ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM
MASTER OF COMPUTER APPLICATIONS (2 YEARS)
DEPARTMENT OF INFORMATION SCIENCE AND TECHNOLOGY

VISION OF THE DEPARTMENT

To educate students with conceptual knowledge and technical skills in the field of Information Technology with moral and ethical values to achieve excellence in academic, industry and research centric environments.

MISSION OF THE DEPARTMENT

1. To inculcate in students a firm foundation in theory and practice of IT skills coupled with the thought process for disruptive innovation and research methodologies, to keep pace with emerging technologies.
2. To provide a conducive environment for all academic, administrative and interdisciplinary research activities using state-of-the-art technologies.
3. To stimulate the growth of graduates and doctorates, who will enter the workforce as productive IT engineers, researchers and entrepreneurs with necessary soft skills, and continue higher professional education with competence in the global market.
4. To enable seamless collaboration with the IT industry and Government for consultancy and sponsored research.
5. To cater to cross-cultural, multinational and demographic diversity of students.
6. To educate the students on the social, ethical, and moral values needed to make significant contributions to society.

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM
MASTER OF COMPUTER APPLICATIONS

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To prepare students with breadth of knowledge to comprehend, analyze, design and create computing solutions to real-life problems and to excel in industry/ technical profession.
2. To provide students with solid foundation in mathematical and computing fundamentals and techniques required to solve technology related problems and to pursue higher studies and research.
3. To inculcate a professional and ethical attitude in students, to enable them to work towards a broad social context.
4. To empower students with skills required to work as member and leader in multidisciplinary teams and with continuous learning ability on technology and trends needed for a successful career.

2. PROGRAMME OUTCOMES (POs):

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

PO#	Programme 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 a degree of mastery over design and development of computer applications.
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 Objectives	PO1	PO2	PO3	PO4	PO5	PO6
I	✓	✓	✓	✓	✓	✓
II	✓		✓	✓	✓	
III			✓			✓
IV	✓	✓	✓	✓	✓	✓

4. Mapping of Course Outcome and Programme Outcome

YEAR	SEM	COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6
YEAR 1	SEMESTER 1	Advanced Applied Mathematics	3	3	3	3	2	2
		Research Methodology and IPR						
		Data Structures	3	2	3	3	2	3
		Database Technologies	3	1	3	2	3	2
		Java Programming	3	2	3	2	2	3
		Computer Networks & Management	3	2	2	3	3	2
	SEMESTER 2	Advanced Software Engineering	2	3	3	3	3	2
		Python Programming with Data Science	3	2	3	2	2	2
		Full Stack Software Development	3		3	3	3	1
		Internet of Things	2	2	2	3	3	2
		Design & Analysis of Algorithms	3		3	2	2	2
		Professional Elective I						
		Professional Elective II						
		Mobile Application Development Laboratory	3	1	3	3	2	2
YEAR 2	SEMESTER 3	Machine Learning	3	1	3	3	2	1
		Cloud Computing Techniques	3	1	2	3	2	3
		Cryptography and security	3		2	2	2	2
		Professional Elective III						
		Professional Elective IV						
		Professional Elective V						
	SEMESTER 4	Project Work						

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM
MASTER OF COMPUTER APPLICATIONS
CURRICULUM AND SYLLABI

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3152	Advanced Applied Mathematics	FC	4	0	0	4	4
2.	RM3151	Research Methodology and IPR	RMC	2	1	0	3	3
3.	CA3101	Data Structures	PCC	3	0	3	6	4.5
4.	CA3102	Database Technologies	PCC	3	0	3	6	4.5
5.	CA3103	Java Programming	PCC	3	0	2	5	4
6.	CA3104	Computer Networks and Management	PCC	3	0	2	5	4
			TOTAL	**18**	**1**	**10**	**29**	**24**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CA3201	Advanced Software Engineering	PCC	3	0	0	3	3
2.	CA3202	Python Programming with Data Science	PCC	3	0	0	3	3
3.	CA3203	Full Stack Software Development	PCC	3	0	3	6	4.5
4.	CA3204	Internet of Things	PCC	3	0	2	5	4
5.	CA3205	Design and Analysis of Algorithms	PCC	3	0	0	3	3
6.		Professional Elective I	PEC	3	0	0	3	3
7.		Professional Elective II	PEC	3	0	0	3	3
PRACTICALS								
8.	CA3211	Mobile Application Development Laboratory	EEC	0	0	3	3	1.5
			TOTAL	**21**	**0**	**8**	**29**	**25**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	CA3301	Machine Learning	PCC	3	0	3	6	4.5
2.	CA3302	Cloud Computing Techniques	PCC	3	0	3	6	4.5
3.	CA3303	Cryptography and Security	PCC	3	0	2	5	4
4.		Professional Elective III	PEC	3	0	0	3	3
5.		Professional Elective IV	PEC	3	0	0	3	3
6.		Professional Elective V	PEC	3	0	0	3	3
			TOTAL	**18**	**0**	**8**	**26**	**22**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	CA3411	Project Work	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 83

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1.	MA3152	Advanced Applied Mathematics	FC	4	0	0	4
					TOTAL CREDITS		4

PROFESSIONAL CORE COURSES (PCC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS	SEMESTER
				L	T	P		
1.	CA3101	Data Structures	PCC	3	0	3	4.5	1
2.	CA3102	Database Technologies	PCC	3	0	3	4.5	1
3.	CA3103	Java Programming	PCC	3	0	2	4	1
4.	CA3104	Computer Networks and Management	PCC	3	0	2	4	1
5.	CA3201	Advanced Software Engineering	PCC	3	0	0	3	2
6.	CA3202	Python Programming with Data Science	PCC	3	0	0	3	2
7.	CA3203	Full Stack Software Development	PCC	3	0	3	4.5	2
8.	CA3204	Internet of Things	PCC	3	0	2	4	2
9.	CA3205	Design and Analysis of Algorithms	PCC	3	0	0	3	2
10.	CA3211	Mobile Application Development Laboratory	PCC	0	0	3	1.5	2

11.	CA3301	Machine Learning	PCC	3	0	3	4.5	3
12.	CA3302	Cloud Computing Techniques	PCC	3	0	3	4.5	3
13.	CA3303	Cryptography and Security	PCC	3	0	2	4	3

PROFESSIONAL ELECTIVE COURSES [PEC]

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
1.	CA3001	Deep Learning Techniques	PEC	3	0	0	3
2.	CA3002	Artificial Intelligence	PEC	3	0	0	3
3.	CA3003	Autonomous Ground Vehicle Systems	PEC	3	0	0	3
4.	CA3004	Big Data Analytics	PEC	3	0	0	3
5.	CA3005	Blockchain Technologies	PEC	3	0	0	3
6.	CA3006	C# and .NET Programming	PEC	3	0	0	3
7.	CA3007	Visualization Techniques	PEC	3	0	0	3
8.	CA3008	Digital Image Processing and Applications	PEC	3	0	0	3
9.	CA3009	Ethical Hacking	PEC	3	0	0	3
10.	CA3010	Game Programming	PEC	3	0	0	3
11.	CA3011	Human Computer Interaction	PEC	3	0	0	3
12.	CA3012	Social Network Analysis	PEC	3	0	0	3
13.	CA3013	Mixed Reality	PEC	3	0	0	3
14.	CA3014	Multicore Architecture and Programming	PEC	3	0	0	3
15.	CA3015	Multimedia Technologies	PEC	3	0	0	3
16.	CA3016	Network Programming and Management	PEC	3	0	0	3
17.	CA3017	Next Generation Networks	PEC	3	0	0	3
18.	CA3018	Service Oriented Architectures and Microservices	PEC	3	0	0	3
19.	CA3019	Software Architecture	PEC	3	0	0	3
20.	CA3020	Software Testing and Automation	PEC	3	0	0	3
21.	CA3021	Mobile Computing	PEC	3	0	0	3
22.	CA3022	UNIX Internals	PEC	3	0	0	3
23.	CA3023	Linux Essentials	PEC	3	0	0	3
24.	CA3024	Wireless Sensor Networks and Body Area Networks	PEC	3	0	0	3
25.	CA3025	Media Processing	PEC	3	0	0	3
26.	CA3026	Advanced Database Systems	PEC	3	0	0	3
27.	CA3027	Software Project Management	PEC	3	0	0	3

METHODOLOGY AND IPR COURSES (RMC)

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1	RM3151	Research Methodology and IPR	2	1	0	3	1
TOTAL CREDITS:						**3**	

EMPLOYABLITY ENHANCEMENT COURSES (EEC)

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			L	T	P		
1	CA3411	Project Work	0	0	24	12	4
TOTAL CREDITS						**12**	

LIST OF BRIDGE COURSES (BC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
			L	T	P		
Before start of the course (Examination along with Semester I)							
1.	BX3001	Fundamentals of Data Structures	3	0	2	5	4
2.	BX3002	Problem Solving and Programming in C	3	0	2	5	4
3.	BX3003	Database Management Systems	3	0	2	5	4
Before semester II **(Before start of Semester II, Examination at the end of Semester II)**							
4.	BX3004	Introduction to Operating System	3	0	0	3	3
5.	BX3005	Introduction to Web Programming	3	0	2	5	4
6.	BX3006	Introduction to Computer Organization	3	0	0	0	3
TOTAL CREDITS							**22**

SEMESTER-WISE CREDIT DISTRIBUTION

MASTER OF COMPUTER APPLICATIONS						
S.No	Subject Area	Credits per Semester				Credits Total
		I	II	III	IV	
1	**FC**	4	-	-	-	4
2	**PCC**	17	17.5	13	-	47.5
3	**PEC**	-	6	9	-	15
5	**EEC**	-	1.5	-	12	13.5
6	**RMC**	3	-	-	-	3
	Total	24	25	22	12	83

MA3152 ADVANCED APPLIED MATHEMATICS L T P C
4 0 0 4

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 --Toeplitz matrices and some applications.

UNIT II ONE DIMENSIONAL RANDOM VARIABLES 12

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 RANDOM PROCESSES 12

Classification – Auto correlation - Cross correlation - Stationary random process – Markov process –- Markov chain - Poisson process – Gaussian process.

UNIT IV LINEAR PROGRAMMING 12

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models

UNIT V FOURIER TRANSFORM FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Fourier transforms: Definitions, properties-Transform of elementary functions, Dirac Delta functions – Convolution theorem – Parseval‘s identity – Solutions to partial differential equations: Heat equations, Wave equations, Laplace and Poisson‘s equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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 Classify various random processes and solve problems involving stochastic processes.
CO4 Formulate and construct mathematical models for linear programming problems and solve the transportation and assignment problems.
CO5 Apply the Fourier transform methods of solving standard partial differential equations.

REFERENCES:

1. Andrews, L.C. and Philips.R.L., “Mathematical Techniques for engineering and scientists”, Printice Hall of India, New Delhi, 2006.
2. Bronson, R., “Matrix Operation”, Schaum‘s outline series, Tata McGrawHill, New York, 2011.
3. O‘Neil P.V., “Advanced Engineering Mathematics”, Cengage Learning, 8th Edition, India, 2017.
4. Oliver C. Ibe, “Fundamentals of Applied Probability and Random Processes”, Academic Press, Boston, 2014.
5. Sankara Rao, K., “Introduction to partial differential equations”, Prentice Hall of India, pvt, Ltd, 3rd Edition, New Delhi, 2010.
6. Taha H.A., “Operations Research: An introduction”, Ninth Edition, Pearson Education, Asia, 10th Edition, New Delhi, 2017.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	2	2
CO2	3	3	3	3	2	2
CO3	3	3	3	3	2	2
CO4	3	3	3	3	2	2
CO5	3	3	3	3	2	2
AVG	3	3	3	3	2	2

RM3151 RESEARCH METHODOLOGY AND IPR L T P C
2 1 0 3

UNIT I RESEARCH PROBLEM FORMULATION 9

Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap

UNIT II RESEARCH DESIGN AND DATA COLLECTION 9

Statistical design of experiments- types and principles; data types & classification; data collection - methods and tools

UNIT III DATA ANALYSIS, INTERPRETATION AND REPORTING 9

Sampling, sampling error, measures of central tendency and variation,; test of hypothesis- concepts; data presentation- types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for wring thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9

Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geographical indications, Copy rights, applicability of these IPR; , IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance.

UNIT V PATENTS 9

Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents.

TOTAL: 45 PERIODS

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Soumitro Banerjee, “Research methodology for natural sciences”, IISc Press, Kolkata, 2022,
3. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.

4. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

CA3101 DATA STRUCTURES L T P C
3 0 3 4.5

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 TREES 9

Introduction, Terminology, Representation of Trees, Binary Trees, Properties of Binary Tress, Binary Tree Representations, Binary Tree Traversal (Inorder, Preorder, Postorder) – Expression Trees – Binary Search Tree ADT- Applications of Trees – some balanced tree mechanisms –AVL trees, 2-3 trees.

UNIT III GRAPHS 9

The Graph Abstract Data Type, Introduction, Definition, Graph Representation, Elementary Graph Operation, Depth First Search, Breadth First Search, Connected Components, Spanning Trees, Biconnected Components, Minimum Cost Spanning Trees, Kruskal Algorithm, Prim’s Algorithm - All-Pairs Shortest Path, Transitive Closure.

UNIT IV PRIORITY QUEUES (HEAPS), SORTING AND SEARHING 9

Binary Heaps – Min Max Heaps – operations - Insertion Sort – Quick Sort – Heap Sort – Merge Sort –Linear Search – Binary Search.

UNIT V HASHING AND FILE STRUCTURES 9

Hashing: The symbol table, Hashing Functions, Collision Resolution Techniques, File Structure: Concepts of fields, records and files, Sequential, Indexed and Relative/Random File Organization, Indexing structure for index files, hashing for direct files, Multi-Key file organization and access methods.

LIST OF EXPERIMENTS:

1. Implementation of Linked List.
2. Implementation of Stack using Arrays and Linked List.
3. Implementation of Queue using Arrays and Linked List.
4. Implementation of Stack and Queue applications.
5. Implementation of Binary Search Tree.
6. Implementation of AVL Tree.
7. Implementation of representation of graphs and topological sort.
8. Implementation of a spanning tree for a given graph using Prim’s algorithm.
9. Implementation of shortest path algorithms such as Dijkstra’s algorithm.
10. Implementation of basic heap operations.
11. Implementation of Insertion Sort, Heap Sort.
12. Implementation of Quick Sort, Merge Sort.
13. Implementation any application using Linear Search.

14. Implementation any application using Binary Search.
15. Implementation of Hashing techniques such as quadratic probing and separate chaining.

TOTAL : 90 PERIODS

COURSE OUTCOMES:

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

CO1: Handle operations like searching, insertion, deletion, traversing mechanism etc. on various linear data structures like list, stack and queues.

CO2: Design and implement tree data structures and its variations.

CO3: Design algorithms using graph structures to solve real life problems.

CO4: Familiarize the concepts of heaps and apply sorting/searching algorithms for a given problem.

CO5: Familiarize the concepts of hashing and understand the file structure mechanisms

CO6: Choose and implement appropriate data structures for a given application.

REFERENCES:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, Second Edition, Pearson Education, 2002.
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. An Introduction to Data Structures with Applications. by Jean-Paul Tremblay & Paul G. Sorenson Publisher-Tata McGraw Hill, July 2017.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	2	2	2
CO2	3		3	3	2	3
CO3	3		3	3	2	3
CO4	3		3	2	2	2
CO5	3		3	2	2	2
CO6	3	2	3	3	2	3

CA3102 DATABASE TECHNOLOGIES L T P C

3 0 3 4.5

UNIT I RELATIONAL DATABASES 9

Purpose of Database System – Views of Data – Data Models – Database System Architecture – Introduction to Relational Databases – Relational Model – Keys – Relational Algebra – Relational Calculus – SQL Fundamentals – Advanced SQL features – Triggers – Embedded SQL.

UNIT II DATABASE DESIGN 9

Entity-Relationship Model – EER 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 - Timestamp-Based Protocols – Deadlock Handling – Recovery System – Failure Classification – Recovery Algorithm - ARIES.

UNIT IV INDEXING AND HASHING TECHNIQUES 9

Indexing and Hashing – Ordered Indices – B+ tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Catalog Information for Cost Estimation – Query Optimization.

UNIT V ADVANCED TOPICS 9

Overview of Distributed Databases – Data Fragmentation – Replication – NOSQL Database: Characteristics – CAP theorem – Types of NoSQL Datastores: Column Oriented, Document, Key-Value and Graph Types – Introduction to MongoDB – Data Model - JSON and BSON - Basic Querying.

LIST OF EXPERIMENTS:

1. Create a database table, add constraints (primary key, unique, check, Not Null), insert rows, update and delete rows using SQL DDL and DML commands.
2. Create set of tables, add foreign key constraints, and incorporate referential integrity.
3. Query the database tables using different 'where' clause conditions and implement aggregate functions.
4. Query the database tables and explore sub queries and simple join operations.
5. Query the database tables and explore natural, equi, and outer joins.
6. Write user defined functions and stored procedures in SQL.
7. Execute complex transactions and realize DCL and TCL commands.
8. Write SQL Triggers for insert, delete, and update operations in database table.
9. Create View and index for database tables with large number of records.
10. Create Column and document - based data using NOSQL database tools.
11. Develop a simple GUI based database application and incorporate all the above-mentioned features.

TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the key principles, structures, and the organization of relational databases and to formulate queries using Relational Algebra/ SQL.

CO2: Identify the methodology of conceptual modelling through ER Model and write various advanced queries such as relational constraints, joins, set operations, aggregate functions, and views.

CO3: Demonstrate the transactions and estimate the procedures for controlling the consequences of concurrent data access.

CO4: Analyze and access various query processing and optimization techniques.

CO5: Understand and use the principles and common features of the distributed, Design and Create NoSQL databases.

CO6: Analyze, Design, Create and Evaluate the real database applications using DBMS APIs.

REFERENCES:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Seventh Edition, Tata McGraw Hill, 2020.
2. Shakuntala Gupta Edward and Navin Sabharwal, “Practical MongoDB: Architecting, Developing, and Administering MongoDB”, Apress, 2015.
3. C. J. Date, A. Kannan, S. Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
4. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, Fourth Edition, Tata McGraw Hill, 2010.
5. Carlos Coronel, Steven Morris, Peter Rob, “Database Systems: Design, Implementation and Management”, Twelfth Edition, Cengage Learning, 2017.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	2	2	2
CO2	3	1	3	3	2	2
CO3	3	1	3	2	2	2
CO4	3	1	3	2	3	2
CO5	3	1	3	2	3	2
CO6	3	2	3	3	3	3

CA3103 JAVA PROGRAMMING L T P C
3 0 2 4

UNIT I JAVA BASICS 9

Overview of Java – Java Fundamentals: Classes, Objects, Methods and Strings – Methods: A Deeper Look – Arrays and Array Lists – Classes and Objects: A Deeper Look – Inheritance – Polymorphism – Interfaces – Packages – Exception Handling.

UNIT II GUI, I/O AND NETWORK PROGRAMMING 9

AWT & Swings – Strings, Characters and Regular Expressions – Files, Streams and Object Serialization – Generic collections – Generic Classes and Methods – Networking: Manipulating URLs – Reading web pages – Using stream sockets – Datagrams – Multicasting – Multicasting sockets.

UNIT III DISTRIBUTED OBJECTS 9

JSON – AJAX Enabled Rich Internet Applications with JSON – Java Mail API – SMTP, POP3 & IMAP.

UNIT IV JDBC AND WEB APPLICATION DEVELOPMENT 9

Servlet – Servlet Architecture – Servlet lifecycle – Generic Servlet – HttpServlet –Server-Side Include – Overview of JSP – JSP Components – Bean – Session Tracking – Accessing Database with JDBC – Basics – Manipulating Databases with JDBC – Java Server Faces – Multitier Application Architecture – MVC Architecture of JSF Apps – Common JSF Components – Session Tracking.

UNIT V ADVANCED FRAMEWORKS 9

Advanced Frameworks – MVC framework – Hibernate – Using Annotations – Hibernate Query language – O/R mapping – Spring Framework –Case Studies.

LIST OF EXPERIMENTS:

1. Design and Implement Java programs that deals with the following:
   a. Classes, Objects and Interfaces.
   b. Exception handling using user defined exceptions.
   c. String Handling (String Class objects – string manipulation functions).
   d. Creation of User Interfaces using SWING and graphic features.
   e. Creation and Manipulation of Generic objects.
2. Java socket programming.
   a. Implementation of chat client-server application.
   b. Implementation of simple http client/server application.
3. Reading websites using URL class.
4. Developing JSON based AJAX enabled rich Internet Applications.
5. Implementation of SMTP, POP3 & IMAP protocols.
6. Implementation of any Information System using JDBC.
7. Web Application development using JSP and JSF.
8. Session Management and Implementation of Cookies using JSF.
9. Development of Hibernate framework-based application for O/R mapping.
10. Web application development using Spring framework.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Implement Object-Oriented concepts of Java programming.
CO2: Work with Generics, Networking and GUI based application development.
CO3: Create responsive applications using AJAX & JSON.
CO4: Develop dynamic web applications with database connectivity using server-side technologies.
CO5: Design and development of applications using advanced frameworks.
CO6: To obtain knowledge on usage of IDEs for design and implementation of real time application in Java.

REFERENCES:

1. Paul J. Deitel, Harvey Deitel, “Java How to Program”, Eleventh Edition, Pearson, 2017.
2. “Core and Advanced Java, Black Book”, Dreamtech Press, 2018.
3. Herbert Schildt , “Java The Complete Reference”, Eighth Edition, Tata McGraw Hill, 2011.
4. Cay S.Horstmann, “Core Java Volume I & II”, Pearson Education, 2018.
5. Paul Dietel, Harvey Dietel, Abbey Dietel, “Internet and World Wide Web”, Fifth Edition, Pearson Education, 2012.
6. Uttam K. Roy , “Advanced Java Programming”, Oxford University Press, 2015.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	2	2	2
CO2	3		3	2	2	2

CO3	3		3	2	2	2
CO4	3	2	3	3	2	3
CO5	3	2	3	3	2	3
CO6	3	1	3	2	2	3

CA3104 COMPUTER NETWORKS AND MANAGEMENT L T P C
3 0 2 4

UNIT I DATA COMMUNICATION AND NETWORKING 9

Data communication systems – Components and their functions - Building networks – Hosts and Networking devices – Switched Networks and Broadcast Networks – Transmission medium - Networking Devices: Hubs, Bridges, Switches, Routers, and Gateways - Edge, Access and Core networks – Role of software and hardware in networking – Layered Architecture – OSI and TCP/IP Reference Models.

UNIT II PHYSICAL AND DATA LINK LAYERS 9

Wired and wireless media – Functions of physical layer – Modems – Transmission errors – Error detection and correction – Framing - Flow control – Sublayers of DLL – Broadcast networks – Collision Domain - Ethernet – CSMA/CD – Token Ring – VLAN – LAN Analyzer – IEEE 802.11 WLAN – CSMA/CA – Bluetooth – Ad hoc networks.

UNIT III NETWORK LAYER 9

Packet switching - Routing – Distance Vector and Link State Algorithms – RIP, OSPF and BGP - IPV4 Packet Format and Addressing – Effective IP address management techniques – Subnetting – CIDR – VLSM – DHCP – NAT – ICMP – Need for IPv6 – Addressing methods and types in IPv6 – IPv6 header – Advantages of IPv6 – Transition from IPv4 to IPv6.

UNIT IV TRANSPORT AND APPLICATION LAYERS 9

Transport Layer functions – End to end semantics – Functions of transport layer - User Datagram Protocol – UDP Applications – Transmission Control Protocol – Connection establishment and release – Flow Control – Retransmission Strategies – Congestion Control – Application layer – Sockets – Protocols – HTTP – FTP Email Protocols – DNS.

UNIT V NETWORK MONITORING AND MANAGEMENT 9

Network centric operations - Network monitoring – Open-source network monitoring tools – Network management model – Abstract Syntax Notation – Overview of MIB and SNMP – Wireshark tool – Network provisioning – Fault detection, location and isolation – Data plane and control plane management using SDN concepts.

LIST OF EXPERIMENTS:

1. Practice different network commands available in Windows and Linux Operating Systems and troubleshoot the network.
2. Configure the network devices such as Router, Switch, Hub, Bridge and Repeater.
3. Analyzing the Network traffic using Packet Analyzer (Wireshark) and understanding the various protocol headers.
4. Configure IPv4 and IPv6 addressing for a network using static and dynamic approaches (SLAAC and DHCP).

5. Configure firewalls and honeypots
6. Performance analysis of Network using NS2/NS3/OPNET (Delay, Bandwidth etc.)
7. Develop client/server-based applications using TCP and UDP sockets.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Become familiar and identify the networking devices and protocol reference models.
CO2: Design and implement Local Area Networks.
CO3: Configure routers and troubleshoot the network layer level connectivity issues.
CO4: Monitor and analyze the packet flow in networks.
CO5: Choose transport layer and application layer protocols and configure them as per the requirements.
CO6: Manage and secure the networks.

REFERENCES:

1. Mani Subramanian, "Network Management: Principles and Practices", Second Edition, Pearson Education, 2010.
2. William Stallings, "Data and Computer Communications", Tenth Edition, Pearson Education, 2017.
3. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Sixth Edition, Morgan Kaufmann Publishers Inc., 2022.
4. Andrew S Tanenbaum, Nick Feamster and David J Wetherall, "Computer Networks", Sixth Edition, Pearson Education, 2022.
5. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", Eighth Edition, Pearson Education, 2022.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	2	2	2
CO2	2	2	3	3	3	3
CO3	3	2	3	3	3	2
CO4	3	2	2	3	3	2
CO5	3	2	2	2	3	2
CO6	3	2	3	3	3	2

CA3201 ADVANCED SOFTWARE ENGINEERING L T P C
3 0 0 3

UNIT I SOFTWARE DEVELOPMENT APPROACHES 9

Software Process Models: Agile Software Development, Lean Software Development, DevOps and Continuous Integration/Deployment, Incremental and Iterative Development, Formal Methods and Model-Driven Engineering

UNIT II REQUIREMENTS ENGINEERING 9

Elicitation and Analysis Techniques; Specification and Validation Methods, Use Case Modeling and Behavior Driven Development, Quality Attributes and Non-functional Requirements, Requirements Traceability and Management.

UNIT III DESIGN PRINCIPLES 9

Design by Contract and Design Constraints, Interface-based Design and Design Patterns, Aspect-Oriented Software Development (AOSD), Generative Programming and Domain-Specific Languages (DSLs), Advanced Object-Oriented Design Techniques.

UNIT IV SOFTWARE TESTING AND QUALITY ASSURANCE 9

Model-Based Testing - Model Checking, Mutation Testing - Fault Injection - Combinatorial Testing - Orthogonal Array Testing - Test Automation Frameworks - Testing AI/ML Systems and Autonomous Software. Quality Models and Standards (e.g., ISO/IEC 25010, CMMI), Continuous Integration, Delivery, and Deployment (CI/CD).

UNIT V SOFTWARE PROJECT MANAGEMENT 9

Project Planning and Estimation - Agile Project Management - Risk Management **-** Secure Software Engineering - Configuration Management- Project Management for Emerging Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Develop models for the software to be developed
- **CO2:** Understand the need of system requirements
- **CO3:** Acquire knowledge about various design patterns and principles
- **CO4:** Learn various testing strategies and the relevant software quality models
- **CO5:** Analyze, Design and implement a system based on software engineering practice and principles.
- **CO6:** Manage the software for any futuristic emerging systems

REFERENCES:

1. Roger Pressman and Bruce Maxim, Software Engineering: A Practitioner's Approach Eighth Edition,McGraw Hill publications,2019.
2. Ian Sommeville , Software Engineering , Tenth Edition ,Pearson Education ,2018.
3. Ian Sommerville,Engineering Software Products: An Introduction To Modern Software Engineering,First edition,Pearson India,2020.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	3	2
CO2	2	3	3	3	2	2
CO3	2	3	2	3	2	1
CO4	2	2	3	3	2	2
CO5	3	2	3	3	3	3
CO6	2	2	2	3	3	3

CA3202 PYTHON PROGRAMMING WITH DATA SCIENCE L T P C
3 0 0 3

UNIT I PYTHON FUNDAMENTALS 9

Introduction to Programming – Problem Solving - Basics of Python – Python Block Structure - Data types – Operators and Operations – Input/Output Statements – Decision Structures and Looping Statements.

UNIT II INTRODUCTION TO FUNCTIONS 9

Introduction to Functions – Types of Functions – Void and Fruitful Functions – Lists – Built-in Functions and methods – Tuples – Indexing and Slicing – Operations – Sets and Dictionary – Basic set Operations -Dictionary – Basic Dictionary – Strings – Built-in Methods, Built-in functions for Strings.

UNIT III MODULES AND PACKAGES 9

Creation of a module – Importing modules – Standard modules in Python – Packages – Errors and Exceptions – Multiple and Exception handling – User defined exceptions – File handling – Types of Files – Handling text files – Handling binary files – Pickle – File handling of Excel Files – Python Context Manager.

UNIT IV PYTHON PACKAGES FOR DATA SCIENCE 9

The Basics of NumPy Arrays – Creation – Properties – Indexing and Slicing Operations – Arithmetic operations – Data analysis – Pandas – Series – Indexing – Data Frames – Data Manipulation – Data visualization using Pandas and Matplotlib – Data Manipulation and Scikit-Learn.

UNIT V DATA SCIENCE USING PYTHON 9

Introduction to Data Science –Data Science Process – Data Acquisition - Big data: Definition, Risks of Big Data, Structure of Big Data - Web Data: Exploratory Data analysis – Data Analytics – Hypothesis Testing - Analysis vs Reporting - Core Analytics versus Advanced Analytics - Modern Data Analytic Tools – Data Visualization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Know the Basics of Python decision and looping structures.
CO2: Understand the basics of function writing.
CO3: Learn to create user-defined modules and packages.
CO4: Understand Python Ecosystem for Data Science.
CO5: Understand the needs for Big Data and applications.
CO6: Design and Implement a Python based Data science application.

REFERENCES:

1. Sridhar S, Indumathi J, Hariharan V.M. Python Programming, Pearson Education, First Edition, 2023.
2. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, First Edition, 2016.
3. Joel Grus, “Data Science from Scratch – First principles with Python”, O’Reilly, Second Edition, 2019.
4. Bill Franks, “Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics”, John Wiley & sons, First Edition, 2012.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	2	2	2
CO2	2		3	2	2	2
CO3	2		3	2	2	2
CO4	3		3	2	2	2
CO5	2		3	2	2	2
CO6	3	2	3	3	2	3

CA3203 FULL STACK SOFTWARE DEVELOPMENT L T P C
3 0 3 4.5

UNIT I SERVER-SIDE ACTION 9

Node and NPM - Installation - Commands - Packaging - filesystem - http/ https - OS - Path - Process - collaborative version control system git – Introduction to MERN stack.

UNIT II CLIENT-SIDE ACTIONS 9

React - Writing different components - Introduction to Typescript - Programming structures - Boolean - Arrays - Tuples - function.

UNIT III ADVANCED TYPESCRIPT 9

Classes - Inheritance - Interfaces - Namespaces - Modules - Decorators - Debugging Typescript apps - development of a simple web application with typescript.

UNIT IV WEBPACK 9

Introduction to webpack - dependency graph - Plugins - Modules - Adding node modules - REST Endpoint - mailer - other examples

UNIT V DEPLOYMENT THROUGH CONTAINERS 9

Containerization - Installation of Docker - Pulling Images - Creating Images - Deploying to Dockerhub - Development and deployment of js applications in docker.

LIST OF EXPERIMENTS:

1. Working with git commands
2. Installation of Typescript
3. Programming with different data structures and functions using Typescript
4. Programming with classes and inheritance
5. Organization of the code with namespace
6. Packaging the code with added modules
7. Development of a web application using React.js
8. Development of a web application using Node.js
9. Development of a full stack web application
10. Deployment of web application using Docker

TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

CO1: Work with collaborative version control
CO2: Develop web applications using Node
CO3: Use Typescript for Client-side actions
CO4: Develop web applications with Typescript
CO5: Explore webpack for creating web applications
CO6: Deploy Web applications through containers

REFERENCES:

1. Frank Zammetti, Modern Full-Stack Development Using TypeScript, React, Node.js, Webpack, and Docker, Apress, First Edition, 2020
2. David Choi, Full-Stack React, TypeScript, and Node, Packt Publications, 2020
3. Vasan Subramanian, Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, A Press Publisher, Second Edition 2019.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	3	3	1
CO2	3		3	3	3	1
CO3	3		3	3	3	1
CO4	3		3	3	3	1
CO5	3		3	3	3	1
CO6	3		3	3	3	1

CA3204 INTERNET OF THINGS L T P C
3 0 2 4

UNIT I INTRODUCTION 8

Evolution of the Internet – Things/Real World Objects – Smart Objects – Technology enablers of IoT – Device layer – Role of WSNs in IoT - Edge/Fog Layer – Role of Cloud in IoT – Possible IoT reference models - M2M Communication – Domain Specific IoTs – Complexity and Levels of IoT based Systems – IIoT and Industry 4.0.

UNIT II DEVICE LAYER 11

Microprocessors vs. Microcontrollers – Open-Source Movement in Hardware – Engineering vs Prototyping – Software Development Lifecycle for Embedded Systems – Arduino IDE – Programming and Developing Sketches – Arduino Rest APIs – Raspberry Pi – Interfaces – Python Packages of Interests for IoT – IoT Design Methodology.

UNIT III IoT PROTOCOLS 9

TCP/IP based IoT protocol stack - MAC Layer Protocols – IEEE 802.15.4 – g and e variants of IEEE 802.15.4 – IEEE 802.11ah – IEEE 1901.2a – LoRaWAN – Role of IPv6 in IoT – 6LoWPAN – From 6LoWPAN to 6Lo - Models of communication – HTTP, CoAP, MQTT and WebSocket protocols.

UNIT IV CLOUD OFFERINGS AND ANALYTICS 10

Cloud Storage Models and Communication API – WAMP AutoBahn – Xively Cloud – Python Web Application Framework – Django–IBM Watson – AWS for IoT - Map Reduce Programming Model, Job Execution and Work Flow, Cluster Setup – Lambda Architecture – Apache Hadoop – REST based and Websocket based approaches in Apache Storm.

UNIT V IoT MANAGEMENT & CASE STUDIES 7

IoT Systems Management – SNMP – NETCONF – YANG – SDN and NFV for IoT – Case studies: Home automation, Smart Cities, Weather monitoring system, Forest fire monitoring, Air pollution monitoring – Smart irrigation.

LIST OF EXPERIMENTS:

1. Develop a BLINK sketch in Arduino.
2. Develop an Arduino sketch that repeats an LED to glow brightly, decrease the brightness, switches off the LED, increases the brightness and LED glows with maximum intensity (a sketch for fading).
3. Develop an Arduino sketch that takes sensor readings for five seconds during the startup, and tracks the highest and lowest values it gets. These sensor readings during the first five seconds of the sketch execution define the minimum and maximum of expected values for the readings taken during the loop (a sketch for calibrating a sensor).
4. Develop an Arduino sketch that reads the value of a variable resistor as an analog input and changes blink rate of the LED.
5. Develop an Arduino sketch to use a piezo element to detect the vibration.
6. Develop a Python program to control an LED using Rapberry Pi.
7. Develop a Python program to interface an LED with a switch using Rapberry Pi.
8. Miniproject.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the evolution of the Internet and the impact of IoT in the society.
CO2: Design portable IoT devices using Arduino IDE/ Raspberry Pi with Python.
CO3: Apply appropriate protocols in various parts of IoT based systems.
CO4: Use cloud offerings and big data tools in IoT based systems.
CO5: Implement Map-Reduce based programs using Apache frameworks.
CO6: Design, deploy and manage complex IoT based systems.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A Hands-On Approach”, Universities Press, First Edition, 2015.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, First Edition, 2014.
3. David Hanes, Gonzalo Salguerio, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for Internet of Things”, Cisco Press, 2017. 4. Perry Lea, “Internet of Things for Architects”, PACKT, 2018.
4. Andy King, “Programming the Internet of Things: An Introduction to Building Integrated, Device to Cloud IoT solutions”, O’REILLY’, 2021.

CO-PO Mapping:

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	3	1	2	2	2
CO2	2	2	3	3	3	2
CO3	3	1	2	3	3	1
CO4	2	1	2	3	3	2
CO5	2	1	2	3	3	1
CO6	3	2	3	3	3	2

CA3205 DESIGN AND ANALYSIS OF ALGORITHMS L T P C
3 0 0 3

UNIT I FUNDAMENTALS 9

Introduction: The Role of Algorithms in Computing – Designing Algorithms – Analyzing Algorithms – Iterative Algorithms and Analysis: Step Count and Operation Count- Recursive Algorithms: Formulation and solving recurrence equations- Substitution Method – Recursion Tree Method – Master Theorem – Asymptotic Notations – Growth of Functions.

UNIT II DESIGN TECHNIQUES 9

Insertion Sort - Merge Sort - Quick sort– Dynamic Programming: Elements of Dynamic Programming- Matrix Chain Multiplication - Naive String-Matching Algorithm-Longest Common Sub sequence - Knuth-Morris-Pratt Algorithm.

UNIT III GREEDY ALGORITHMS AND MATRIX OPERATIONS 9

Greedy Strategy: Knapsack Problem - Transform and Conquer Approach: Gaussian Elimination Method – LUP Decomposition – Matrix Inverse and Determinant of a Matrix.

UNIT IV LINEAR PROGRAMMING, BACKTRACKING AND BRANCH & BOUND 9

Linear Programming: Formulation of LPPs– Simplex Algorithm- Backtracking*:* Basics of Backtracking- 8-queen - Sum of Subsets, Branch and Bound: 0/1 Knapsack.

UNIT V COMPUTATIONAL COMPLEXITY 9

Understanding of Computational Complexity – NP-Hard – NP-Completeness –Reducibility-Satisfiability Problem and Cook's Theorem- NP-Completeness Proofs: SAT - Probabilistic Analysis and Randomized Algorithm: The Hiring problem – Randomized Quick Sort - Approximation Algorithms - Set Cover and Vertex Cover.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Analyze algorithms based on time and space complexity
- **CO2:** Design efficient algorithms and analyze with appropriate sorting and dynamic programming strategies
- **CO3:** Apply greedy methods and matrix methods involving Gaussian elimination for solving computational problems
- **CO4:** Design and Solve Linear programming, backtracking and branch and bound technique towards efficient problem solving

CO5: Solve a problem in polynomial time or prove that to be an NP-Complete problem
CO6: Obtain the knowledge of Randomized and approximate algorithms.

REFERENCES:

1. S. Sridhar, “Design and Analysis of Algorithms”, Oxford University Press, First Edition, 2015.
2. Thomas H Cormen, Charles E Leiserson, Ronald L Revest, Clifford Stein, “Introduction to Algorithms” Third Edition, The MIT Press Cambridge, Massachusetts London, England,2014.
3. Antany Levitin, “Introduction to the Design and Analysis of Algorithms”, Third Edition, Pearson Education, 2012.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	2	2	2
CO2	3		3	2	2	2
CO3	3		3	2	2	2
CO4	3		3	2	2	2
CO5	3		3	2	2	2
CO6	3		3	2	2	2

CA3211 MOBILE APPLICATION DEVELOPMENT LABORATORY L T P C
0 0 3 1.5

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.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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.
CO6: Configure open source tools like Flutter or Unity.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
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
CO6	2		3	3	2	2

CA3301 MACHINE LEARNING L T P C
3 0 3 4.5

UNIT I INTRODUCTION 9

Machine Learning – Basic Concepts in Machine Learning – Types of Machine Learning – Applications of Machine Learning - Understanding Data - Data types - Bivariate Data and Multivariate Data Statistics -Probability Distributions - Basics of Learning Theory – Concept Learning - Hypothesis Space - Find-S algorithm - Version spaces - Bias-Variance Tradeoffs - Modelling in Machine learning- Model Selection and Model Evaluation - Model Performance - Resampling Methods.

UNIT II SUPERVISED LEARNING - I 9

Linear Regression – Multiple variable regression – Logistic regression – Regularization techniques - LASSO, Ridge and Elastic Net Regression - Decision Tree Learning- ID3 - C4.5 – CART - Instance based Learning - k-Nearest Neighbor Algorithm.

UNIT III SUPERVISED LEARNING II 9

Support Vector Machines – Support Vector Regression - Neural Networks – Perceptron - Feed-Forward Networks for binary and multi-class classification- Multi Layer Perceptron - Back Propagation - Ensemble Methods – Bagging – Random Forest - Boosting – AdaBoost.

UNIT IV PROBABILISTIC GRAPHICAL MODELS 9

Bayesian Learning - Naive Bayes Algorithm - Introduction to Graphs – Bayesian Belief Networks - Inference in Graphical Models - Markov Chain – Markov Model - Hidden Markov Models – Inference – Learning - Generalization – Undirected Graphical Models.

UNIT V UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING 9

Clustering– K-means Clustering– Hierarchical Clustering – Expectation Maximization algorithm – Gaussian Mixture Model - The Curse of Dimensionality – Dimensionality Reduction – Principal Component Analysis – Linear Discriminant Analysis (LDA) - Latent Variable Models (LVM) – Latent Dirichlet Allocation (LDA). Overview of Reinforcement Learning - Components of Reinforcement Learning - Model Based Learning - Model Free Learning - Q Learning.

LIST OF EXPERIMENTS:

1. Develop python programs to import and export data using NumPy, Pandas library functions.
2. Demonstrate various data pre-processing techniques for a given dataset.
3. Develop Python programs to demonstrate various Data Visualization techniques.
4. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples.
5. Develop an application that makes predictions from data using Linear Regression.
6. Develop an application that makes predictions from data using Logistic Regression.
7. Implement a classifier using ID3, C4.5 algorithms.
8. Implement a classifier using CART algorithm and visualize the decision tree.
9. Implement a classifier using Perceptron.
10. Implement a classifier using Multi Layer Perceptron.
11. Develop a system to implement a classifier using SVM
12. Implement Ensemble Models using Random Forest
13. Implement Ensemble Models using AdaBoost.
14. Develop a system that can extract the word from the given sentences using the Hidden Markov model.
15. Develop a system that can automatically group articles by similarity using K–Means clustering.

TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

CO1: Disseminate the key elements of machine learning, types of data and the basics of learning theory.

CO2: Describe Instance based learning and apply regression analysis and decision tree models for regression and classification problems.

CO3: Implement SVM or Neural Network model for an appropriate application and improve the performance using ensemble models.

CO4: Design and implement a BBN, HMM for a sequence model type of application and implement a PGM for any real time application using an open-source tool.

CO5: Use a tool to implement typical clustering algorithms for different types of applications.

CO6: Analyze and apply Reinforcement learning for suitable learning tasks.

REFERENCES:

1. Sridhar S, Vijayalakshmi M, “Machine Learning”, First Edition, Oxford University Press, 2022.
2. Christopher Bishop, “Pattern Recognition and Machine Learning”, First Edition, Springer, 2006.
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
4. EthemAlpaydin, “Introduction to Machine Learning”, Third Edition, Prentice Hall of India, 2005.
5. Tom Mitchell, “Machine Learning”, McGraw-Hill, First Edition, 1997.
6. T. Hastie, R. Tibshirani, J. Friedman, “The Elements of Statistical Learning”, Second Edition, Springer, 2008.
7. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, CRC Press, Second Edition, 2014.
8. T. V. Geetha, S. Sendhilkumar, “Machine Learning: Concepts, Techniques and Applications” Chapman & Hall/CRC Press, 2023.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	2	2	1
CO2	3		3	3	2	1
CO3	3	1	3	3	2	1
CO4	3	1	3	3	2	1
CO5	3	1	3	3	2	1
CO6	3		3	3	2	1

CA3302 CLOUD COMPUTING TECHNIQUES L T P C
3 0 3 4.5

UNIT I INTRODUCTION TO DISTRIBUTED SYSTEM CONCEPTS 9

Introduction to Distributed Systems – Characteristics – Issues in Distributed Systems –Distributed System Model – Request/Reply Protocols – RPC – RMI – Logical Clocks and Casual Ordering of Events – Introduction to Web Service and Service Oriented Architecture – SOAP – REST– Introduction to OS Concepts – ISA, Emulation, Process and Memory Management.

UNIT II INTRODUCTION TO CLOUD COMPUTING 9

Introduction to Cloud Computing – Evolution of Cloud Computing – Cloud Characteristics Elasticity in Cloud – On-demand Provisioning – NIST Cloud Computing Reference Architecture –Architectural Design Challenges – Cloud Deployment Models: Public, Private and Hybrid Clouds –Cloud Service Models: IaaS, PaaS, SaaS Models – Benefits of Cloud Computing – Overview of Cloud Standards.

UNIT III 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 IV CLOUD MANAGEMENT AND SECURITY 9

Cloud Management Products – Cloud Storage – Provisioning Cloud Storage – Managed and Unmanaged Cloud Storage – Cloud Security Overview – Cloud Security Challenges – Security Architecture Design – Virtual Machine Security – Application Security – Data Security – Cloud Networking – Introduction to Software Defined Networking and Network Function Virtualization – Automation with DevOps.

UNIT V CLOUD SOFTWARE AND COMPUTING PLATFORMS 9

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

LIST OF EXPERIMENTS:

1. Study about virtual environment using VMware
2. Installation of VMware and creation of virtual environment
3. Implement simple chat application incorporating virtual machine communication.

4. Installation of OpenStack.
5. Creation of VMs and installing applications and executing simple programs in OpenStack.
6. Simple applications for communication across VMs.
7. Test ping command to test the communication between the guest OS and Host OS.
8. Install Hadoop and manipulate a large dataset and run on Hadoop.
9. Simulate a Cloud scenario using Cloud Sim and implement a scheduling algorithm not present in Cloud sim.
10. Install Google App Engine. Create hello world app and other simple web applications using Python/Java.
11. Use GAE launcher to launch the above developed web applications
12. Establish an AWS account. Use the AWS Management Console to launch an EC2 instance and connect to it and run the simple web applications developed above.
13. Create a Windows Azure account and launch a virtual machine in Azure platform and run the developed applications in the VM.

TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

CO1: Appreciate distributed computing, distributed resource management.

CO2: Articulate the main concepts, key technologies, strengths and limitations of cloud computing and deploy applications over commercial cloud computing infrastructures.

CO3: Gain knowledge about cloud and virtualization along with it how one can migrate over it.

CO4: Develop the ability to manage the cloud environment and understand the concepts of cloud storage, security.

CO5: Choose the appropriate technologies, algorithms and approaches for implementation of cloud environment using Openstack, AWS and Google App engine.

CO6: Apply the knowledge of cloud computing techniques to solve real world problems through group collaborations.

REFERENCES:

1. Kai Hwang, Geofrey C. Fox and Jack J. Dongarra, Distributed and Cloud Computing, MorganKaufmann, First Edition, 2012.
2. Cloud Computing: A Practical Approach, Anthony T.Velte, Toby J. Velte, Robert Elsenpeter,Tata-McGraw- Hill, First Edition, New Delhi – 2010.
3. James E. Smith and Ravi Nair, Virtual Machines, Morgan Kaufman, First Edition, 2005.
4. RajkumarBuyya,Christian Vecchiola,S.ThamaraiSelvi,Mastering Cloud Computing, Tata Mcgraw Hill, First Edition, 2013.
5. George Reese, Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, O'Reilly, First Edition, 2009.
6. John W.Rittinghouse and James F.Ransome, “Cloud Computing: Implementation, Management, and Security”, CRC Press, First Edition, 2010.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	**1**	1	3	2	2
CO2	3	**1**	2	3	2	3
CO3	2	**1**	2	3	2	3
CO4	2	**1**	3	3	2	3
CO5	3	**1**	3	3	2	3
CO6	3	**1**	3	3	3	3

CA3303 CRYPTOGRAPHY AND SECURITY L T P C
3 0 2 4

UNIT I INTRODUCTION TO SECURITY AND NUMBER THEORY 9

Basics of Security – CIA Triad – Threats, Attacks and Services – Classical Cryptography – Substitution and Transposition ciphers – One-time Pad– Number Theory – Modular Arithmetic – Euclidean Theorem – Extended Euclidean Theorem – Algebraic Structures – Galois Field – Primality test –Pseudo randomness - Fermat's Theorem – Euler's Theorem – Chinese Remainder theorem – Logarithms – Elliptic Curve Arithmetic.

UNIT II SYMMETRIC KEY CRYPTOGRAPHY 9

Modern Cryptography – Symmetric Cipher – Block and Stream Cipher – Feistel Ciphers – Data Encryption Standard (DES) – DES Structure – Key Generation – Simplified DES – Linear and Differential cryptanalysis –CPA, CCA– Advanced Encryption Standard (AES)– Analysis of AES.

UNIT III ASYMMETRIC KEY CRYPTOGRAPHY 9

Public Key Cryptosystems – RSA Algorithm – ElGamal Cryptosystems – Diffie-Hellman key exchange – Elliptic curve cryptography – Hash functions – Hash algorithms – Secure Hash Algorithm: SHA – MD5 – Message Authentication Codes – zero knowledge protocols - Introduction to Quantum Cryptography– Threshold Cryptography.

UNIT IV SECURITY APPLICATIONS 9

Digital Signatures Schemes– Digital Certificate – Key Management – Kerberos – Key Agreement and Distribution – PKI – X.509 Certificate – E-Mail Security – PGP – S/MIME – IP security – Virtual Private Network (VPN) – Web Security – Secure Socket Layer (SSL) – Transport Layer Security – Secure Electronic Transaction (SET)

UNIT V SYSTEM SECURITY 9

Malwares – Password Management – Firewall – Intrusion Detection System and types – Intrusion Prevention System –– Penetration testing: concept, types, steps – OWASP top ten vulnerabilities – Secure Coding

LIST OF EXPERIMENTS:

The following exercises are based on cryptographic algorithms and cryptanalysis. They can be implemented using any Programming Language:

1. Implement basic mathematical requirements for cryptography.
2. Write a program to perform encryption and decryption of classic cryptosystems. Perform cryptanalysis using Brute-force Attack.
3. Write a program to demonstrate symmetric key encryption process using DES and AES algorithm (academic versions). Also perform cryptanalysis using CCA, CPA.
4. Write a program to implement RSA algorithm and demonstrate the key generation and encryption process and analyze the same using factorization attack.
5. Write a program to generate message digest for the given message using the SHA/MD5 algorithm and verify the integrity of message.
6. 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.
7. Study and exploration of Wireshark tool

a. To analyze network traffic for various protocols, e.g. ping, DNS and telnet.
b. To learn about setting up ssh keys and configure the ssh client.
c. To verify whether the data are encrypted or not.

8. Study and exploration of Metasploit tool to learn about cracking of hashed files in Windows environment.
9. Configure a firewall on Ubuntu platform.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Apply the basic security algorithms and policies required for a computing system.
CO2: Predict the vulnerabilities across any computing system and hence be able to design security solution for any computing system.
CO3: Identify any network security issues and resolve the issues.
CO4: Manage the firewall and WLAN security.
CO5: Evaluate the system related vulnerabilities and mitigation.
CO6: Design secured web applications in real-time.

REFERENCES:

1. William Stallings, “Cryptography and Network Security Principles and Practices”, Pearson/PHI, Eighth Edition, 2023.
2. Wenbo Mao, “Modern Cryptography Theory and Practice”, Pearson Education, Reprint 2004.
3. Pfleeger and Pfleeger, “Security in computing”, PHI/Pearson, Fifth Edition, 2018.
4. Behourz Forouzan, Debdeep Mukhopadyay, “Cryptography and Network Security”, Tata McGraw Hill Education Pvt. Ltd, New Delhi, Second Edition, 2010.
5. Gilles van Assche, “Quantum Cryptography and Secret-Key Distillation”, Cambridge University Press, 2010.
6. Oded Goldreich, Foundations of Cryptography (two volumes) Cambridge university Press, First Edition, 2004.
7. Patrick Engebretson, “The basics of Hacking and Penetration Testing”, Elsevier, Second Edition, 2011.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	2	2	2	2
CO2	3	-	2	2	2	2
CO3	1	-	1	1	2	2
CO4	3	-	3	3	1	1
CO5	3	-	1	2	2	2
CO6	3	-	3	3	3	1

CA3001 DEEP LEARNING TECHNIQUES L T P C
3 0 0 3

UNIT I BASICS OF NEURAL NETWORKS 9

Basic concept of Neurons – Perceptron Algorithm – Feed Forward and Back Propagation Networks.

UNIT II CONVOLUTIONAL NEURAL NETWORKS 9

CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning

UNIT III MORE DEEP LEARNING ARCHITECTURES 9

LSTM, GRU, Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Adversarial Generative Networks – Autoencoder and DBM

UNIT IV DEEP REINFORCEMENT LEARNING 9

Introduction to Reinforcement Learning – Deep Q Networks – Naïve REINFORCE Algorithm - Actor–Critic Method – Introduction to Deep Belief Networks.

UNIT V APPLICATIONS OF DEEP LEARNING 9

Image Segmentation – Object Detection – Automatic Image Captioning – Image Generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision – Analysis using Recursive Neural Networks – Dialogue Generation with LSTMs – Transformers like BERT.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the role of Deep learning in Machine Learning Applications.
CO2: To get familiar with the use of TensorFlow/Keras in Deep Learning Applications.
CO3: To design and implement Deep Learning Applications.
CO4: Critically Analyse Different Deep Learning Models in Image Related Projects.
CO5: To design and implement Convolutional Neural Networks.
CO6: To know about applications of Deep Learning in NLP and Image Processing.

REFERENCES:

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Francois Chollet, “Deep Learning with Python”, Manning Publications, First Edition, 2018.
3. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence,” Apress, 2017.
4. Jon Krohn,” Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence,” Addison-Wesley, First Edition, 2020.
5. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.
6. Andrew Glassner, “Deep Learning – A visual Approach,” No Starch Press, 2021.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2	2	2	2
CO2	3		3	3	2	2
CO3	3	2	3	3	2	2
CO4	3	1	3	3	2	2
CO5	3	1	3	3	2	2
CO6	3	2	3	3	2	3

CA3002 ARTIFICIAL INTELLIGENCE L T P C
3 0 0 3

UNIT I INTELLIGENT AGENTS AND SEARCH TECHNIQUES 9

Agents and Environments – Good Behaviour: The Concepts of Rationality – The Nature of Environments – The Structure of Agents – Problem Solving by Search – Uninformed Search – Searching with Costs – Informed State Space Search – Heuristic Search: Greedy – A* Search – Problem Reduction Search – Game Search – Constraint Satisfaction Problems.

UNIT II REASONING WITH LOWER ORDER LOGICS 9

Logical Agent – Proposition Logic – Syntax and Semantics – Theorem Proving – Model Checking – Inference in First Order Logic: Forward Chaining – Backward Chaining – Resolution.

UNIT III KNOWLEDGE REPRESENTATION AND AI PLANNING 9

Ontological Engineering – Categories and Objects- Events- Mental Objects and Modal Logic – Reasoning Systems for Categories - Classical Planning – Algorithms for Classical Planning – Heuristics for Planning – Hierarchical Planning – Planning and Acting in Non-Deterministic Domains.

UNIT IV LEARNING TECHNIQUES 9

Learning from Examples: Forms of Learning - Supervised Learning - Model Selection and Optimization - The Theory of Learning - Nonparametric Models - Ensemble Learning; Learning Probabilistic Models : Statistical Learning - Learning with Complete Data - Learning with Hidden Variables: The EM Algorithm- Introduction to Reinforcement Learning.

UNIT V AI APPLICATIONS 9

Natural Language Processing: Language Models – Grammar – Parsing - Augmented Grammars; Robotics : Robotic Perception - Planning and Control - Planning Uncertain Movements - Reinforcement Learning in Robotics ; Computer Vision : Image Classification - Detecting Objects – ChatGPT – Text Generation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand and use the various search strategies based on the problem domain.
CO2: Apply various reasoning techniques to real world problems.
CO3: Analyze and apply the appropriate knowledge representation technique based on the application.
CO4: Understand the usage of various AI Planning techniques.
CO5: Design and implement various learning models based on the problem requirements.
CO6: Create AI applications to address real world problems.

REFERENCES:

1. Stuart J. Russell, Peter Norvig, “Artificial Intelligence - A Modern Approach”, Fourth Edition, Pearson Publishers, 2021.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, Third Edition, Tata McGraw-Hill Education, 2008.
3. Dheepak Khemani, “A first course in Artificial Intelligence”, McGraw Hill Education Pvt Ltd., NewDelhi, 2013.
4. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, O’Reilly, 2009, https://www.nltk.org/book/.

5. Nils J. Nilsson, “Artificial Intelligence: A New Synthesis”, Morgan Kaufmaan Publishers Inc; Second Edition, 2003.
6. NPTEL, “Artificial Intelligence”, http://nptel.ac.in/courses/106105079/2.
7. Udacity, “Introduction to Artificial Intelligence”, https://in.udacity.com/course/intro-toartificial-intelligence--cs271.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	2	2	2
CO2	3	1	3	3	2	2
CO3	3	1	3	2	2	2
CO4	3		3	2	2	2
CO5	3	2	3	3	2	2
CO6	3	2	3	3	2	3

CA3003 AUTONOMOUS GROUND VEHICLE SYSTEMS L T P C
3 0 0 3

UNIT I INTRODUCTION TO AUTONOMOUS DRIVING 9

Autonomous Driving Technologies Overview – Autonomous Driving Algorithms –Autonomous Driving Client System – Autonomous Driving Cloud Platform – Components of autonomy – Difference between Unmanned and Autonomous Vehicles – Introduction to Unmanned Aerial Vehicles (UAVs) – History of UAVs – Classification: scale, lift generation method – Applications: Military, Government and Civil, Application of CARLA simulator in AGVs.

UNIT II SENSORS FOR AUTONOMOUS GROUND VEHICLES 9

Sensor Characteristics –Vehicle Internal State Sensing: OEM Vehicle Sensors, GPS, Inertial Measurements, Magnetometer – External World Sensing: RADAR, Lidar, Image Processing Sensors, IMU sensor for Raspberry Pi, Jetson.

UNIT III ENVIRONMENT PERCEPTION AND MODELING 9

Road Recognition: Basic Mean Shift Algorithm, Mean Shift Clustering, Mean Shift Segmentation, Mean Shift Tracking, Road Recognition Algorithm –Vehicle Detection and Tracking: Generating ROIs, Multi Resolution Vehicle Hypothesis, Vehicle Validation using Gabor Features and SVM, Boosted Gabor Features – Multiple Sensor Based Multiple Object Tracking.

UNIT IV NAVIGATION FUNDAMENTALS 9

Introduction – Navigation: GNSS Overview, GPS, GLONASS, Galileo, Compass – Inertial Navigation Overview: Inertial Sensor Technology – GNSS/INS Integration Overview – Case Study on Kalman Filtering.

UNIT V VEHICLE CONTROL AND CONNECTED VEHICLE 9

Vehicle Control: Cruise Control, Antilock Brake Systems, Steering Control and Lane Following, Parking – Connected Vehicles: Vehicle to Vehicle Communication, Vehicle to Infrastructure Communication, Device to Device Communication, Security for Autonomous Ground Vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Identify the requirements and design challenges of AGVs.
CO2: Select suitable sensors to sense the internal state and external world of AGVs.
CO3: Implement lane detection, road detection & vehicle detection algorithms.
CO4: Simulate/Implement ground vehicle navigation algorithms.
CO5: Simulate/Implement ground vehicle control systems.
CO6: Design communication protocols for connected vehicles.

REFERENCES:

1. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, "Creating Autonomous Vehicle Systems", Morgan & Claypool, 2018.
2. Umit Ozguner, Tankut Acarman, Keith Redmill, "Autonomous Ground Vehicles", Artech House, 2011.
3. R. Jha, "Theory, design and applications of Unmanned Aerial Vehicles", First Edition, 2016.
4. Hong Cheng, "Autonomous Intelligent Vehicles Theory, Algorithms, and Implementation", Springer, 2011.
5. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone, "Global Navigation Satellite Systems, Inertial Navigation, and Integration", Third Edition, John Wiley & Sons, 2013.
6. Kenzo Nonami, Muljiowidodo Kartidjo, "Autonomous Control Systems and Vehicles", Intelligent Unmanned Systems, Springer, First Edition Reprint, 2013.
7. Anthony Finn, Steve Scheding, "Development and challenges for Autonomous Unmanned Vehicles", A compendium, Springer, 2010.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	2	2	2
CO2	2		3	2	2	2
CO3	3	**1**	3	3	2	2
CO4	3	**1**	3	3	2	2
CO5	3	**1**	3	3	2	2
CO6	3		3	2	2	2

CA3004 **BIG DATA ANALYTICS** **L T P C**
3 0 0 3

UNIT I INTRODUCTION TO BIG DATA 9

Introduction to Big Data - Need for processing Big Data – Need for analytics- Characteristics of big data, Domain-specific examples of big data, Big Data Stack – Setting up of Hadoop.

UNIT II MAPREDUCE AND NEW SOFTWARE STACK 9

Distributed File System – MapReduce, algorithms using MapReduce, Extensions – Communication model – Complexity Theory for MapReduce. Overview of Spark.

UNIT III BIG-DATA TECHNOLOGY OVERVIEW 9

Big Data Collection Systems – Apache Flume – Big data Storage – HDFS Systems – Pig and Hadoop – Grunt – Data Model – pig Latin – hive Overview – Hive Ql – Overview of Hbase - Overview of Workflow – Apache Oozie – Workflow and Scheduling - Introduction to NoSQL Databases – Basics of MongoDB.

UNIT IV BIG DATA ANALYTICS 9

Introduction to Stream analytics – Stream data model – Sampling Data – filtering streams – Count distinct elements in a stream, Counting ones, Estimating moments – Decaying windows – Link Analysis – PageRank Computation – Market Basket model – Limited pass algorithms for Frequent Item sets.

UNIT V MORE BIG-DATA APPLICATIONS 9

Advertising on Web – Online Algorithms – matching Problem – Adwords problem and Implementation – recommendation systems – Collaboration filtering – Dimensionality reduction – mining social – Network graphs – Clustering of social network graphs – Partitioning of graphs – Simrank – counting triangles – Neighborhoods properties of Graphs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the basics of Big Data
CO2: Know about Hadoop and MapReduce
CO3: Know about Big Data Technology, Tools, and Algorithms
CO4: Analyze the stream data and Link analysis.
CO5: Know about the role of big data in Recommender systems and social network analysis.
CO6: Design and Implementation of basic data intensive applications.

REFERENCES:

1. Mining of Massive Datasets, Third Edition, Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Cambridge University Press, New Delhi, Third Edition, 2020.
2. Big Data Science & Analytics, A Hands-on Approach, Arshdeep Bagha and Vijay Madisetti, 2016, New Delhi.
3. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
4. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley Publishers, First Edition, 2014.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	2	2	2
CO2	2		3	2	2	2
CO3	2		3	2	2	2
CO4	2		2	2	2	2
CO5	3		3	2	2	2
CO6	3	1	3	3	2	3

CA3005 BLOCKCHAIN TECHNOLOGIES L T P C
3 0 0 3

UNIT I INTRODUCTION TO BLOCKCHAIN 9

Historical Background and Evolution of Blockchain; Blockchain Architecture - Distributed Ledger Technology (DLT); Blocks and Chain Structure; Types of Blockchains; Consensus algorithms-Proof of Work (PoW) , Proof of Stake (PoS) , Delegated Proof of Stake (DPoS), Proof of Authority, Proof of Elapsed Time- Role of Consensus Algorithms in Achieving Trust and Security; Smart Contracts and Decentralized Applications (DApps).

UNIT II INTRODUCTION TO CRYPTOCURRENCY 9

History and Origins of Bitcoin; Bitcoin Technology and Architecture - Transactions and Scripting Language- Bitcoin Wallets; Bitcoin Mining; Bitcoin Transactions and Network; Bitcoin Security and Privacy; Bitcoin Scalability and Lightning Network; Alternative Coins – Theoretical Limitations – Bitcoin Limitations – Name Coin – Prime Coin – Zcash – Smart Contracts – Ricardian Contracts.

UNIT III ETHEREUM 9

Ethereum and its features; Ethereum Architecture : Ethereum Virtual Machine (EVM) and bytecode, Accounts and Addresses, Gas and Fees, Ethereum Clients; Ethereum Development: Solidity Programming Languages, Smart Contracts Development ; Ethereum Scaling Solutions, Ethereum DApps and Use Cases; Ethereum Community and Ecosystem.

UNIT IV WEB3 AND HYPERLEDGER 9

Introduction to Web3 – Contract Deployment – POST Requests – Development frameworks – Hyperledger as a protocol – The Reference Architecture – Hyperledger Frameworks – Hyperledger Tools.

UNIT V ALTERNATIVE BLOCKCHAINS AND NEXT EMERGING TRENDS 9

Kadena – Ripple- Rootstock – Quorum – Tendermint – Interoperability and Cross-Chain Communication - Scalability – Privacy – Tokenization and Digital Assets – Blockchain Research – Notable Projects – Miscellaneous tools.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the technology components of Blockchain and how it works behind-the scenes.
CO2: Aware of different approaches to developing decentralized applications.
CO3: Understand the Bitcoin and its limitations by comparing with other alternative coins.
CO4: Establish deep understanding of the Ethereum model, its consensus model, code execution.
CO5: Understand the architectural components of a Hyperledger and its development framework.
CO6: Come to know the Alternative blockchains and emerging trends in blockchain.

REFERENCES:

1. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.
2. Arshdeep Bahga, Vijay Madisetti, “Blockchain Applications: A Hands-On Approach”, VPT, 2017.
3. Andreas Antonopoulos, Satoshi Nakamoto, “Mastering Bitcoin”, O’Reilly Publishing, Second Edition, 2014.

4. Roger Wattenhofer, “The Science of the Blockchain” CreateSpace Independent Publishing Platform, 2016.
5. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.
6. Alex Leverington, “Ethereum Programming”, Packt Publishing, 2017.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	3	3
CO2	2	2	2	2	2	3
CO3	3	3	3	3	3	1
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	2
CO6	3	3	3	3	3	3

CA3006 C# AND .NET PROGRAMMING L T P C
3 0 0 3

UNIT I C# LANGUAGE BASICS 9

.Net Architecture – Core C# – Variables – Data Types – Flow control – Objects and TypesClasses and Structs – Inheritance- Generics – Arrays and Tuples – Operators and Casts – Indexers-Assemblies – Shared Assemblies – CLR Hosting – Appdomains.

UNIT II C# ADVANCED FEATURES 9

Delegates – Lambdas – Lambda Expressions – Events – Event Publisher – Event Listener – Strings and Regular Expressions – Generics – Collections – Memory Management and Pointers – Errors and Exceptions – Reflection.

UNIT III BASE CLASS LIBRARIES AND DATA MANIPULATION 9

Diagnostics Tasks – Threads and Synchronization – Manipulating XML – SAX and DOM – Manipulating files and the Registry – Transactions – Data access with ADO.NET: Introduction, LINQ to Entities and the ADO.NET Entity Framework, Querying a Database with LINQ – Creating the ADO.NET Entity Data Model Class Library, Creating a Windows Forms Project – Data Bindings Between Controls and the Entity Data Model – Dynamically Binding Query Results.

UNIT IV WINDOW AND WEB BASED APPLICATIONS 9

Window Based Applications – Core ASP.NET – ASP.NET Web Forms – Server Controls, Data Binding – ASP.NET State Management, Tracing, Caching, Error Handling, Security, Deployment, User and Custom Controls – Windows Communication Foundation (WCF) – Introduction to Web Services.

UNIT V .NET COMPACT FRAMEWORK 9

Reflection – .Net Remoting-.Net Security – Localization – Peer-to-Peer Networking – Building P2P Applications – .Net Compact Framework – Compact Edition DataStores – Testing and Debugging – Optimizing performance – Packaging and Deployment.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the difference between .NET and Java framework.
CO2: Work with the basic and advanced features of C# language.
CO3: Create applications using various data providers.
CO4: Create web application using ASP.NET.
CO5: Create mobile application using .NET compact framework.
CO6: Integrate all the features of C# language and build complex web applications in .NET framework.

REFERENCES:

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner, "Professional C# and .NET 4.5", Wiley, 2012.
2. Andrew Troelsen, "Pro C# 5.0 and the .NET 4.5 Framework", Apress publication, Sixth edition, 2012.
3. Ian Gariffiths, Mathew Adams, Jesse Liberty, "Programming C# 4.0", O'Reilly, Sixth Edition, Sixth edition, 2010.
4. Andy Wigley, Daniel Moth, "Peter Foot, —Mobile Development Handbook", Microsoft Press, 2011.
5. Herbert Schildt, "C# The Complete Reference", Tata McGraw Hill, 2004.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2	1	2	2
CO2	3		3	2	2	2
CO3	3		3	3	2	2
CO4	3		3	3	2	2
CO5	3		3	3	2	2
CO6	3	1	3	3	2	3

CA3007 VISUALIZATION TECHNIQUES **L T P C**
3 0 0 3

UNIT I INTRODUCTION **9**

Presentation-Explorative Analysis-Confirmative Analysis-Mental Model-Scientific Visualization-Reference Model-Designing a Visual Application-Linear Data Representation-Perception-Issues.

UNIT II VISUAL REPRESENTATION **9**

Information Visualization Process - Representation Techniques - Human Factor and Interaction-Relation and Connection-Multivariate Analysis – Trees – Graphs -Network and Hierarchies - World Wide Web Manipulable and Transformable Representation.

UNIT III MULTIMODAL PRESENTATION **9**

Human Vision – Presentation in Space- Temporal Consideration- Space and Time – Techniques for Spatial Data, Geospatial Data, Time-oriented Data- Text Document- Data Analysis using Tableau

and R language.

UNIT IV INTERACTION TYPES 9

Interaction Concepts and Techniques – Problem of Information overload – Interaction Types- Human Computer Interaction-Norman's Action Cycle-Interaction for: Information Visualization, Navigation, Models, Involuntary, Interactive Medical Application- Tactile Maps for Visually Challenged People.

UNIT V ADVANCE DESIGN TECHNIQUES 9

Designing Effective Visualization, Comparing and Evaluating- Research Directions –Systems- Personal view –Attitude-Idea Generation- Convergence- Sketching- Evaluation Criteria – Analytic and Empirical Method – Case Study – Interactive Calendars –Selecting one from many- Animation Design for Simulation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student should be able to:

CO1: Understand the concepts and techniques used in Visualization Techniques.
CO2: Implement different techniques of information representation.
CO3: Implement various presentations of information.
CO4: Apply different interaction types used to present information.
CO5: Design and implement effective Visualization.
CO6: Create and evaluate interactive data Visualization real-time problem.

REFERENCES:

1. O.Ward, Georges Grinstein and Daniel Keim," Interactive Data Visualization Foundations, Techniques, and Applications", Second Edition, A K Peters,2021.
2. Robert Spence, "Information Visualization An Introduction", Third Edition, Pearson Education, 2014.
3. Colin Ware, "Information Visualization Perception for Design", Third Edition, Morgan Kaufmann Publishers, 2012..
4. Jason Gregory, "Game Engine Architecture", Third Edition, A K Press, 2015.
5. Riccardo Mazza, "Introduction to Information Visualization", Springer.
6. Joerg Osarek, "Virtual Reality Analytics", Gordon's Arcade, 2016

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	2	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2
CO4	3	2	3	3	2	2
CO5	3	2	3	3	2	2
CO6	3	2	3	3	2	2

CA3008 DIGITAL IMAGE PROCESSING AND APPLICATIONS L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 9

Introduction – Applications of Image Processing – Steps in Image Processing Applications – Human vision and color perception- Digital Imaging System – Imaging Sensors-Sampling and Quantization – Pixel Connectivity – Distance Measures – Colour Fundamentals and Models – File Formats – Image Operations.

UNIT II IMAGE ENHANCEMENT AND TRANSFORMS 9

Image Transforms: Discrete Fourier Transform – Fast Fourier Transform – – Wavelet Transforms - Image Enhancement in Spatial and Frequency Domain – Grey Level Transformations – Histogram Processing –Spatial Filtering – Smoothing and Sharpening – Frequency Domain: Filtering in Frequency Domain.

UNIT III RESTORATION AND BOUNDRY DETECTION 9

Image Restoration – Image Degradation Model – Noise Modeling – Blur – Order Statistic Filters – Image Restoration - Morphological operations- dialation-erotion-opening-closing- edge detection-corner detection - detection of Discontinuities Edge Linking and Boundary Detection.

UNIT IV IMAGE SEGMENTATION AND FEATURE EXTRACTION 9

Image Segmentation — Thresholding – Region based Segmentation – Image Features and Extraction – Image Features – Types of Features – Feature extraction – SIFT, SURF– Feature reduction algorithms- PCA.

UNIT V IMAGE CLASSIFIER AND APPLICATIONS 9

Image Classifiers – Supervised Learning – maximum likely hood-minimum distence-parallopiped-Support Vector Machines, Image Clustering – Unsupervised Learning – kMeans-Hierarchical and Partition based Clustering Algorithms –ANN-Deep learning image classifier.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Implement basic image processing operations.
- **CO2:** Apply and develop new techniques in the areas of image enhancement and frequency transforms
- **CO3:** Restore images from noise and to extract edges and boundaries.
- **CO4:** Understand the image segmentation algorithms and Extract features from images.
- **CO5:** Apply classifiers and clustering algorithms for image classification and clustering.
- **CO6:** Design and develop an image processing application that uses different concepts of image processing.

REFERENCES:

1. Rafael Gonzalez, Richard E. Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2018.
2. S. Sridhar, “Digital Image Processing”, Second Edition, Oxford University Press, 2016.
3. Forsyth and Ponce, “Computer Vision – A Modern Approach”, Second Edition, Prentice Hall, 2011.
4. Anil K. Jain, “Fundamentals of Digital Image Processing”, PHI, 2011. 2. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing Analysis and Machine Vision”, Fourth Edition, Cengage India, 2017.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	3	2	2
CO2	3	-	3	3	2	2
CO3	3	-	3	3	2	2
CO4	3	-	3	3	2	2
CO5	3	-	3	3	2	2
CO6	3	1	3	3	2	2

CA3009 ETHICAL HACKING L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Ethical Hacking Overview - Role of Security and Penetration Testers. - Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing. - Network and Computer Attacks-Phishing Attacks - Malware - Protecting Against Malware Attacks. - Intruder Attacks - Addressing Physical Security.

UNIT II FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS 9

Footprinting Concepts - Footprinting through Search Engines, Web Services, Social Networking Sites, Website, Email - Competitive Intelligence - Footprinting through Social Engineering - Footprinting Tools - API Analysis - Network Scanning Concepts - Port-Scanning Tools - Scanning Techniques - Scanning Beyond IDS and Firewall – Exploiting Third-Party Dependencies.

UNIT III ENUMERATION AND VULNERABILITY ANALYSIS 9

Enumeration Concepts - Building your hack box - NetBIOS Enumeration – SNMP, LDAP, NTP, SMTP and DNS Enumeration - Vulnerability Assessment Concepts - Desktop and Server OS Vulnerabilities - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities in Windows- Linux OS Vulnerabilities- Vulnerabilities of Embedded OS - The world wide web of Vulnerabilities

UNIT IV SYSTEM HACKING 9

Hacking Web Servers - Web Application Components- Vulnerabilities - Tools for Web Attackers and Security Testers Hacking Wireless Networks - Components of a Wireless Network – Wardriving- Wireless Hacking - Tools of the Trade - Securing Modern Web Applications - Securing Third-Party Dependencies.

UNIT V NETWORK PROTECTION SYSTEMS 9

Files and File sharing - Access Control Lists. - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Based Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems -Network- and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams –Honeypots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Express knowledge on basics of computer-based vulnerabilities

CO2: Gain understanding on different foot printing, reconnaissance and scanning methods.

CO3: Demonstrate the enumeration and vulnerability analysis methods
CO4: Gain knowledge on hacking options available in Web and wireless applications.
CO5: Acquire knowledge on the options for network protection.
CO6: Use tools to perform ethical hacking to expose the vulnerabilities.

REFERENCES:

1. Simpson, Michael T., Kent Backman, and James Corley. Hands-on ethical hacking and network defens, Course Technology Press, Second Edition, 2012.
2. Hickey, Matthew, and Jennifer Arcuri. Hands on Hacking: Become an Expert at Next Gen Penetration Testing and Purple Teaming. John Wiley & Sons, First Edition, 2020.
3. Hoffman, Andrew. Web Application security: exploitation and countermeasures for modern web applications. O'Reilly Media, 2020.
4. Black Hat Python: Python Programming for Hackers and Pentesters. Seitz, Justin, and Tim Arnold, No starch press, Second Edition, 2021.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		3	2	1	1
CO2	2		3	2	1	1
CO3	2		3	2	1	2
CO4	2		3	2	1	2
CO5	2		3	3	1	1
CO6	2		3	2	1	2

CA3010 GAME PROGRAMMING L T P C
3 0 0 3

UNIT I INTRODUCTION TO GAME PROGRAMMING 9

Games- Designing and Developing Games-Genres- Understanding: Players, Machine-Game: Concepts, Worlds-Creative and Expressive Play- Character Development-Storytelling-Creating User Experience-Game play- Core Mechanics- Game Balancing- Level Design.

UNIT II MATH FOR GAME PROGRAMMING 9

Cartesian Coordinate Systems-Vectors-Multiple Coordinate Spaces-Matrices and Linear – Transformations - Polar Coordinate Systems-3D Rotations-Geometric Primitives-Viewing in 3D.

UNIT III MECHANICS FOR GAME PROGRAMMING 9

Linear Kinematics and Calculus –Linear and Rotational Dynamics - Curves in 3D – Lighting - Intersection Testing - Rigid Body Dynamics - Animation System – Controller based animation-Sound – Cameras Details.

UNIT IV ARCHITECTURE AND ALGORITHMS FOR GAME PROGRAMMING 9

Foundation- Low-Level Engine System - Game Play - Path and Waypoints – Navigation – Behaviors - Collision Detection - Game Logic - Game Artificial Intelligence - Spatial Sorting - singleton - Object pooling.

UNIT V LANGUAGE FOR GAME PROGRAMMING 9

Scripting Languages and Data Format – PyGame/Unity-Networked Games – Sample Game – iOS, Windows, Android-Developing 2D and 3D interactive games using Unity - DirectX – Isometric and Tile Based Games - Puzzle games - Single Player games - Multi Player game.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student should be able to:

CO1: Understand the concepts and techniques used in game development.
CO2: Apply the mathematical concept for game development
CO3: Apply the mechanic's concepts for game development.
CO4: Design and implement algorithms and techniques applied to game development.
CO5: Analyse the various language and platforms of game development.
CO6: Create and implement interactive games.

REFERENCES:

1. Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach", Addison Wesley, First Edition, 2013
2. Ernest Adams and Andrew Rollings, "Fundamentals of Game Design", First edition, Prentice Hall, First Edition, 2006.
3. Sebastiano M.Cossu, "Beginning Game AI with Unity: Programming Artificial Intelligence with C#", Apress, First Edition, 2020.
4. James M, Van Verth, Lars M.Bishop, "Essential Mathematics for Game anf Interactive Application", Third Edition, CRC Press, 2015.
5. Michael Dawson, "Beginning C++ Through Game Programming", Fourth Edition, Cengage Learning PTR, 2015.
6. Jason Gregory, "Game Engine Architecture", Third Edition, A K Press, 2015.
7. Fletcher Dunn, LanParberry, "3D Math Primer for Graphics and Game Development", Second Edition, CRC Press, 2011.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	2	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2
CO4	3	2	3	3	2	2
CO5	3	2	3	3	2	2
CO6	3	2	3	3	2	2

CA3011 HUMAN COMPUTER INTERACTION L T P C
3 0 0 3

UNIT I INTRODUCTION TO HUMAN-COMPUTER INTERACTION 9

The Human - Information Processing – The Computer – Information Processing – Human Computer Interaction – Models – Ergonomics – Interaction Styles – Interactivity – Context of Interaction – Strategies for building interactive systems – Paradigms of Interaction.

UNIT II DESIGNING INTERACTIVE SYSTEMS 9

Introduction to basics of design – Process – User focus – Navigation – Screen design – Iteration and Prototyping – HCI in software process – Usability Engineering - Iteration and Prototyping – Design Rules – Principles – Standards – Guidelines – Golden rules and heuristics – Implementation support – Windowing systems – Programming in the application – Toolkits – User Interface Management Systems

UNIT III EVALUATION AND UNIVERSAL DESIGN PRINCIPLES 9

Need for evaluation – Goals – Expert Analysis – User Participation and Feedback – Reporting Results - Choosing the evaluation method – Universal Design Principles – Multimodal Interaction – Designing for Diversity - Requirements for User support – Approaches - Adaptive help systems.

UNIT IV MODELS AND THEORIES 9

Cognitive Models – Goals & Task Hierarchies – Linguistic models – Challenges of the display-based system – Physical – Device models – Socio- Organizational issues – Communication and collaboration – Face-to-face – conversation – text based – group working – Task analysis techniques – decomposition of task – knowledge-based analysis – entity-relationship based analysis – Dialog design model – design notations – graphical – textual – semantics – System models – formalisms – interactions – continuous behaviour.

UNIT V HCI IN COLLABORATIVE APPLICATIONS 9

Groupware – Computer – Mediated Communication – Meeting & Decision Support – Shared applications and artifacts – Frameworks – Synchronous groupware – Ubiquitous computing – Virtual and Augmented Reality – Information & Data visualization – Web – Hypertext – Finding things – Issues – Static web – Dynamic web

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate a comprehensive understanding of the concepts and theories related to human-computer interaction and their application in designing interactive systems.

CO2: Apply user-centred design principles and guidelines to create intuitive and effective user interfaces for interactive systems.

CO3: Utilize appropriate evaluation methods and techniques to assess the usability and user experience of interactive systems, and report evaluation results effectively.

CO4: Analyze and apply various HCI models, such as task models and dialogue models, to design interactive systems.

CO5: Explore and discuss the challenges and implications of HCI in collaborative applications, such as groupware and computer-mediated communication.

CO6: Demonstrate a comprehensive understanding of the principles, theories, and methodologies of human-computer interaction and effectively apply them in the design of user-friendly and effecient interactive systems.

REFERENCES:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, “Human Computer Interaction”, Third Edition, Prentice Hall, 2004.
2. Preece, J., Sharp, H., Rogers, Y., “Interaction Design: Beyond Human-Computer Interaction”, Sixth Edition, Wiley, 2022.
3. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, “Research Methods in Human-Computer Interaction”, Second Edition, Morgan Kaufmann, 2021.

4. Ben Shneiderman, Catherine Plaisant, “Designing the User Interface: Strategies for Effective Human-Computer Interaction”, Sixth Edition, Addison Wesley, 2021.
5. Jeff Johnson, “Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Rules”, Third Edition, Morgan Kaufmann, 2020.
6. Benyon, D, “Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design”, Third Edition, Pearson Education Limited, 2019.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	-	-
CO2	3	2	3	3	-	1
CO3	3	-	2	2	-	-
CO4	3	-	3	3	-	1
CO5	3	2	3	3	-	-
CO6	3	1	3	3	1	1

CA3012 SOCIAL NETWORK ANALYSIS L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Social Network Analysis: Definition and Features – The Development of Social Network Analysis – Basic Graph Theoretical Concepts of Social Network Analysis – Ties, Density, Path, Length, Distance, Betweenness, Centrality, Clique – Electronic Sources for Network Analysis – Electronic Discussion Networks, Blogs and Online Communities, Web-based Networks – Applications of Social Network Analysis.

UNIT II SOCIAL NETWORK ANALYSIS 9

Introduction to Social Networks Profiles – Types of Commercial Social Network Profiles (CSNP) – Quantitative and Qualitative Analysis of CSNP – Analysis of Social Networks Extracted from Log Files – Data Mining Methods Related to SNA and Log Mining – Clustering Techniques – Case Study.

UNIT III SEMANTIC TECHNOLOGY FOR SOCIAL NETWORK ANALYSIS 9

Introduction to Ontology-based Knowledge Representation – Ontology Languages for the Semantic Web – RDF and OWL – Modeling Social Network Data – Network Data Representation, Ontological Representation of Social Individuals and Relationships – Aggregating and Reasoning with Social Network Data – Advanced Representations.

UNIT IV SOCIAL NETWORK MINING 9

Detecting and Discovering Communities in Social Network: Evaluating Communities – Methods for Community Detection – Trust factor- Applications of Community Mining Algorithms –Ethical Practices in Social Network Mining – Understanding and Predicting Human Behavior for Social Communities – Decentralized Online Social Networks – Multi-Relational Characterization of Dynamic Social Network Communities – Inferential Methods in Social Network Analysis.

UNIT V VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS 9

Visualization of Social Networks Node-Edge Diagrams – Random Layout – Force-Directed Layout – Tree Layout – Matrix Representations –Matrix and Node-Link Diagrams – Hybrid Representations

– Visualizing Online Social Networks – Applications – Covert Networks – Community Welfare – Collaboration Networks – Co-Citation Networks – Data Privacy in Social Networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand basic principles behind network analysis algorithms and develop practical skills in network analysis.
CO2: Model and represent knowledge for social semantic Web.
CO3: Apply data mining techniques on social networks.
CO4: Use extraction and mining tools for analyzing Social networks.
CO5: Develop secure social network applications.
CO6: Develop personalized visualization for Social networks.

REFERENCES:

1. Peter Mika, “Social Networks and the Semantic Web”, Springer, First Edition, 2007.
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, 2010.
3. Song Yang, Franziska B. Keller, Lu Zheng, “Social Network Analysis: Methods and Examples”, Sage Publication, First Edition, 2016.
4. GuandongXu, Yanchun Zhang, Lin Li, “Web Mining and Social Networking Techniques and Applications”, Springer, 2011.
5. Max Chevalier, Christine Julien, Chantal Soulé-Dupuy, “Collaborative and Social Information Retrieval and Access: Techniques for Improved User Modelling”, IGI Global, 2009.
6. John G. Breslin, Alexandre Passant, Stefan Decker, “The Social Semantic Web”, Springer, 2009.
7. John Scott, Peter J. Carrington, “The SAGE Handbook of Social Network Analysis”, Sage Publication, First Edition, 2011.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	2	1	1
CO2	2	1	3	3	1	-
CO3	3	1	3	3	1	-
CO4	2	-	3	3	-	1
CO5	2	-	3	3	-	1
CO6	3	-	3	3	-	1

CA3013 **MIXED REALITY** **L T P C**
3 0 0 3

UNIT I INTRODUCTION TO MIXED REALITY 9

Introduction to virtual reality (VR), Augmented reality (AR), and Mixed Reality (MR) – History – MR Use cases & Designing for MR platforms – Mixing Virtual with Real - MR hardware and devices – The Input – The output – Optical see-through displays – Eye Tracking- Computer vision for MR

UNIT II INTERACTION DESIGN IN MR 9

Integrating Framework For MR –Embedded MR environment - Tangible Interaction – Auditory-Induced presence – Exertion in MR systems – Mixed Interaction in MR

UNIT III SOFTWARE DESIGN AND IMPLEMENTATION 9

Outdoor MR Systems – Multimodal Excitatory Interfaces – Tracking in Mixed Reality – Authoring Immersive MR – Collaborative AR – Software Engineering Method for MR

UNIT IV MIXED REALITY AND HUMAN-ROBOT INTERACTION 9

Mixed Reality for Robots – User-centered HRI – Mental Transformation in HRI – Computational Cognitive Modeling – Evaluating the usability of the virtual environment – Security Robot

UNIT V APPLICATIONS OF MIXED REALITY 9

MR in healthcare and medical simulations – Teleoperation interface for MR Robot - MR in psychological experimentation – MR in Sports – MR Prototypes to support early creative design – MR Companion Robots

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Demonstrate knowledge and understanding of VR, AR, and MR concepts, technologies, and applications.
- **CO2:** Apply design principles and considerations specific to Mixed Reality platforms.
- **CO3:** Understand interaction design principles in Mixed Reality.
- **CO4:** Apply software design and implementation skills for Mixed Reality systems.
- **CO5:** Demonstrate knowledge of the intersection of Mixed Reality and Human-Robot Interaction (HRI).
- **CO6:** Analyze and evaluate the integration of Mixed Reality technologies and principles into real-world applications.

REFERENCES:

1. O'Connell, Kharis, “Designing for Mixed Reality”, O'Reilly Media, Inc, 2016.
2. Dubois E, Gray P, Nigay L, “The engineering of mixed reality systems” Springer Science & Business Media, 2009.
3. Wang, Xiangyu, “Mixed reality and human-robot interaction”. Vol. 47. Springer Science & Business Media, 2011.
4. Benyon, D, “Designing Interactive Systems: A Comprehensive Guide to HCI, UX and Interaction Design”, Third Edition, Pearson Education Limited, 2013.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	3	2	1	1
CO2	3	1	3	3	-	-
CO3	3	1	3	2	1	-
CO4	3	-	3	3	-	-
CO5	3	-	3	3	-	1
CO6	3	1	3	3	-	1

CA3014 MULTICORE ARCHITECTURE AND PROGRAMMING L T P C
3 0 0 3

UNIT I MULTI-CORE PROCESSORS 9

Single core to Multi-core architectures – SIMD and MIMD systems – Interconnection networks – Symmetric and Distributed Shared Memory Architectures – Cache coherence – Performance Issues – Parallel program design.

UNIT II PARALLEL PROGRAM CHALLENGES 9

Performance – Scalability – Synchronization and data sharing – Data races – Synchronization primitives (mutexes, locks, semaphores, barriers) – deadlocks and livelocks – communication between threads (condition variables, signals, message queues and pipes).

UNIT III SHARED MEMORY PROGRAMMING WITH OpenMP 9

OpenMP Execution Model – Memory Model – OpenMP Directives – Work-sharing Constructs – Library functions – Handling Data and Functional Parallelism – Handling Loops – Performance Considerations.

UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

MPI program execution – MPI constructs – libraries – MPI send and receive – Point-to-point and Collective communication – MPI derived datatypes – Performance evaluation

UNIT V PARALLEL PROGRAM DEVELOPMENT 9

Case studies – n-Body solvers – Tree Search – OpenMP and MPI implementations and comparison.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

- **CO1:** Explore multicore architectures and identify their characteristics and challenges.
- **CO2:** Identify the issues in programming Parallel Processors.
- **CO3:** Write programs using OpenMP and MPI.
- **CO4:** Design parallel programming solutions to common problems.
- **CO5:** Compare and contrast programming for serial processors and programming for parallel processors.
- **CO6:** Utilize parallel program design for High Power Computation processor

REFERENCES:

1. Peter S. Pacheco, “An Introduction to Parallel Programming, Morgan-Kauffman/Elsevier, 2021.
2. Darryl Gove, “Multicore Application Programming for Windows, Linux, and Oracle Solaris, Pearson, First Edition, 2011.
3. Michael J Quinn, “Parallel programming in C with MPI and OpenMP, Tata McGraw Hill,2003.
4. Victor Alessandrini, Shared Memory Application Programming, Concepts and Strategies in Multicore Application Programming, Morgan Kaufmann, First Edition 2015.
5. Yan Solihin, Fundamentals of Parallel Multicore Architecture, CRC Press, First Edition, 2015.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	2	2
CO2	3	2	3	3	2	-
CO3	3	1	3	3	2	1
CO4	2	2	3	3	2	2
CO5	3	2	3	3	2	2
CO6	3	1	3	3	2	-

CA3015 MULTIMEDIA TECHNOLOGIES L T P C
3 0 0 3

UNIT I INTRODUCTION TO MULTIMEDIA ELEMENTS 9

Multimedia – Medium – Properties of a Multimedia System – Traditional Data Stream Characteristics – Data Stream Characteristics of Continuous Media – Basic Sound Concepts – Speech – Images and Graphics – Computer Image Processing – Video and Animation – Computer Based Animation.

UNIT II MULTIMEDIA COMPRESSION 9

Storage Space – Coding Requirements – Hybrid Coding – JPEG: Image Preparation, Lossy Mode, Lossless Mode, Huffman, Arithmetic LZW coding, Hierarchical Mode – H.261 – MPEG: Video Encoding, Audio Encoding, Data Stream, MPEG 3, MPEG 7, MPEG 21 – DVI – Audio Encoding.

UNIT III MULTIMEDIA ARCHITECTURES 9

User Interfaces – OS multimedia support – Multimedia Extensions – Hardware Support – Distributed multimedia applications – Real-time protocols – Playback Architectures – Synchronization – Document and document architecture – Hypermedia concepts – Hypermedia design – Digital copyrights – Digital Library – Multimedia Archives.

UNIT IV MULTIMEDIA OPERATING SYSTEM AND DATABASES 9

Real-time – Resource Management – Process Management – File systems – Interprocess communication and synchronization – Memory management – Device Management – Characteristics of MDBMS – Data Analysis – Data structures – Operations on data – Integration in a database model.

UNIT V MULTIMEDIA COMMUNICATION & APPLICATIONS 9

Tele Services – Implementation of Conversational Services, Messaging Services, Retrieval Services, Tele Action Services, Tele Operation Services – Media Consumption – Media Entertainment – Multimedia Application Development – Virtual Reality – Interactive Audio – Interactive Video – Games.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Handle the multimedia elements effectively.

CO2: Encode and decode the multimedia elements.

CO3: Understand the underlying multimedia computing architectures used for media development.
CO4: Develop effective strategies to deliver Quality-of-Experience in multimedia applications.
CO5: Design and implement algorithms and techniques related to multimedia objects.
CO6: Design and develop multimedia applications in various domains.

REFERENCES:

1. Ralf Steinmetz, Klara Nahrstedt, "Multimedia computing, communications, and applications", Pearson India, 2009.
2. Ranjan Parekh, "Principles of Multimedia", Second Edition, McGraw Hill Education, 2017.
3. Ralf Steinmetz, Klara Nahrstedt, "Multimedia Systems", Springer IE, 2004.
4. Tay Vaughan, "Multimedia: Making it Work", McGraw – Hill Education, Ninth Edition, 2014.
5. Ze-Nian Li, Mark S. Drew , Jiangchuan Liu, "Fundamentals of multimedia", Third Edition, Springer, 2021.
6. Jerry D. Gibson, Toby Berger, Tom Lookabaugh, Dave Lindbergh, Richard L. Baker, "Digital Compression for Multimedia: Principles and Standards", Elsevier, 2006.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	3	3	1	1
CO2	3	1	3	3	1	-
CO3	2	1	3	3	1	-
CO4	3	-	3	3	1	1
CO5	3	1	3	3	-	1
CO6	3	1	3	3	-	1

CA3016 NETWORK PROGRAMMING AND MANAGEMENT L T P C
3 0 0 3

UNIT I SOCKETS AND APPLICATION DEVELOPMENT 9

Introduction to Socket Programming – System Calls – Address Conversion Functions – POSIX Signal Handling – Server with Multiple Clients – Boundary Conditions – Server Process Crashes, Server Host Crashes, Server Crashes and Reboots, Server Shutdown – I/O Multiplexing – I/O Models – TCP Echo Client/Server with I/O Multiplexing.

UNIT II SOCKET OPTIONS 9

Socket Options – getsockopt and setsockopt Functions – Generic Socket Options – IP Socket Options – ICMP Socket Options – TCP Socket Options – Multiplexing TCP and UDP Sockets – Domain Name System – gethostbyname, gethostbyaddr, getservbyname and getservbyport functions – Protocol Independent Functions – getaddrinfo and freeaddrinfo Functions.

UNIT III ADVANCED SOCKETS 9

IPv4 and IPv6 Interoperability – Threaded Servers – Thread Creation and Termination – TCP Echo Server using Threads – Mutex – Condition Variables – Raw Sockets – Raw Socket Creation – Raw Socket Output – Raw Socket Input – Ping Program – Trace Route Program.

UNIT IV SIMPLE NETWORK MANAGEMENT 9

SNMP Network Management Concepts – SNMPv1 – Management Information – MIB Structure – Object Syntax – Standard MIB‘s – MIB–II Groups – SNMPv1 Protocol and Practical Issues – Overview of RMON – Statistics and Collection – Alarms and Filters.

UNIT V NETWORK MANAGEMENT TOOLS & SYSTEMS 9

System Utilities – Network Status Tools – Traffic monitoring Tools – Network Routing Tools – SNMP Tools – Network Statistics measurement systems – NMS Design – Network Management Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Implement client/server communications using TCP and UDP Sockets.
CO2: Describe the usage of socket options for handling various Sockets in programming.
CO3: Understand handling of raw sockets.
CO4: Explain functionalities of SNMP and MIB structure.
CO5: Experiment with various tools available to manage a network.
CO6: Handle technical issues in a network.

REFERENCES:

1. James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, Eighth Edition, Pearson Education, 2022.
2. W. Richard Stevens, “UNIX Network Programming Vol I”, Third Edition, PHI/ Pearson Education, 2003.
3. William Stallings, “SNMP, SNMPv2, SNMPv3 and RMON 1 and 2”, Third Edition, Pearson Education, 2009.
4. D.E. Comer, “Internetworking with TCP/IP , Vol–I”, Sixth Edition, Pearson Edition, 2015.
5. D. E. Comer, “Internetworking with TCP/IP Vol–III: Client–Server Programming and Application BSD Sockets Version”, Second Edition, Pearson Education, 2015.
6. Mani Subramanian, “Network Management – Principles and Practice”, Second Edition, Pearson Education, 2013.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	3	2	3
CO2	3	2	2	3	2	3
CO3	3	2	2	3	2	2
CO4	3	2	2	3	2	2
CO5	3	2	2	3	2	2
CO6	3	2	2	3	2	3

CA3017 NEXT GENERATION NETWORKS L T P C
3 0 0 3

UNIT I 5G INTERNET AND LEAP TO 6G VISION 9

Historical Trend of Wireless Communications – Evolution of LTE Technology to Beyond 4G – 5G Roadmap – Ten Pillars of 5G – The 6G Vision -6G Vertical Industries-Technologies enabling 6G-Other 6G Considerations

UNIT II SMALL CELLS FOR 5G MOBILE NETWORKS 9

Introduction to Small Cells – Capacity Limits and Achievable Gains with Densification – Mobile Data Demand – Demand vs. Capacity – Small Cell Challenges.

UNIT III COOPERATION FOR NEXT GENERATION WIRELESS NETWORKS 9

Cooperative Diversity and Relaying Strategies: Cooperation and Network Coding, Cooperative ARQ MAC Protocols – PHY Layer Impact on MAC Protocol Analysis**-**Introduction – The Mobile Cloud – Mobile Cloud Enablers – Network Coding – Overview of Cognitive Radio Technology in 5G Wireless – Spectrum Optimization using Cognitive Radio – Relevant Spectrum Optimization Literature in 5G

UNIT IV NETWORKING TECHNIQUES AND APPLICATIONS FOR 5G NETWORKS 9

5G RAN Architecture: C-RAN with NGFI- User-Centric Wireless Network for 5G - Energy Harvesting Based Green Heterogeneous Wireless Access for 5G -Resource Allocation for Cooperative D2D Communication Networks- Fog Computing and Its Applications in 5G -A Conceptual 5G Vehicular Networking -Communications Protocol Design for 5G Vehicular Networks -Next-Generation High-Efficiency WLAN -Shaping 5G for the Tactile Internet

UNIT V FUTURISTIC TECHNOLOGICAL ASPECTS OF 6G 9

6G Beamforming Techniques-Aerial and Satellite Components of 6G Networks-Underwater Communication Components of 6G Networks-6G Networks-Radar Sensing-Imaging and Sensing-Localization-Other verticals

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Compare the 5G network with older generations of networks.
CO2: Identify suitable small cells for different applications in 5G networks.
CO3: Simulate 5G network scenarios.
CO4: Connect applications of FOG Computing
CO5: Design applications with 5G network support.
CO6: Analyze the 6G Networks

REFERENCES:

1. Jonathan Rodriguez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015.
2. Wireless Communications: Principles and Practice, by Theodore S. Rappaport, Prentice Hall., First Edition, 2014
3. Mobile Communication Networks: 5G and a Vision of 6G springer Božanić, Mladen, and Saurabh Sinha. *Mobile Communication Networks: 5G and a Vision of 6G*. Springer, First Edition, 2021.
4. 5G Mobile Communications: Concepts and Technologies First Edition

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	2	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	2	2
CO4	2	2	3	3	2	2
CO5	3	2	3	3	2	2
CO6	3	2	3	3	2	2

CA3018 SERVICE ORIENTED ARCHITECTURES AND MICROSERVICES L T P C
3 0 0 3

UNIT I SOFTWARE ENGINEERING PRACTICES 9

Need for Software Architecture – Types of IT Architecture – Pattern & Style – Architecting Process for Software Applications – High Level Architecture – Solution Architecture – Software Platforms – Enterprise Applications

UNIT II SOA AND MICROSERVICE ARCHITECTURE BASICS 9

SOA and MSA – Basics – Evolution of SOA & MSA – Emergence of MSA – Enterprise-wide SOA – Strawman and SOA Reference Architecture – OOAD Process & SOAD Process

UNIT III CONTENTS SERVICE – ORIENTED ENTERPRISE APPLICATIONS 9

Considerations for Service-Oriented Enterprise Applications – Patterns for SOA – Pattern Based Architecture for Service-Oriented Enterprise Applications: Reference Model of Service Oriented Java EE Enterprise Application – SOA Programming Models,

UNIT IV SERVICE ORIENTED ANALYSIS AND DESIGN 9

Principles of Service Design – Design of Activity, Data, Client, Business Process Services – Resilience Services –Technologies for SOA

UNIT V MICROSERVICE ARCHITECTURE 9

Introduction to Micro Services – Micro Services in Depth, Micro Services Architecture – Architecture for Digital Business – Indispensable Cloud

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze and design SOA based solutions.
CO2: Understand the basic principles of Service Orientation.
CO3: Implement and analyze Java EE Enterprise Application
CO4: Understand the technology underlying service design.
CO5: Implement SOA with Micro Services applications.
CO6: Classify and make reasoned decision about the adoption of different SOA platforms.

REFERENCES:

1. Shankar Kambhampaty, “Service-oriented Architecture & Microservice Architecture: For Enterprise, Cloud, Big Data and Mobile”, Third Edition, Wiley, 2018.

2. Practical Microservices Architectural Patterns, Event-Based Java Microservices with Spring Boot and Spring Cloud, Binildas Christudas, APress, First Edition, 2019.
3. Thomas Erl, “Service Oriented Architecture: Concepts, Technology, and Design”, Pearson Education, 2005.
4. Practical Event-Driven Microservices Architecture (Building Sustainable and Highly Scalable Event-Driven Microservices), Hugo Filipe Oliveira Rocha, Apress, 2022.
5. Nicolai M. Josuttis, “SOA in Design – The Art of Distributed System Design”, O’REILLY publication, 2007.
6. Raj Balasubramanian, Benjamin Carlyle, Thomas Erl, Cesare Pautasso, “SOA with REST – Principles, Patterns & Constraints for Building Enterprise Solutions with REST”, Prentice Hall, First Edition, 2013.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	3
CO2	2	2	3	2	1	2
CO3	2	2	3	2	3	2
CO4	2	3	3	2	2	3
CO5	2	3	2	2	1	2
CO6	3	2	2	2	2	2

CA3019 SOFTWARE ARCHITECTURE L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Software architecture; Importance of software architecture; Architectural Views and Perspectives-Functional View, Concurrency View, Development View, Deployment View, Operational View, Use Cases and Scenarios.

UNIT II DESIGN PATTERNS 9

Architectural Styles and Patterns- Layered architecture, Client-server architecture, Micro services architecture, Event-driven architecture, Model-View-Controller (MVC) pattern, Publish-Subscribe pattern, Repository pattern, Dependency Injection pattern - Architectural Quality Attributes, Architectural Decision-Making-Architectural Drivers and Constraints, Architectural Decisions and Trade-offs, Architectural Decision-Making Process

UNIT III ARCHITECTURAL FRAMEWORKS AND VIEWS 9

Architectural Frameworks and Methodologies -TOGAF (The Open Group Architecture Framework)-Zachman Framework, Agile Architecture, Domain-Driven Design (DDD) -Architecture Documentation Principles, Views and Viewpoints, UML Diagrams for Architecture Documentation.

UNIT IV DESIGN PRINCIPLES 9

Architectural Design Principles-Separation of concerns -Modularity and component-based design-Abstraction and encapsulation, Loose coupling and high cohesion, Design by Contract,

Orthogonality - Architectural Quality attributes and trade-offs- Scalability and performance considerations--Software Interfaces-Architecturally Significant Requirements.

UNIT V MANAGING ARCHITECTURE 9

Designing an Architecture-Evaluating an Architecture- Documenting an Architecture- Managing Architecture Debt-The Role of Architects in Projects-Architecture Competence-Software Architecture Metrics-Four Key Metrics - Fitness Function Testing Pyramid- Evolutionary Architecture.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the creation and evolution of software architecture
CO2: Learn the importance of design patterns in building the systems
CO3: To analyze the different styles of architecture
CO4: To exercise different architectural styles and their deployment in various domains
CO5: To learn the architectures for emerging technologies and how to document them
CO6: Obtain an insight into the concepts of architectural evolution

REFERENCES:

1. Software Architecture_ Perspectives on an Emerging Discipline- Mary Shaw, David Garlan - Prentice Hall, First Edition, 1996.
2. Len Bass,Paul Clements,Rick Kazman - Software Architecture in Practice, 4th Edition-Addison-Wesley Professional, 2021.
3. Software Architecture Metrics: Case Studies to Improve the Quality of Your Architecture by Andrew Harmel-Law , Carola Lilienthal , Christian Ciceri , Dave Farley , Michael Keeling , Neal Ford -O'Reilly Media, 2022.
4. Documenting Software Architectures - Views and Beyond - David Garlan, Felix Bachmann, James Ivers, Reed Little, Judith Stafford, Len Bass, Paul Clements, Paulo Merson, Robert Nord – Addison, Second Edition, 2010.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3	3	3	2
CO2	3	3	2	3	3	1
CO3	3	3	3	3	3	2
CO4	3	3	3	2	3	2
CO5	3	3	2	3	3	1
CO6	3	3	3	3	3	2

CA3020 SOFTWARE TESTING AND AUTOMATION L T P C
3 0 0 3

UNIT I TESTING PRINCIPLES AND AXIOMS 9

Testing as a Process – Testing Maturity Model- Testing Axioms –Software Testing Principles – Origins and Cost of Defects – Defect Classes and Examples –Developer/Tester Support of Developing a Defect Repository – Defect Analysis and Prevention Strategies.

UNIT II BLACK BOX, WHITE BOX TESTING AND TEST ADEQUACY 9

Test Case Design Strategies – Black Box Approach –Boundary Value Analysis – Equivalence Class Partitioning – Syntax testing - Finite State-Based Testing – User Documentation Testing –White Box Approach – Static Testing vs. Structural Testing – Code Functional Testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – Cyclomatic Complexity – Test Adequacy Criteria- Evaluating Test Adequacy Criteria.

UNIT III LEVELS OF TESTING 9

Unit Test Planning – Designing and Running the Unit Tests– Integration Test Planning – Scenario Testing – System Testing–Defect Bash Elimination System Testing- Acceptance Testing – Performance Testing – Regression Testing – Internationalization Testing – Ad-Hoc Testing – Alpha, Beta Tests.

UNIT IV TEST MANAGEMENT 9

Organization Structures For Testing Teams – Testing Services – Test Planning– Locating Test Items – Test Management – Reporting Test Results – The Role of Three Groups in Test Planning and Policy Development – Introducing the Test Specialist – Skills Needed by a Test Specialist – Structure of Testing Group -Building a Testing Group.

UNIT V TEST AUTOMATION 9

Software Test Automation – Framework for test automation-Skill Needed for Automation – Scope of Automation – Generic Test Automation Architecture – Requirements & Criteria for Test Tool selection -Challenges in Automation – Test Metrics and Measurements – CASE STUDY: Web Accessibility Testing, Disabled Object Verification Through Force

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Obtain an insight to software testing.
CO2: Apply both black box testing and white box testing.
CO3: Understand and apply multiple levels of testing.
CO4: Understand the role of a tester as an individual and as a team member.
CO5: Apply software testing for large projects using automated testing tools.
CO6: Maintain documentation on testing.

REFERENCES:

1. Jorgensen, Paul C. Software testing: a craftsman's approach. CRC press, Fourth Edition, 2018.
2. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing – Principles and Practices", Pearson Education, First edition, 2009.
3. Palani, N. Automated Software Testing with Cypress. Taylor & Francis. CRC Press, First edition, 2021.
4. Glenford J. Myers, Tom Badgett, Corey Sandler, "The Art of Software Testing", Third Edition, John Wiley & Sons, Third Edition, 2012.
5. Kossiakoff, A., Biemer, S. M., Seymour, S. J., & Flanigan, D. A. Systems engineering principles and practice. John Wiley & Sons, Third Edition, 2020.
6. Aniche, M. Effective Software Testing: A developer's guide. Simon and Schuster, 2022.
7. Ali Mili, Fairouz Chier, "Software Testing: Concepts and Operations", Wiley, 2015.
8. Axelrod, A. Complete Guide to Test Automation: Techniques. Practices, and Patterns for Building and Maintaining Effective Software Projects, 2018.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	2	2
CO2	3	3	2	3	3	2
CO3	3	3	3	2	3	3
CO4	3	3	3	2	3	3
CO5	-	3	3	3	3	3
CO6	2	3	2	2	2	3

CA3021 MOBILE COMPUTING L T P C
3 0 0 3

UNIT I WIRELESS COMMUNICATION AND CELLULAR NETWORKS 9

Electromagnetic Spectrum – Antenna – Propagation Ranges and Effects – Multipath Propagation – Spread Spectrum –Multiple Access Techniques: FDMA, TDMA, CDMA, OFDMA – Duplexing Techniques: FDD, TDD – Cellular Networks – Tessellation, Frequency Reuse and Handoff – Generations of Cellular Networks – 5G Systems.

UNIT II 4G AND 5G WIRELESS MOBILE NETWORKS 9

User Equipment, RNS, UTRAN - Node B - RNC Functions – IP Multimedia Subsystem – 4G /5G Cellular Networks – LTE – Control Plane – NAS and RRC – User Plane – PDCP, RLC And NAC – IMT– Advanced Standard – Features Of LTE– Advanced.

UNIT III MOBILITY SUPPORT IN IP AND TCP 9

Mobile IP – Mobile Agent- Foreign Agent - Tunneling, IP within IP – Mobility Support in IPV6 – Dynamic Home Agent Address Discovery - Cache Management – TCP Over Wireless Networks – Indirect TCP –Snoop TCP – Mobile TCP.

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

COURSE OUTCOMES:

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

CO1: Obtain knowledge on the architecture and protocols of 2G, 3G, and 4G cellular system.
CO2: Deploy various protocols that support mobility at network layer and transport layer.
CO3: Design and implement the user interfaces for mobile applications.
CO4: Design the mobile applications that are aware of the resource constraints of mobile devices.
CO5: Develop advanced mobile applications that access the databases and the web.

CO6: Understand the intricacies in deploying cellular networks and developing mobile applications based on resilient programming practices.

REFERENCES:

1. Clint Smith, Daniel Collins, “Wireless Networks”, Third Edition, McGraw Hill Publications, 2014.
2. Share Conder, Lauren Darcey, “Android Wireless Application Development”, Volume I, Third Edition, Pearson, 2014.
3. Jochen Schiller, “Mobile Communications”, Second Edition, Pearson, 2009.
4. Paul Bedell, “Cellular networks: Design and Operation – A real world Perspective”, Outskirts Press, 2014.
5. Zigurd Mednieks, Laird Dornin, G, Blake Meike and Masumi Nakamura, “Programming Android”, O’Reilly, First Edition, 2011.
6. Alasdair Allan, “iPhone Programming”, O’Reilly, First Edition, 2010.
7. Donny Wals, “Mastering iOS 12 Programming”, Packt, Third Edition, 2018.
8. Reza B’Far, “Mobile Computing principles”, Cambridge University Press, 2005

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3	3	2	2
CO2	2	3	2	2	3	1
CO3	2	3	3	2	3	2
CO4	3	3	2	3	3	3
CO5	3	3	3	2	3	3
CO6	3	3	3	3	2	3

CA3022 UNIX INTERNALS L T P C
3 0 0 3

UNIT I OVERVIEW 9

General Overview of the System: History – System Structure – User Perspective – Operating System Services – Assumptions about Hardware – Introduction to the Kernel Architecture of the UNIX Operating System – Introduction to System Concept – The Buffer Cache – Buffer headers – Structure of the Buffer Pool – Scenarios for Retrieval of a Buffer– Reading and Writing Disk Blocks – Advantages and Disadvantages of the Buffer Cache.

UNIT II FILE SUBSYSTEM 9

Internal Representation of Files: inodes – Structure of a Regular File – Directories – Conversion of a Path Name to an Inode – Super Block – Inode Assignment to a New File – Allocation of Disk Blocks.

UNIT III SYSTEM CALLS FOR THE FILE SYSTEM 9

Open – Read – Write – File and Record Locking – Adjusting the Position of File I/O – lseek – Close – File Creation – Creation of Special Files – Changing Directory – Root – Owner – Mode – stat and fstat – Pipes – dup – Mounting And Unmounting File Systems – link – unlink.

UNIT IV PROCESSES **9**

Process States and Transitions – Layout of System Memory – The Context of a Process – Saving the Context of a Process – Manipulation of the Process Address Space – Process Control – Process Creation – Signals – Process Termination – Awaiting Process Termination – Invoking other programs – User Id of a Process – Changing the Size of a Process – Shell System Boot and the INIT Process – Process Scheduling.

UNIT V MEMORY MANAGEMENT AND I/O **9**

Memory Management Policies – Swapping – Demand Paging - The I/O Subsystem: Driver Interface – Disk Drivers – Terminal Drivers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand UNIX architecture and explain how they interact with computer hardware.
CO2: Critically analyze the internal structure of files in the UNIX system and algorithms used in the building of a kernel.
CO3: Gain a deeper understanding of system calls for the file system in Unix operating system.
CO4: Implement the process state model and its control for the UNIX system
CO5: Implement the memory management policies in an operating system.
CO6: Implement the I/O subsystems in UNIX system.

REFERENCES:

1. Maurice J. Bach, “The Design of the Unix Operating System”, Pearson Education, First Edition,1999.
2. B. Goodheart, J. Cox, “The Magic Garden Explained”, Prentice Hall of India, 1986.
3. S. J. Leffler, M. K. Mckusick, M. J. .Karels, J. S. Quarterman., “The Design and Implementation of the 4.3 BSD Unix Operating System”, Addison Wesley, 1998.
4. Robert Love, “Linux Kernel Development”, Third Edition, Addison Wesley, 2010.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	3	2
CO2	3	2	3	2	3	2
CO3	3	2	3	2	3	2
CO4	3	2	3	2	3	2
CO5	3	2	3	2	3	2
CO6	3	2	3	2	3	2

CA3023 LINUX ESSENTIALS **L T P C**
3 0 0 3

UNIT I INTRODUCTION **9**

Levels and layers of Abstraction in a Linux System – Hardware – Kernel: Process Management, Memory Management, Device drivers and Management, System Calls and Support – User Space – Shell Commands

UNIT II DEVICES, DISKS and FILE SYSTEMS 9

Device Files – Device Path – Device name summary – udev – SCSI and Linux Kernel – Partitioning Disk Devices – Filesystems – Swap space

UNIT III KERNEL SPACE AND USER SPACE 9

How the Linux Kernel Boots: Startup messages – Kernel initialization and Boot options – Kernel Parameters – Bootloaders – GRUB – UEFI – Chainloading other operating systems – How the User space starts: Introduction to Init – System V Runlevels – systemd – Upstart – System V init – Shutting down the system – initial RAM Filesystem – Emergency booting and Single-User modelling

UNIT IV SYSTEM CONFIGURATION, PROCESS AND RESOURCE UTILIZATION 9

Structure of etc – System logging – User management files – time – scheduling tasks with cron and at – Identification and Authentication – Process and Resource Utilization: Tracking processes – lsof – Tracing program execution and system calls – Threads – Measuring CPU time – Adjusting Process Priorities – Load Averages – Memory – I/0 Monitoring

UNIT V NETWORK CONFIGURATION AND SERVICES 9

Network basics – Network Layers – Routes and Kernel Routing table – Basic ICMP and DNS tools – Physical Layer and Ethernet – Kernel Network Interfaces – NIC configuration – Resolving Hostname – Localhost – The transport layer: TCP, UDP and Services – Revisiting a simple Local Network – Understanding DHCP – Configuring Linux as a Router – Firewalls – Ethernet, IP and ARP - Wireless Ethernet – Secure Shell ssh – diagnostic tools

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand an overall view of the structure of Linux
CO2: Access the different devices through commands
CO3: Work with kernel and user spaces in Linux environment
CO4: Automate tasks using scheduling tools
CO5: Configure network files based on the specific need
CO6: Acquire Linux Administration skills to manage a server

REFERENCES:

1. Brian Ward, How Linux Works – what every superuser should know, Second edition No starch press, 2015.
2. https://developer.ibm.com/technologies/linux/

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	3	3	1
CO2	3		3	3	3	1
CO3	3		3	3	3	1
CO4	3		3	3	3	1
CO5	3		3	3	3	1
CO6	3		3	3	3	1

CA3024 WIRELESS SENSOR NETWORKS AND BODY AREA NETWORKS L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF WSN 9

Wireless Adhoc Networks – Distributed Sensing – Sensors and Transducers – Types of Sensors – Accuracy, Resolution and Hysteresis – Architecture of a Sensor Node and WSN – Sensor Network Design Considerations – Energy Efficient Design Principles for WSNs – Applications of WSNs.

UNIT II MAC LAYER OF WSN AND ZIGBEE STANDARD 9

Energy issues in Transceiver Design and Channel Access – PHY Frame Structure – Roles of Nodes – End device, Router and Coordinator – Full Function Device and Reduced Function Device – Star, Mesh and Tree topology – Medium Access Control – Duty cycle S– MAC protocol – IEEE 802.15.4 standard and ZigBee.

UNIT III DATA CENTRIC COMPUTING IN WSN 9

Data Gathering and Dissemination–Broadcasting and Geocasting from Sink – Data Aggregation – LMST based Aggregation – Power Efficient Data gathering and Aggregation (PEDAP) – In–Network Processing – Aggregate Queries – Routing Challenges and Strategies in WSNs – SPIN, Directed Diffusion, Energy Aware Routing, Gradient based Routing**.**

UNIT IV SYNCHRONIZATION, LOCALIZATION AND TRACKING IN WSNs 9

Sensor Management – Topology Control Protocols and Sensing Mode Selection Protocols – Time Synchronization – Localization and Positioning – Ranging techniques – Range based localization algorithms – Location services – Scene analysis, GPS and RFID.

UNIT V DESIGN REQUIREMENT OF BAN AND WBAN 9

BAN Positioning- Architecture of BAN - Requirements of BAN - BAN Standardization - The Media Access Control (MAC) - Frame Processing- Physical Layer (PHY) - Design Requirement of WBAN - WBAN Reference architecture - Software frameworks for programming WBAN- Hardware Development and systems for WBAN.

Application of BAN – Rational Routing-Cognitive Routing-Energy aware routing- Energy harvesting methods for WBAN

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand different types of sensors, their actuators and the architecture of motes.
CO2: Design a WBAN using different networking concepts and hardware interfaces.
CO3: Understand and apply data centric computing in wireless sensor networks.
CO4: Apply appropriate localization techniques for different scenarios.
CO5: Manage sensor networks by synchronizing the time, locating and tracking objects.
CO6: Design a Wireless Sensor and body area network for a real-world application.

REFERENCES:

1. Mohammed A. Matin, “Wireless Sensor Networks: Technology and Protocols”, InTech, First Edition, 2012.
2. Holger Karl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley, 2011.
3. Robert Faludi, “Building Wireless Sensor Networks”, O‘Reilly Media, 2011.

4. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Morgan Kaufmann, 2004 5. Bob Tucker, “Wireless Sensor Networks: Signals and Communication Technology”, NY Research Press, 2015
5. Al-Turjman, Fadi. Internet of nano-things and wireless body area networks (WBAN). CRC Press, First Edition, 2019.
6. Mehmet R. Yuce, Jamil Khan , “Wireless Body Area Networks: Technology, Implementation, and Applications”, CRC press,2012.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	3	1	1
CO2	3	2	3	3	2	2
CO3	3	2	3	3	1	1
CO4	3	2	3	3	2	1
CO5	3	2	3	3	2	1
CO6	3	2	3	3	2	2

CA3025 MEDIA PROCESSING L T P C
3 0 0 3

UNIT I TEXT PROCESSING 9

NLP- Tokenization - content retrieval-keyword generation- Text summarization-question generation- - language translation - text analysis-report analysis- recent trends –Applications

UNIT II SPEECH PROCESSING 9

Speech processing– Central analysis of speech, format and pitch estimation, Applications of speech processing - Speech recognition, Speech synthesis and speaker verification - voice to text conversion- language processing-API s for audio processing-recent trends-applications

UNIT III IMAGE PROCESSING FUNDAMENTALS 9

Introduction – Applications of Image Processing – Steps in Image Processing Applications-– Imaging sensors- Colour Fundamentals and Models- image operations-Image Enhancement in Spatial and Frequency Domain- Histogram Processing

UNIT IV IMAGE CLASSIFICATION 9

Image Segmentation -Thersholding-Feature extraction-Image classification- supervised-unsupervised – ANN classifier- deep learning-based image classification-object detection and tracking- applications

UNIT V VIDEO PROCESSING 9

Basic Concepts and Terminology- Key frame extraction-Video Segmentation–motion detection-Motion Estimation -Video Mining –Video Content Analysis -Video Indexing and Abstraction for Retrieval – Applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Implement basic text processing operations
CO2: Implement basic audio processing operations
CO3: Implement basic image processing operations
CO4: Apply classifiers and clustering algorithms for images
CO5: Implement basic video processing opeartions
CO6: Design and develop different media processing application that uses different concepts of text, image,audio and video processing

REFERENCES:

1. Rafael Gonzalez, Richard E. Woods, “Digital Image Processing”, Fourth Edition, Pearson Education, 2018.
2. Oge Marques, “Practical Image and Video Processing Using Matlab” By Florida Atlantic University-Willey Publications, First Edition, 2011.
3. Nikos Tsourakis “Machine Learning Techniques for Text: Apply modern techniques with Python for text processing, dimensionality reduction, classification, and evaluation” Packt publishing, 2022
4. Udo Zolzer , Digital Audio Signal Processing, Willey publication, Third Edition, 2022

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	3	3	1
CO2	3		3	3	3	1
CO3	3		3	3	3	1
CO4	3		3	3	3	1
CO5	3		3	3	3	1
CO6	3	1	3	3	2	2

CA3026 ADVANCED DATABASE SYSTEMS L T P C
3 0 0 3

UNIT I RELATIONAL DATABASES 9

Introduction to Relational Databases – Relational Model – Keys - Entity-Relationship Model – 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 II DISTRIBUTED DATABASES 9

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

UNIT III NOSQL DATABASES 9

NoSQL – CAP Theorem – Sharding – Document based - MongoDB Operation: Insert, Update, Delete, Query, Indexing, Application, Replication, Sharding, Deployment – Using MongoDB with PHP / JAVA/ Python – Cassandra: Data Model – Key Space – Table Operations – CURD Operations – CQL Types – HIVE : Data types – Database Operations – Partitioning – HiveQL

UNIT IV DOCUMENT DATABASES 9

Document (MongoDB) Data Model – JSON and BSON – Polymorphic Schemas – Using MongoDB Shell – Basic Querying – Create and Insert – Creating Collections

UNIT V GRAPH DATABASES 9

Introduction to Graph Databases – The Power of Graph Databases – Data Modeling with Graphs – Querying Graphs – Introduction to Cypher – CQL Clauses – Write Clause – Read Clause – General Clauses – CQL Functions – Building a Graph Database application.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate an understanding of normalization theory and apply such knowledge to normalize real time databases.

CO2: Design a distributed database system and execute distributed queries.

CO3: Understand the usage of NoSQL database systems and manipulate the data associated with it.

CO4: Design and develop document databases using XML /JSON databases.

CO5: Build a simple real time application using graph databases and execute queries on it.

CO6: Analyse and evaluate the user requirements and develop a real time database accordingly.

REFERENCES:

1. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Sixth Edition, McGraw-Hill, 2011.
2. Ian Robinson, Jim Webber and Emil Eifrem, "Graph Databases”, O’Reilly Media, Second Edition, 2015.
3. Elliotte Rusty Harold, W. Scott Means, “XML in a Nutshell“,O’Reilly Media, Third Edition, 2004.
4. R. Elmasri, S. B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education/Addison Wesley, 2017.
5. C. J. Date, A. Kannan, S. Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
6. Brad Dayley, “Teach Yourself NoSQL with MongoDB in 24 Hours”, Sams, 2014.
7. Shashank Tiwari, “Professional NoSQL”, O’Reilly Media, 2011.
8. Vijay Kumar, “Mobile Database Systems”, John Wiley, 2006.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	2	2	2
CO2	3		3	3	2	2
CO3	2		2	2	2	2
CO4	3	1	3	3	2	2
CO5	3	1	3	3	2	2
CO6	3	2	3	3	2	3

CA3027 SOFTWARE PROJECT MANAGEMENT L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Project – Software Projects versus Other Types of Project – Contract Management and Technical Project Management – Activities – Plans, Methods and Methodologies – Requirement Specification – Management Control – Overview of Project Planning – Introduction to Step Wise Project Planning – Programme Management and Project Evaluation

UNIT II SOFTWARE EFFORT ESTIMATION AND ACTIVITY PLANNING 9

Software Effort Estimation: Problems with Over and Under Estimates – Basis of Software Estimating – Techniques – Expert Judgment – Cosmic Full Function Points – A Procedural Code Oriented Approach – COCOMO: A Parametric Model – Activity Planning: Objectives – Project Schedules – Projects and Activities – Sequencing and Scheduling Activities – Network Planning Models – Formulating A Network Model – Identifying Critical Path – Shortening the Project Duration – Identifying Critical Activities – Activity-on-arrow Networks.

UNIT III SOFTWARE RISK AND PEOPLE MANAGEMENT 9

Categories of Risk – Framework for Dealing with Risk – Risk Identification – Risk Assessment – Risk Planning – Risk Management – Evaluating Risks to the Schedule – Applying the PERT Technique – Monte Carlo Simulation – Critical Chain Concepts – Resource Allocation: Nature of Resources – Identifying Resource Requirements – Scheduling Resources – Creating Critical Paths – Counting the Cost – Cost Schedules – Scheduling Sequence.

UNIT IV SOFTWARE PROJECT MONITORING AND CONTROL 9

Creating the Framework – Collecting the Data: Partial Completion Reporting – Risk Reporting – Visualizing Progress: Gantt chart – Slip chart – Ball Charts – The Timeline – Cost Monitoring – Earned Value Analysis – Prioritizing Monitoring – Getting the Project Back to Target – Change Control.

UNIT V SOFTWARE QUALITY MANAGEMENT 9

Managing Contracts: The ISO 12207 Approach, Supply Process, Types, Stages, Contract Management Managing People and Organizing Teams: Understanding Behaviour, Organizational Behaviour, Motivation, The Oldham– Hackman Job Characteristics Model, Decision Making, Leadership, Dispersed And Virtual Teams, Software Quality – Defining Software Quality- Software Quality Measures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Differentiate between various software process models.
CO2: Prepare project planning documents.
CO3: Estimate the software cost for projects.
CO4: Perform effective activity planning.
CO5: Prepare effective project scheduling work product.
CO6: Perform software quality management activities.

REFERENCES:

1. Bob Hughes, Mike Cotterell, “Software Project Management”, Fifth Edition, Tata McGraw-Hill, 2011.
2. Walker Royce, “Software Project Management: A Unified Framework”, Pearson Education,

2004.
3. S. A. Kelkar, “Software Project Management: A Concise Study Paperback”, Prentice Hall of India, 2013.
4. Ramesh Gopalaswamy, “Managing Global Software Projects”, Tata McGraw Hill, 2001.
5. Humphrey Watts, “Managing the software process”, Addison Wesley, 1989.
6. Ashfaque Ahmed, “Software Project Management Process Driven Approach”, Auerbach Publications, 2011.

CO-PO Mapping:

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	3	1
CO3	3	3	3	3	3	2
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	1
CO6	3	3	3	3	3	2

BRIDGE COURSES (BC)

BX3001 FUNDAMENTALS OF DATA STRUCTURES L T P C
3 0 2 4

UNIT I INTRODUCTION 9+6

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 frame work – Asymptotic notations, Properties, Recurrence Relation.

LIST OF 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 9+6

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

LIST OF EXPERIMENTS:

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

UNIT III LINEAR DATA STRUCTURES – STACK AND QUEUE 9+6

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.

LIST OF EXPERIMENTS:

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

UNIT IV SEARCHING AND SORTING 9+6

Searching: Linear search – Binary Search- comparison of linear search and binary search, Sorting algorithms: Insertion sort – Bubble sort – Selection sort – Quick sort.

LIST OF 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 9+6

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

LIST OF EXPERIMENTS:

1. Write a program to create a Binary tree and perform traversals on it.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze a given algorithm and determine its time complexity.
CO2: Understand the concepts of linear data structures and its usage.
CO3: Apply linear data structures to solve the given problem.
CO4: Apply different sorting and searching techniques based on the given application.
CO5: Understand the usage of non-linear data structures.
CO6: Solve the given problem by applying suitable data structures.

REFERENCES:

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

BX3002 PROBLEM SOLVING AND PROGRAMMING IN C L T P C
3 0 2 4

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: Algorithm to check whether a given number is Armstrong number or not, Find factorial of a number.

UNIT II BASICS OF C PROGRAMMING 9+8

Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process.

LIST OF EXPERIMENTS:

1. Write programs to get some input, perform some operation and display the output using I/O statements.
2. Write a program to execute some specific statements based on the test condition.
3. Write programs to implement nested loop.

UNIT III ARRAYS AND STRINGS - FUNCTIONS AND POINTERS 9+8

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search. Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Pointers – Pointer

operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference.

LIST OF EXPERIMENTS:

1. Write a program in C to get the largest element of an array using functions.
2. Display all prime numbers between two intervals using functions.
3. Reverse a sentence using recursion.
4. Write a C program to concatenate two strings.

UNIT IV STRUCTURES AND UNION 9+7

Structure - Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility.

LIST OF EXPERIMENTS:

1. Write a C program to Store Student Information in Structure and Display it.

UNIT V FILE PROCESSING 9+7

Files – Types of file processing: Sequential access, Random access – Sequential access file - Random access file - Command line arguments.

LIST OF EXPERIMENTS:

1. The annual examination is conducted for 10 students for five subjects. Write a program to read the data from a file and determine the following:
    a. Total marks obtained by each student.
    b. Topper of the class.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Develop algorithmic solutions to simple computational problems.
CO2: Write simple C programs using conditionals and loops for solving problems.
CO3: Develop and implement arrays, strings, functions and pointers using C.
CO4: Develop applications in C using structures and union.
CO5: Design applications using sequential and random-access file processing.
CO6: Developing application to solve real world problem using C.

REFERENCES:

1. Paul Deitel and Harvey Deitel, “C How to Program with an Introduction to C++”, Eighth edition, Pearson Education, 2018.
2. Byron S Gottfried, —Programming with C, Schaums Outlines, Second Edition, Tata McGraw-Hill, 2006.
3. Brian W. Kernighan and Dennis M. Ritchie, “The C programming Language”, Second edition 2015, Pearson Education India.
4. How to solve it by Computer, R. G. Dromey, Pearson education, Fifth Edition, 2007
5. Kamthane, A.N., “Programming with ANSI and Turbo C”, Pearson Education, Delhi, ThirdEdition, 2015.
6. PradipDey, ManasGhosh, —Computer Fundamentals and Programming in C, Second Edition, Oxford University Press, 2013.

BX3003 DATABASE MANAGEMENT SYSTEMS L T P C
3 0 2 4

UNIT I INTRODUCTION 9

File systems versus Database systems – Data Models – DBMS Architecture – Data Independence – Data Modeling using Entity – Relationship Model.

UNIT II RELATIONAL MODEL AND QUERY PROCESSING 9

Relational Model Concepts – Relational Algebra – SQL – Basic Queries – Set Operations – Aggregate functions – Nested subqueries – Modification of database.

UNIT III ADVANCED QUERY PROCESSING 9

Complex Queries – Join Expressions – Views – Functions and procedures – Triggers – Embedded SQL.

UNIT IV DATABASE DESIGN 9

Er-Model – Constraints – Removing Redundant Attributes – ER Diagrams – ER Design Issues – Extended ER Features – Functional Dependency.

UNIT V STORAGE AND FILE STRUCTURE 9

Overview of Physical Storage Media – Magnetic Tape – Flash Storage – RAID – Tertiary Storage – File Organization.

LIST OF EXPERIMENTS:

1. Data Definition Commands to create, describe, alter, rename, drop and truncate the tables.
2. Data Manipulation Commands for inserting, deleting, updating and retrieving in Tables.
3. Transaction Control Language Commands like Commit, Rollback and Save Point.
4. Illustrate the statements to create index and drop index.
5. Perform database querying using simple query and nested query operations.
6. Perform database querying using complex queries, Joins and Views.
7. Create a PL/SQL block to implement implicit and explicit cursors.
8. Create a PL/SQL block to implement procedures and functions.
9. Create a PL/SQL block to execute triggers.
10. Execute a procedure which handles exception using PL/SQL.
11. Create an embedded PL/SQL block to connect with any host language like ‘C’.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the basic concepts of the database and data models.
CO2: Acquire the knowledge of query processing to run queries for a given application.
CO3: Perform Advanced SQL queries based on the user requirements.
CO4: Design a database using ER diagrams and map ER into Relations.
CO5: Understand the usage of various DB storage techniques.
CO6: Develop a small database application by understanding user requirements properly.

REFERENCES:

1. Abraham Silberschatz, Henry F.Korth and S.Sundarshan “Database System Concepts”, Seventh Edition, McGraw Hill, 2017.
2. RamezElamassri and ShankantBNavathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education Delhi, 2017.

3. RaghuRamakrishnan, —Database Management Systems‖, Fourth Edition, McGrawHill College Publications, 2015.
4. Lee Chao, “Database Development and Management”, Auerbach Publications, First edition, 2010.
5. Carlos Coronel, Peter Rob, and Stephen Morris, “Database Principles Fundamentals of Design, Implementation, and Management, Tenth Edition”, Course Technology, Cengage Learning, 2013.
6. C.J. Date, “An Introduction to Database Systems”, Eighth Edition, Pearson Education Delhi, 2003.

BX3004 INTRODUCTION TO OPERATING SYSTEM L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Introduction – Operating System Operations – Virtualization – Operating System Services – User and Operating System Interface – System Calls – Operating System Structures.

UNIT II PROCESS MANAGEMENT 9

Process concept - Process Scheduling - Operation on Processes – Inter process Communication - CPU Scheduling - Scheduling Criteria - Scheduling Algorithms - Multiple-Processor Scheduling.

UNIT III PROCESS SYNCHRONIZATION 9

Process Synchronization –The Critical-Section Problem – Semaphores – Monitors –Deadlock Characterization – Methods for handling Deadlocks – Deadlock Prevention-Deadlock avoidance – Deadlock Detection – Deadlock Recovery.

UNIT IV MEMORY MANAGEMENT 9

Main Memory – Contiguous Memory allocation – Paging – Swapping – Virtual Memory –Demand Paging – Page Replacement – Thrashing.

UNIT V FILE SYSTEM 9

Disk Structures – Disk Scheduling – File-System Interface – File concepts - Access Methods – Directory Structure – File-System Implementation – File-System Structure and Operations – Directory Implementation –Allocation Methods – Free Space management – File-System Internals – File-System Mounting – File Sharing – Virtual File Systems – Remote File Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Articulate the main concepts, key ideas, strengths and limitations of operating systems.
CO2: Design various process scheduling algorithms.
CO3: Understanding process synchronization and deadlock handling.
CO4: Design and implement memory management schemes.
CO5: Understand various file management systems.
CO6: Understand operating system components and services with the recent OS

REFERENCES:

1. Silberschatz Abraham, Greg Gagne, Peter B. Galvin. “Operating System Concepts”, Tenth Edition, Wiley, 2018.

2. Andrew S.Tanenbaum, “Modern operating Systems”, Third Edition, PHI Learning Pvt. Ltd., 2008.
3. D M Dhamdhere, “Operating Systems: A Concept-based Approach”, Second Edition, Tata McGraw-Hill Education, 2007.
4. H M Deital, P J Deital and D R Choffnes, “Operating Systems”, Third edition, Pearson Education, 2011.
5. William Stallings, “Operating Systems: Internals and Design Principles”, Seventh Edition, Prentice Hall, 2011.

BX3005 INTRODUCTION TO WEB PROGRAMMING L T P C
3 0 2 4

UNIT I WEB ESSENTIALS 9

Introduction to Computers and The Internet - The World Wide Web – WWW Architecture - Web Basics – Multitier Application architecture - Client-Side Scripting versus Server-Side Scripting – Internet Standards – SMTP – POP3 – File Transfer Protocol - Overview of HTTP, HTTP request – response.

UNIT II FRONT-END TECHNOLOGIES 9

Markup Language (HTML5): Basics of Html - Introduction to Internet Basics – Browser Fundamentals – Introduction to HTML5 – HTML5 Tags – HTML5 Forms – Cascading Style Sheets (CSS3) Fundamentals - Basic syntax and structure Inline Styles – Embedding Style Sheets - Linking External Style Sheets - Introduction to CSS3 – Backgrounds - Manipulating text - Margins and Padding - Positioning using CSS.

UNIT III OVERVIEW OF JAVASCRIPT 9

Introduction - Core features - Data types and Variables - Operators, Expressions, and Statements - Functions – Arrays - Objects - Document Object Model: Objects and Collections - Event Handling - Form validations.

UNIT IV RESPONSIVE WEB DESIGN AND DATABASES 9

Introduction to JSON – JSON Structure – Introduction to jQuery – AJAX - Structured Query Language (SQL) for interacting with databases.

UNIT V SERVER-SIDE ESSENTIALS (PHP) 9

Introduction to PHP – PHP Variables – Constants – Operators – Flow Control and Looping – Arrays – Strings – Functions – File Handling – Exception Handling – PHP and HTML –
Database Management – Introduction to MySQL – MySQL Commands – MySQL Database Creation – Connecting MySQL and PHP – Querying MySQL Database with PHP

LIST OF EXPERIMENTS:

1. Design of static webpage primarily with text and CSS.
2. Apply the inline and block level elements to identify the difference in the layout.
3. Design the HTML forms (text boxes, text areas, radio buttons, check boxes and other elements by understanding the input types and specified needs).
4. Include image/audio and video elements in the web pages.

5. Format and position the text using CSS borders, background and color by understanding the box model.
6. Validate the HTML form elements by creating small client-side validation scripts using JavaScript.
7. Create small PHP scripts to manipulate data using various operators and PHP functions and display the results.
8. Write two different PHP scripts to demonstrate passing variables to a URL.
9. Create Website Registration Form using text box, check box, radio button, select, submit button, and display user inserted value in new PHP page.
10. Create a dynamic web site using PHP and MySQL.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand all the web essentials.

CO2: Design and develop static web pages by using the markup languages that meet the specified needs and interests.

CO3: Validate HTML forms developed using the JavaScript.

CO4: Design rich responsive websites using Ajax.

CO5: Address/solve the real-time issues by developing data centric applications using PHP.

CO6: Develop responsive websites using the programming languages and techniques associated with the World Wide Web.

REFERENCES:

1. David Flanagan, “JavaScript: The Definitive Guide, Sixth Edition”, O'Reilly Media, 2011.
2. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, “Internet and World Wide Web - How To Program”, Fifth Edition, Pearson Education, 2011.
3. James Lee, BrentWare , “Open Source Development with LAMP: Using Linux, Apache, MySQL, Perl, and PHP” AddisonWesley, Pearson Education, 2003.
4. Thomas A. Powell, “HTML & CSS: The Complete Reference”, McGraw Hill Education, Fifth Edition, 2017.
5. Thomas A Powell, Fritz Schneider, “JavaScript: The Complete Reference”, Third Edition, Tata McGraw Hill, 2013.
6. Thomas A Powell, “Ajax: The Complete Reference”, McGraw Hill, First Edition, 2008.

BX3006 INTRODUCTION TO COMPUTER ORGANIZATION L T P C
3 0 0 3

UNIT I DIGITAL FUNDAMENTALS 9

Number Systems and Conversions – Boolean Algebra an Simplifications – Minimization of Boolean Functions – Karnaugh Map, Quine McClusky Method. Logic Gates – NAND NOR implementation.

UNIT II COMBINATIONAL AND SEQUENTIAL CIRCUITS 9

Design of Circuits –Adder /Subtracter – Encoder – Decoder – MUX /DEMUX – Comparators, Flip flops – Triggering – Master – Slave Flip Flop – State Diagram and Minimization – Counters - Registers

UNIT III BASIC STRUCTURE OF COMPUTER 9

Functional Units - Basic Operational Concepts – Bus structures – Performance and Metrics –

instruction and instruction sequencing – Hardware Software Interface – Addressing modes – Instruction Sets – RISC and CISC – ALU Design – Fixed point and Floating point operations

UNIT IV PROCESSOR DESIGN 9

Processor basics –CPU Organization – Data Path Design – Control Design – Basic concepts – Hardwired control – Micro Programmed control – Pipe control – Hazards super scale operations

UNIT V MEMORY AND I/O SYSTEMS 9

Memory technology – Memory Systems- Virtual Memory – Caches – Design Methods – Associative memories – Input /output system – Programmed I/O – DMA and interrupts – I/O devices and Interfaces

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Simplify using laws of Boolean algebra and Karnaugh map method
CO2: Design various combinational and sequential circuits
CO3: Trace the flow of execution of an instruction in a processor
CO4: Differentiate between the various mapping policies used in cache memories
CO5: Understand the implementation of virtual memory
CO6: Analyze the various types of I/O transfers

REFERENCES:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, “Computer Organization and Embedded Systems”, Sixth Edition, Tata McGraw Hill, 2012.
2. Carl Hamacher, Zvonko vranesic and Safwat Zaky, “Computer Organisation”, Fifth Edition, Tata Mc Graw Hill, 2002.
3. Charles H. Roth, Jr., “Fundamentals of Logic Design”, Jaico Publishing House, Fourth Edition 1992.
4. David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware/Software Interface”, Second Edition, Morgan Kaufmann , 2002.
5. Morris Mano “Digital Design”, Printice Hall of India 1997 5. John P. Hayes, “Computer Architecture and Organization”, Third Edition, Tata McGraw Hill, 1998
6. William Stallings,“Computer Organization & Architecture – Designing for Performance”, Sixth Edition Pearson Education, 2003.