.

UNIT V NON LINEAR DATA STRUCTURES - TREES AND GRAPHS 3 + 2

Trees and its representation – left child right sibling data structures for general trees Binary Tree – Binary tree traversals – Binary Search Tree - Graphs and its representation - Graph Traversals - Depth-first traversal – breadth-first traversal - Application of graphs.

Lab Experiments:
1. Write a program to delete a node from a given Binary search tree
2. Write a program to perform Graph Traversals

TOTAL: 25 PERIODS

REFERENCES:
1. Anany Levitin "Introduction to the Design and Analysis of Algorithms" 3rd Edition, Pearson Education
2. A.K. Sharma, "Data Structures using C", 2nd Edition, Pearson Education Asia, 2013
3. E.Horowitz, Anderson-Freed and S.Sahni, "Fundamentals of Data structures in C",2nd Edition, University Press, 2007
4. E.Balagursamy," Data Structures using C", Tata McGraw Hill 2015 Reprint
5. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, India, 2016
6. Jean Paul Tremblay and Paul G. Sorensen, "An Introduction to Data Structures with Applications", 2nd Edition, Tata McGraw Hill, New Delhi, 2017.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Analyze algorithms and determines their time complexity.

CO2: Understand the concepts of data types, data structures and linear structures.

CO3: Apply data structures to solve various problems.

CO4: Apply different Sorting, Searching and Hashing algorithms.

CO5: Understand non-linear data structures.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	2	2	2
CO2	2	1	2	2	2	2
CO3	2	1	2	2	2	2
CO4	2	1	2	2	2	2
CO5	2	1	2	2	2	2
AVG	2	1	2	2	2	2

BC4201   **INTRODUCTION TO COMPUTER ORGANIZATION AND**
                              OPERATING SYSTEMS   L   T   P   C
                                                             3   0   0   0

COURSE OBJECTIVES:

- ▪ To learn the basic structure and operations of a computer.
- ▪ To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
- ▪ To understand the memory hierarchies, cache memories and virtual memories and to learn the different ways of communication with I/O devices.
- ▪ To understand the basic concepts and functions of operating systems.
- ▪ To understand process and various scheduling algorithms of OS.

UNIT I   **BASIC STRUCTURE AND ARITHMETIC OPERATIONS**   **3**

Functional Units - Basic Operational Concepts - Instructions: Language of the Computer - Operations, Operands – Instruction representation – Logical operations – Decision Making – MIPS Addressing- Arithmetic for Computers

UNIT II   **PROCESSOR AND CONTROL UNIT**   **3**

A Basic MIPS implementation - Building a Data path - Control Implementation Scheme - Pipelining –Pipelined data path and control – Handling Data Hazards & Control Hazards – Exceptions.

UNIT III   **MEMORY & I/O SYSTEMS**   **3**

Memory Hierarchy - Memory technologies – cache memory – measuring and improving cache performance- virtual memory – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure -Interface circuits – USB

UNIT IV   **OPERATING SYSTEMS OVERVIEW**   **3**

Operating system overview-objectives and functions, Evolution of Operating System Operating System Structure - System Calls- Processes – Process Concept, Inter-process Communication

UNIT V   **PROCESS MANAGEMENT**   **3**

CPU Scheduling – Scheduling criteria, Scheduling algorithms, Multiple-processor scheduling, Threads Overview- The critical-section problem, Semaphores, Classical problems of synchronization, Critical regions

TOTAL: 15 PERIODS

REFERENCES:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier
2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012
3. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne - Operating System Concepts, 9th Edition, John Wiley and Sons Inc., 2012.
4. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012.
5. John L.Hennessey and David A. Patterson, Computer Architecture - A Quantitative Approach, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.
6. Andrew S. Tanenbaum - Modern Operating Systems, 4th Edition, Pearson Education, 2014.

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Understand the basics structure of computers, operations and instructions.

CO2: Design arithmetic and logic unit, control unit.

CO3: Understand the various memory systems and I/O communication.

CO4: Understand operating system functions, types, system calls.

CO5: Analyze Process and various scheduling algorithms.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	2	2	2
CO2	2	1	2	2	2	2
CO3	2	1	2	2	2	2
CO4	2	1	2	2	2	2
CO5	2	1	2	2	2	2
AVG	2	1	2	2	2	2

BC4301   **MATHEMATICAL FOUNDATIONS OF COMPUTER SCIENCE**   **L T P C**
                                                   3 0 0 0

COURSE OBJECTIVES:

- To introduce Mathematical Logic and their rules for validating arguments and programmes.
- To introduce counting principles for solving combinatorial problems.
- To give exposure to Graph models and their utility in connectivity problems.
- To introduce abstract notion of Algebraic structures for studying cryptographic and its related areas.
- To introduce Boolean algebra as a special algebraic structure for understanding logical circuit problems.

UNIT I   LOGIC AND PROOFS   3

Propositional Logic - Propositional Equivalences - Predicates and Quantifiers - Nested Quantifiers -Rules of Inference – Introduction to Proofs – Proof Methods and Strategy.

UNIT II   COMBINATORICS   3

Mathematical Induction – Strong Induction and Well Ordering – The Basics of Counting - The Pigeonhole Principle - Permutations and Combinations – Recurrence Relations Solving Linear Recurrence Relations Using Generating Functions - Inclusion - Exclusion - Principle and Its Applications

UNIT III   GRAPHS   3

Graphs and Graph Models – Graph Terminology and Special Types of Graphs – Matrix Representation of Graphs and Graph Isomorphism – Connectivity – Euler and Hamilton Paths.

UNIT IV   ALGEBRAIC STRUCTURES   3

Groups – Subgroups – Homomorphisms – Normal Subgroup and Coset – Lagrange's Theorem – Definitions and Examples of Rings and Fields.

UNIT V   LATTICES AND BOOLEAN ALGEBRA   3

Partial Ordering – Posets – Lattices as Posets – Properties of Lattices – Lattices as Algebraic Systems – Sub Lattices – Direct Product And Homomorphism – Some Special Lattices – Boolean Algebra

TOTAL: 15 PERIODS

REFERENCES:

1. Kenneth H.Rosen, "Discrete Mathematics and its Applications", Tata McGraw Hill Pub. Co.Ltd., Seventh Edition, Special Indian Edition, New Delhi, 2011.
2. Tremblay J.P. and Manohar R, "Discrete Mathematical Structures with Applications to Computer Science", Tata McGraw Hill Pub.Co.Ltd, 30th Reprint, New Delhi,2011.
3. Ralph. P.Grimaldi, "Discrete and Combinatorial Mathematics: An Applied Introduction", Pearson Education, 3rd Edition, New Delhi, 2014.
4. Thomas Koshy, "Discrete Mathematics with Applications", 2nd Edition, Elsevier Publications, Boston, 2006.
5. Seymour Lipschutz and Mark Lipson, "Discrete Mathematics", Schaum's Outlines, Tata McGrawHill Pub. Co. Ltd., Third Edition, New Delhi, 2013

COURSE OUTCOMES (COs):

At the end of the course, students will be able to

CO1: Apply Mathematical Logic to validate logical arguments and programmes.

CO2: Apply combinatorial counting principles to solve application problems.

CO3: Apply graph model and graph techniques for solving network other connectivity related problems.

CO4: Apply algebraic ideas in developing cryptograph techniques for solving network security problems.

CO5: Apply Boolean laws in developing and simplifying logical circuits.

CO's- PO's MAPPING

Course Outcomes	PROGRAM OUTCOMES					
	1	2	3	4	5	6
CO1	2	1	2	2	2	2
CO2	2	1	2	2	2	2
CO3	2	1	2	2	2	2
CO4	2	1	2	2	2	2
CO5	2	1	2	2	2	2
AVG	2	1	2	2	2	2