ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.TECH. INFORMATION TECHNOLOGY
REGULATIONS - 2023
CHOICE BASED CREDIT SYSTEM

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.

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1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. To prepare students to excel in research or to succeed in Information Technology Profession by adapting to the rapid advances in new emerging technologies through rigorous graduate education.

II. To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to provide IT solutions to real-world problems of Industries, Businesses and Society.

III. To train students with good computer science and engineering knowledge so as to comprehend, analyze, design and create novel products and novel IT services.

IV. To inculcate students in solving real-time problems through IT knowledge and with attention to team work, effective communication skills and critical thinking.

V. To provide student with an academic environment aware of excellence, leadership, ethical codes and guidelines, learning and teamwork for a successful professional career.

2. PROGRAMME OUTCOMES (POs):

On successful completion of the programme, the students will acquire the following:

PO #	Programme Outcome
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	A degree of mastery over the field of Information Technology.
4	An ability to comprehend, select and adopt appropriate and emerging computing and communication technologies to solve the challenging problems of this information era.
5	An ability to recognize the need for applying efficient software and hardware based solutions to improve the quality of life.
6	An ability to function effectively as an individual and a team member, in project and product development and to follow professional ethics in the career.

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3. **PEO / PO Mapping:**

Programme Educational Objectives	PO1	PO2	PO3	PO4	PO5	PO6
PEO1	3	3	3	3	3	
PEO2	3	3	3	3	3	
PEO3	3	3		3	3	3
PEO4						3
PEO5	3			3	3	3

4. Mapping of Course Outcome and Programme Outcome

Year	Semester	Course Name	PO1	PO2	PO3	PO4	PO5	PO6
Year I	Sem 1	Probability and Statistical Methods	3	3	3	3	2	2
		Advanced Data Structures and Algorithms	3	1	3	2.5	2.17	1.17
		Full Stack Technologies	3	0	3	3	3	2.2
		Advanced Database Management Systems	3	2	3	3	3	1.8
		High Performance Computing	2.7	1.2	1.5	1.8	2	1.8
		Research Methodology and IPR						
	Sem 2	Software Design Methodologies	3	1	3	2.7	3	1
		Fundamentals of Machine Learning	3	1	3	3	2.7	2.2
		Information Security	3	1	3	2.2	3	3
		Professional Elective I						
		Professional Elective II						
Year 2	Sem 3	Next Generation Wireless Networks	2	2	2	2	2	1.8
		Professional Elective III						
		Professional Elective IV						
		Professional Elective V						
		Project Work I	3	3	3	3	3	2
	Sem 4	Project Work II	3	3	3	3	3	2

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CURRICULA AND SYLLABI

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA3160	Probability and Statistical Methods	FC	4	0	0	4	4
2.	RM3151	Research Methodology and IPR	RMC	2	1	0	3	3
3.	IF3151	Advanced Data Structures and Algorithms	PCC	3	0	3	6	4.5
4.	IF3101	Full Stack Technologies	PCC	3	0	3	6	4.5
5.	IF3152	Advanced Database Management Systems	PCC	3	0	2	5	4
6.	IF3102	High Performance Computing	PCC	3	0	0	3	3
			TOTAL	**18**	**1**	**8**	**27**	**23**

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IF3201	Software Design Methodologies	PCC	3	0	2	5	4
2.	IF3202	Fundamentals of Machine Learning	PCC	3	0	2	5	4
3.	IF3203	Information Security	PCC	3	0	0	3	3
4.		Professional Elective I	PEC	3	0	0	3	3
5.		Professional Elective II	PEC	3	0	2	5	4
			TOTAL	**15**	**0**	**6**	**21**	**18**

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IF3351	Next Generation Wireless Networks	PCC	3	0	2	5	4
2.		Professional Elective III	PEC	3	0	2	5	4
3.		Professional Elective IV	PEC	3	0	2	5	4
4.		Professional Elective V	PEC	3	0	2	5	4
PRACTICALS								
5.	IF3311	Project Work I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**20**	**32**	**22**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	IF3411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS 75

METHODOLOGY AND IPR COURSES (RMC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	RM3151	Research Methodology and IPR	RMC	2	1	0	3	3

FOUNDATION COURSE (FC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MA3160	Probability And Statistical Methods	FC	4	0	0	4	4

PROGRAM CORE COURSE (PCC)

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IF3151	Advanced Data Structures and Algorithms	PCC	3	0	3	6	4.5
2.	IF3101	Full Stack Technologies	PCC	3	0	3	6	4.5
3.	IF3152	Advanced Database Management Systems	PCC	3	0	2	5	4
4.	IF3102	High Performance Computing	PCC	3	0	0	3	3

5.	IF3201	Software Design Methodologies	PCC	3	0	2	5	4
6.	IF3202	Fundamentals of Machine Learning	PCC	3	0	2	5	4
7.	IF3203	Information Security	PCC	3	0	0	3	3
8.	IF3351	Next Generation Wireless Networks	PCC	3	0	2	5	4

LIST OF PROFESSIONAL ELECTIVES (PEC)

(GROUP – I)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IF3051	Artificial Life and Robotics	PEC	3	0	0	3	3
2.	IF3057	Information Retrieval	PEC	3	0	0	3	3
3.	IF3055	Human Computer Interaction	PEC	3	0	0	3	3
4.	IF3052	Autonomous Ground Vehicle Systems	PEC	3	0	0	3	3
5.	IF3060	Open Source Technologies	PEC	3	0	0	3	3
6.	IF3061	Reasoning Methods in Computer Science	PEC	3	0	0	3	3
7.	IF3062	Social Network Analysis	PEC	3	0	0	3	3
8.	IF3001	Conversational Systems	PEC	3	0	0	3	3

LIST OF PROFESSIONAL ELECTIVES (PEC)

(GROUP – II)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IF3002	Wireless Sensor Networks and Protocols	PEC	3	0	2	5	4
2.	IF3003	Advanced Computer Architecture	PEC	3	0	2	5	4
3.	IF3004	Virtualization	PEC	3	0	2	5	4
4.	IF3005	Advanced Operating System Techniques	PEC	3	0	2	5	4
5.	IF3006	Deep Learning	PEC	3	0	2	5	4
6.	IF3059	Mobile Application Development and Deployment	PEC	3	0	2	5	4
7.	IF3053	Blockchain Technologies	PEC	3	0	2	5	4
8.	IF3054	Building IOT Systems	PEC	3	0	2	5	4
9.	IF3063	Visualization Methods and Techniques	PEC	3	0	2	5	4
10.	IF3056	Image Processing and Computer Vision	PEC	3	0	2	5	4
11.	IF3058	Mixed Reality Techniques	PEC	3	0	2	5	4

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12.	IF3007	GPU Architecture and Programming	PEC	3	0	2	5	4
13.	IF3008	Service Oriented Architecture and Microservices	PEC	3	0	2	5	4
14.	IF3009	Cyber Forensics	PEC	3	0	2	5	4
15.	IF3010	BioMetrics	PEC	3	0	2	5	4
16.	IF3011	Advanced Computer Graphics and Animation	PEC	3	0	2	5	4

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IF3311	Project Work I	EEC	0	0	12	12	6
2.	IF3411	Project Work II	EEC	0	0	24	24	12
TOTAL CREDITS								**18**

SUMMARY

	Name of the Programme: M.TECH. INFORMATION TECHNOLOGY					
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	4				4
2.	PCC	16	11	4		31
3.	PEC		7	12		19
4.	RMC	3				3
5.	EEC			6	12	18
6.	**TOTAL CREDIT**	**23**	**18**	**22**	**12**	**75**

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MA3160 PROBABILITY AND STATISTICAL METHODS L T P C
4 0 0 4

UNIT I 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 – Functions of a Random Variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation.

UNIT III ESTIMATION THEORY 12

Unbiased Estimators – Method of Moments – Maximum Likelihood Estimation - Curve fitting by Principle of least squares – Regression Lines.

UNIT IV TESTING OF HYPOTHESES 12

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi-Square and F distributions for testing of mean, variance and proportions – Tests for Independence of attributes and Goodness of fit.

UNIT V MULTIVARIATE ANALYSIS 12

Random Vectors and Matrices - Mean vectors and Covariance matrices - Multivariate Normal density and its properties - Principal components: Population principal components – Principal components from standardized variables.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

CO1 Use the appropriate and relevant, fundamental and applied mathematical and statistics knowledge and methodologies in solving practical problem.

CO2 Bring together and flexibly apply knowledge to characterize, analyse and solve a wide range of problems.

CO3 Understand the balance between the complexity/accuracy of the mathematical/statistical models used and the timeliness of the delivery of the solution.

CO4 Steeped in research methods and rigor.

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

REFERENCES:

1. Dallas E Johnson , “Applied multivariate methods for data analysis”, Thomson and Duxbury press, Singapore, 1998.
2. Gupta S.C. and Kapoor V.K. “Fundamentals of Mathematical Statistics”, Sultan and Sons, 11th Edition, Reprint, New Delhi, 2019.

3. Jay L. Devore, “Probability and statistics for Engineering and Sciences”, Thomson and Duxbury, 9th Edition, Singapore, Boston, 2016.
4. Krishnaiah K. and Shahabudeen P, “Applied Design of Experiments and Taguchi Methods”, PHI, New Delhi, 2012.
5. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”, Pearson Education, Fifth Edition, 6th Edition, New Delhi, 2013.
6. Richard Johnson. ”Miller & Freund"s Probability and Statistics for Engineer”, Prentice Hall of India Private Ltd., 8th Edition, New Delhi, 2011.

	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 writing 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

COURSE OUTCOMES

Upon completion of the course, the student can

CO1: Describe different types of research; identify, review and define the research problem

CO2: Select suitable design of experiment s; describe types of data and the tools for collection of data

CO3: Explain the process of data analysis; interpret and present the result in suitable form

CO4: Explain about Intellectual property rights, types and procedures

CO5: Execute patent filing and licensing

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.

IF3151 ADVANCED DATA STRUCTURES AND ALGORITHMS **L T P C**

3 0 3 4.5

UNIT I ALGORITHMS IN COMPUTING **9**

Algorithms – Iterative and Recursive Algorithms – Insertion Sort – Analyzing Algorithms – Designing Algorithms – Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions – Recurrences: The Substitution Method – The Recursion Tree Method – Randomized Algorithms – Quick Sort.

UNIT II ALGORITHM DESIGN TECHNIQUES **9**

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence – Greedy Algorithms: An Activity Selection Problem – Elements of the Greedy Strategy – Huffman Codes – Amortized analysis: Aggregate Analysis – The accounting method – The potential method.

UNIT III HIERARCHICAL DATA STRUCTURES **9**

Binary Search Trees: Basics – Querying a Binary Search Tree – Insertion and Deletion – Red-Black Trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion – Definition of B-trees – Basic Operations on B-Trees – Deleting a Key from a B-Tree – Splay Tree (Amortized bound) -Min Max Heaps – Leftist Heaps – Fibonacci Heaps (Amortized analysis)

UNIT IV GRAPH ALGORITHMS 9

Graphs: Representations of Graphs – Breadth First Search- Depth First Search- Topological Sort – Strongly Connected Components – Minimum Spanning Trees: Kruskal and Prim – Single-Source Shortest Paths: The Bellman Ford Algorithm, Single-Source Shortest Paths in Directed Acyclic Graphs, Dijkstra's Algorithm – All- Pairs Shortest Paths: The Floyd-Warshall Algorithm.

UNIT V NP-COMPLETE AND NP–HARD 9

NP-Completeness – Polynomial Time – Polynomial-Time Verification – NP Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems – Clique Problem – The Hamiltonian Cycle Problem – Approximation Algorithms – Vertex Cover Problem- Travelling Salesman Problem.

PRACTICAL EXCERCISE: 45

1. Iterative and recursive algorithms and its complexity analysis.
2. Merge sort algorithm analysis using Divide and Conquer approach.
3. Quick sort algorithm using randomized algorithmic approach.
4. Matrix chain multiplication using Dynamic programming approach.
5. Activity selection and Huffman coding using Greedy approach.
6. Binary search tree and a Red-Black tree implementation.
7. Implementation of basic heap operations.
8. Implementation of Top down Splay and Fibonacci Heap operations using Amortized analysis.
9. Representation of Graphs and Graph traversals.
10. Implementation of a Spanning tree for a given graph using Prim's algorithm.
11. Implementation of a Shortest path of a given graph using Dijkstra's algorithm

TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

CO1: Analyze and implement suitable iterative or recursive algorithms for a given problem with minimum complexity.

CO2: Create suitable design strategies to solve a problem in an efficient manner.

CO3: Implement hierarchical data structures to approach a real time problem and also to solve it in amortized runs.

CO4: Understand and develop algorithms using graph structures for suitable applications.

CO5: Solve NP Complete problems efficiently.

CO6: Apply appropriate data structures and suitable algorithmic design to implement real time applications.

REFERENCES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", Fourth Edition, Prentice-Hall, 2022.
2. S. Sridhar, "Design and Analysis of Algorithms", Second Edition, Oxford University Press, 2014.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis using C", Second Edition, Pearson Education, 2002.
4. Robert Sedgewick, Kevin Wayne, "Algorithms", Fourth Edition, Pearson Education. 2011.

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

IF3101 **FULL STACK TECHNOLOGIES** **L T P C**
3 0 3 4.5

UNIT I SERVER SIDE ACTIONS **9**

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

UNIT II CLIENT SIDE ACTIONS **9**

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

TOTAL: 45 PERIODS

PRACTICAL EXCERCISE:

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. Packaging the code with added modules
6. Development of a web application using React.js
7. Development of a web application using Node.js
8. Development of a full stack web application
9. Deployment of web application using Docker

TOTAL: 45 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 applications through containers

REFERENCES:

1. Frank Zammetti, Modern Full-Stack Development Using TypeScript, React, Node.js, Webpack, and Docker, Apress, 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, Vasan Subramanian, A Press Publisher, 2019.

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

IF3152 ADVANCED DATABASE MANAGEMENT SYSTEMS

L	T	P	C
3	0	2	4

UNIT I DISTRIBUTED DATABASES **9**

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

UNIT II 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 – CRUD Operations – CQL Types – HIVE : Data types – Database Operations – Partitioning – HiveQL.

UNIT III ADVANCED DATABASE SYSTEMS **9**

Spatial Databases: Spatial Data Types – Spatial Relationships – Spatial Data Structures – Spatial Access Methods – Temporal Databases: Overview – Active Database – Deductive Databases – Recursive Queries in SQL – Mobile Databases: Location and Handoff Management – Mobile Transaction Models – Concurrency - Transaction Commit Protocols – Multimedia Databases.

UNIT IV DOCUMENT DATABASES **9**

XML Database: XML – XML Schema – XML DOM – XSL – XSLT – XPath and XQuery – JSON Document Databases – Document (MongoDB) Data Model - JSON and BSON– Polymorphic Schemas – Using MongoDB Shell – Basic Querying – Create and Insert – Creating Collections – Update and Delete.

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.

PRACTICAL EXERCISES: **30**

1. Create a distributed database using horizontal and vertical fragmentation in any DBMS.
2. Creation of distributed queries using the fragmented data created.
3. Create a document based database using MongoDB and manipulate the data.
4. Create a document database using Cassandra and manipulate the data.
5. Create a database to store multimedia elements and perform data retrieval operations.
6. Create a temporal database and explore the usage of temporal queries in it.
7. Creation of an XML document and validate it using an XML schema.
8. Given JSON and BSON document database and manipulate the data.
9. Create a simple Recommendation engine in E commerce use graph database.
10. Develop a social media application using Graph database.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Design a distributed database system and execute distributed queries.
CO2: Implement NoSQL database systems and manipulate the data associated with it.
CO3: Disseminate knowledge on advanced database system concepts.
CO4: Create real time applications using Spatial, temporal and Mobile Databases.
CO5: Design and develop document databases using XML /JSON databases.
CO6: Build a simple real time application using graph databases and execute queries on it.

REFERENCES:

1. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Sixth Edition, McGraw-Hill, 2011.
2. R. Elmasri, S. B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education/Addison Wesley, 2017.
3. C. J. Date, A. Kannan, S. Swamynathan, “An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
4. Brad Dayley, “Teach Yourself NoSQL with MongoDB in 24 Hours”, Sams, 2014.
5. Shashank Tiwari, “Professional NoSQL”, O’Reilly Media, 2011.
6. Vijay Kumar, “Mobile Database Systems”, John Wiley, 2006.
7. Ian Robinson, Jim Webber and Emil Eifrem, "Graph Databases”, O’Reilly Media, Second Edition, 2015
8. Elliotte Rusty Harold, W. Scott Means, “XML in a Nutshell“,O’Reilly Media, Third Edition, 2004.
9. Shakuntala Gupta Edward (Author), Navin Sabharwal, “Practical MongoDB: Architecting, Developing, and Administering MongoDB”, APRESS, First Edition, 2018.

	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	2	3	3	3	3

CO5	3		3	3	3	2
CO6	3	2	3	3	3	3

IF3102 **HIGH PERFORMANCE COMPUTING** **L T P C**
3 0 0 3

UNIT I MODERN PROCESSORS AND OPTIMIZATION TECHNIQUES 9

Stored Program Computer Architecture - General cache-based microprocessor architecture - Memory hierarchies –Multicore processors - Multithreaded processors - Vector processors- Scalar profiling - Simple measures, large impact - The role of compilers - Dynamic memory management - Storage order- Case study: Jacobi algorithm and Dense matrix transpose.

UNIT II PARALLEL COMPUTING 9

Taxonomy of parallel computing paradigms - Shared-memory computers - Cache coherence - UMA – ccNUMA - Distributed-memory computers - Hierarchical (hybrid) systems - Networks- Basic performance characteristics of networks - Buses, Switched and fat-tree networks - Mesh networks, Hybrids - Parallelism- Data parallelism - Functional parallelism - Parallel scalability - Factors that limit parallel execution - Scalability metrics, Simple scalability laws - Parallel efficiency, Serial performance versus strong scalability - Refined performance models.

UNIT III SHARED MEMORY PARALLEL PROGRAMMING 9

Introduction to OpenMP - Parallel execution - Data scoping - OpenMP work sharing for loops – Synchronization – Reductions - Loop scheduling, Tasking - Case study: OpenMP- parallel Jacobi algorithm - Advanced OpenMP: Wave front parallelization - Efficient OpenMP programming - Performance pitfalls - Determining OpenMP overhead for short loops – Serialization - Case study: Parallel sparse matrix vector multiply.

UNIT IV DISTRIBUTED MEMORY PARALLEL PROGRAMMING 9

Distributed-memory parallel programming with MPI- Message passing - Messages and point-to-point Communication, Collective Communication - Nonblocking point-to-point Communication - Virtual topologies - Example: MPI parallelization of a Jacobi solver - MPI implementation - Performance properties, MPI performance tools - Communication parameters - Synchronization, serialization, contention - Reducing Communication overhead.

UNIT V PARALLELISM ON THE NODES 9

LESLIE3D – Parallel Ocean Programming – SWIM – S3D – Load Imbalance – Communication Bottlenecks – Optimization of Input and Output – Node Performance – WUPWISE - MGRID – GALGEL - APSI- EQUAKE – ART.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Acquire the knowledge of Modern processors and concepts
CO2: Acquire the ability to identify parallel computers
CO3: Appreciate the concepts of parallelization in shared memory programming
CO4: Apply the knowledge on parallel programming using Open MP in distributed memory

CO5: Acquire the knowledge on parallel programming using MPI
CO6: Analyse the performance of parallelism on nodes using multiprocessor programming concepts

REFERENCES:

1. Georg Hager, Gerhard Wellein,"Introduction to High Performance Computing for Scientists and Engineers", Chapman & Hall/CRC Computational Science series, 2011.
2. John Levesque, Gene Wagenbreth, “High Performance Computing: Programming and Application, CRC Press, 2010
3. Kai Hwang, Zhiweixu, “Scalable Parallel Computing: Technology, Architecture, Programming, McGraw Hill Education, 1998
4. Charles Severance, Kevin Dowd, "High Performance Computing", O‘Reilly Media, 2nd Edition,1998.
5. Introduction to Parallel Computing, Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, 2nd edition, Addison-Welsey, 2003.
6. Petascale Computing: Algorithms and Applications, David A. Bader (Ed.), Chapman &Hall/CRC Computational Science Series, 2007.
7. Sterling, Thomas, Maciej Brodowicz, and Matthew Anderson. *High performance computing: modern systems and practices*. Morgan Kaufmann, 2017.

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

IF3201 SOFTWARE DESIGN METHODOLOGIES L T P C
3 0 2 4

UNIT I INTRODUCTION AND FORMAL METHODS 9

Software and Software Engineering – Formal methods of software design- Mathematical Foundations for Software Engineering- Software Design with Formal Methods- Formal Verification Techniques for Software Design-Software Process Models – Scrum Methodology– Agile Development – Agile Software – Process Improvement

UNIT II REQUIREMENTS ENGINEERING AND MANAGEMENT 9

Requirements Engineering – Requirements Elicitation – Analysis and Negotiation – Requirements Modeling and Specification – Requirements Validation and Verification – Requirements Management - Requirements Management -Requirements Documentation and Communication- Real-time Requirement specification

UNIT III SOFTWARE DESIGN AND SOFTWARE IMPLEMENTATION 9

Software Design Process – Component based and Model-driven Development – Design Methods: Procedural and Structural Design Methods, Object Oriented Design Method, Real-time Software Design -– Design Guidelines for Real-time Software- Design Thinking with Agile - Agile UX Design - Unified Modeling Language.

UNIT IV SOFTWARE PRACTICES, PROCESSES AND ARCHITECTURE 9

Software Engineering Practices – Essence – Core Principles – Communication Practice – Planning Practice – General Structure of a Process – Process Framework – Process Improvements – Software Development Methodologies – Object Oriented Development Process – Unified Process – RAD Model – Software Testing.

UNIT V SOFTWARE PROJECT MANAGEMENT 9

Risk Management- Planning and Scheduling – Configuration Management – Software Quality Management – Stakeholder management-Software Quality Methodologies- Scope management-Resource Management- Software Metrics-Cost.

PRACTICAL EXERCISES: 30

Design, develop, implement and test any one of the following projects:

1. Data Mining.
2. Embedded Projects, Smart Card/Biometrics.
3. Web Based Projects.
4. Information Security.
5. Artificial Intelligence.

The road map for the project will be the following:

- Identify and propose ways to build quality software for the chosen project.
- Identify, justify and develop an appropriate generic software process model for the chosen project.
- Using the FDD feature template, define a feature set for the chosen project.
- Perform requirements elicitation mechanisms on the selected project and justify the selection of an appropriate strategy.
- Categorize the requirements (considering contradicting, omission, commission of requirements) in a software project.
- Perform analysis.
- Develop a complete process framework.
- Design and model for the chosen project.
- Draw the activity network representation of the tasks for the chosen project.
- Determine ES, EF, and LS, LF for every task.
- Develop the Gantt chart representation for the project.
- Perform software project management tasks.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Analytically apply general principles of software development in the development of complex software and software- intensive systems.

CO2: Understand methods and techniques for advanced software development and also be able to use these in various development situations.
CO3: Apply testing techniques for object oriented software and web-based systems.
CO4: Familiarize with the basic concepts of Software design and implementation.
CO5: Apply various software metrics on software quality products.
CO6: Apply various skills on real-time projects.

REFERENCES:

1. Ian Sommerville, Engineering Software Products: An Introduction To Modern Software Engineering, 1st edition, Pearson India,2020.
2. Roger Pressman, ISE Software Engineering: A Practitioner's Approach, Ninth edition McGraw Hill, 2019.
3. Learning Agile, Andrew Stellman and Jennifer Greene, O'Reilly, 4th Indian Reprint, 2018

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

IF3202 FUNDAMENTALS OF MACHINE LEARNING L T P C
3 0 2 4

UNIT I INTRODUCTION 9

Machine Learning – Basic Concepts in Machine Learning – Types of Machine Learning – Applications of Machine Learning - Basics of Learning Theory – Concept Learning - Hypothesis Space - Find-S algorithm - Version spaces - Bias-Variance Trade offs - 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 .

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

Introduction to Graphs – Inference in Graphical Models – Bayesian Belief Networks - Markov Chain – Markov Model - Hidden Markov Models – Inference – Learning - Generalization – Undirected Graphical Models – Markov Random Fields – Conditional Independence Properties – Conditional Random Fields.

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UNIT V UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING 9

Clustering– K-means Clustering– Hierarchical Clustering – Expectation Maximization algorithm – Gaussian Mixture Model - Cluster Evaluation Methods. Overview of Reinforcement Learning - Components of Reinforcement Learning - Model Based Learning - Model Free Learning - Q Learning.

PRACTICAL EXERCISES: 30

1. Develop an application that makes predictions from data using Linear Regression.
2. Develop an application that makes predictions from data using Logistic Regression.
3. Implement a classifier using ID3 and CART algorithms.
4. Implement a classifier using Perceptron and Multi-Layer Perceptron.
5. Develop a system to implement a classifier using SVM
6. Implement Ensemble Models using Random Forest and AdaBoost.
7. Develop a system that can extract the word from the given sentences using the Hidden Markov model.
8. Develop a system that can automatically group articles by similarity using K–Means cclustering.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

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

CO2: 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 an 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: Identify suitable learning tasks to which Reinforcement learning techniques can be applied.

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. T. V. Geetha, S. Sendhilkumar, “Machine Learning: Concepts, Techniques and Applications” Chapman & Hall/CRC Press, 2023.
4. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
5. EthemAlpaydin, “Introduction to Machine Learning”, Third Edition, Prentice Hall of India, 2005.
6. Tom Mitchell, “Machine Learning”, McGraw-Hill, 1997.
7. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, CRC Press, 2009.

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

IF3203 INFORMATION SECURITY L T P C
3 0 0 3

UNIT I INTRODUCTION TO SECURITY AND MATHEMATICAL FOUNDATIONS 9

Introduction to Security – Mathematics of Security: Number theory – Modular Arithmetic – Extended Euclidean Theorem – Algebraic structures – Galois field – Primality test – Fermat and Euler's theorem – Chinese Remainder theorem – Discrete Logarithms – Elliptic Curves arithmetic– Classical Cryptosystems.

UNIT II SYMMETRIC CRYPTOGRAPHY 9

Symmetric and Asymmetric cipher – Block and Stream Cipher – Feistel Ciphers – Non Feistel Ciphers – Data Encryption Standard –Linear and Differential cryptanalysis – CCA, CPA- Triple DES – Advanced Encryption Standard (AES) – RC4.

UNIT III ASYMMETRIC KEY CRYPTOGRAPHY 9

Asymmetric Key Cryptography – RSA – ElGamal Public Key Cryptosystems – Diffie-Hellman Key Exchange – Elliptic Curve Cryptography Key Exchange – Hash Functions – Hash Algorithms – Secure Hash – Birthday Attacks – MD5 – Message Authentication Codes – Authentication protocols – Digital Signatures.

UNIT IV NETWORK SECURITY 9

Authentication applications – Kerberos – PKI – Digital Certificates: X.509 – Electronic Mail security – PGP-IP Security – Web Security – Transport layer Security: SSL, SET – Firewall: Firewall Generation – Intrusion Detection System – Types of IDS – Wireless LAN – Wireless LAN Security – Configuration of WLAN Security – Security Administration – ISO and GLBA Standards on Information Security – Access Control Models – ACL. 89

UNIT V SYSTEM SECURITY 9

Penetration testing – Vulnerability Assessment tools – System security: Security models – Trusted Operating systems – Data Assurance –Database security – Multilevel databases – Multi–level security – Cloud Security – Ethical Hacking – Crypto Currency – Introduction to Blockchain.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

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

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

CO3: Apply the different cryptographic operations of public key cryptography.
CO4: Apply the various Authentication schemes to simulate different applications.
CO5: Understand various Security practices and System security standards
CO6: Know the state of art technologies like Ethical Hacking, Block chain etc.

REFERENCES:

1. William Stallings, "Cryptography and Network security Principles and Practices", Pearson Education/PHI, Fourth Edition, 2006.
2. Behourz Forouzan, Debdeep Mukhopadyay, "Cryptography & Network Security" Tata MCGraw-Hill Education, 2010
3. Charles P. Pfleeger, Shari L. Pfleeger, "Security in Computing", Third Edition, PHI/Pearson Education, 2003.
4. Wenbo Mao, "Modern Cryptography Theory and Practice", Pearson Education, 2004.
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, 2004.
7. Patrick Engebretson, "The basics of Hacking and Penetration Testing", Elsevier, 2011

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

IF3351 NEXT GENERATION WIRELESS NETWORKS L T P C
3 0 2 4

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

PRACTICAL EXERCISES: 30

1. Model,Simulate and Test 5G NR PHY in Matlab
2. Evaluating 5G cloud based networks system using C-RAN Simulator.
3. Model a simulator software to generates realistic spatial and temporal wideband channel impulse response using NYUSIM
4. Model and simulate 6G-enabling technologies with MATLAB
5. Create and optimize your intellectual property (IP) for 6G using open MATLAB functions and compare your innovations to existing benchmarks.
6. Explore 6G waveform generation beyond the parameters allowed in the current 5G standard (with new frequency ranges, bandwidths, numerologies).
7. Scale your simulations for massive MIMO, larger bandwidths, and higher sampling rates. Manage large and long-running simulations by distributing them on multiple cores, clusters, or the cloud and by leveraging GPUs.
8. Perform faster and more accurate RF component modeling for new mmWave and sub-THz frequencies.
9. Simulate propagation loss and channel models in mmWave and sub-THz frequency ranges.
10. Model non-terrestrial networks (NTN) by performing end-to-end link-level simulations, scenario modeling, orbit propagation, and visualization.
11. Explore RF sensing and detect the presence of events or persons in a scene by analyzing RF waveforms.
12. Examine the effect of reconfigurable intelligent surfaces (RIS) on overall system performance.
13. Apply artificial intelligence (AI) techniques, including machine learning, deep learning, or reinforcement learning workflows to solve 6G wireless communications problems.

TOTAL: 75 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., 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, 2021.
4. 5G Mobile Communications: Concepts and Technologies 1st Edition

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

IF3311 **PROJECT WORK I** **L T P C**
0 0 12 6

Individual student carry out project I , the goal of project I is to choose the final year project, Perform Literature Survey, refer IEEE papers, IEEE/ACM papers, study the implementation issues, familiarize with the tools needed for implementation, study necessary simulation software (if any) and implement the initial phase of the project. Three reviews needs to be conducted project report has to be submitted by the team. Final review will be conducted by external member.

COURSE OUTCOMES:

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

CO1: Work as a team, identify a real-world problem that can be solved using IT tools and techniques.

CO2: Analyse existing artifacts and solutions and design novel effective approaches.

CO3: Explore, select, and deploy the appropriate tools for effective implementation of the design.

CO4: Prepare the documentation for the design and implementation, write reports and make presentations justifying the choices made.

CO5: Develop the required collaboration and communication skills to work in a professional team and multi-disciplinary context.

CO6: Quickly develop Proof-of-Concept of solutions to problems.

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	3	3	3	2

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CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	2
CO6	3	3	3	3	3	2

IF3411 **PROJECT WORK II** **L T P C**
0 0 24 12

Individual student carry out project II , which can be a continuation of project I work or a new problem can be formulated, with necessary Literature Survey by referring to IEEE/ACM transactions/standard peer reviewed journals/conference papers, identify the challenges to be addressed/gaps in the existing research works, propose a solution with necessary architecture with modular design including data required, relevant algorithms, study of necessary simulation software (if any), implement the project, evaluate the work with relevant metrics and finally present the project work with a detailed report.

COURSE OUTCOMES:

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

CO1: Apply the acquired knowledge of basic science and engineering concepts to solve real-world problems.

CO2: Analyse, design and develop IT solutions following best practices.

CO3: Explore, select, and deploy the appropriate tools for effective implementation of projects.

CO4: Prepare the documentation for the design and implementation, write reports and make presentations justifying the choices made.

CO5: Develop the required collaboration and communication skills to work in a professional team and multi-disciplinary context.

CO6: Develop and showcase the complete solution for a given problem in industry/research.

PO/CO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	3	3	3	2
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	2
CO6	3	3	3	3	3	2

IF3051 **ARTIFICIAL LIFE AND ROBOTICS** **L T P C**
3 0 0 3

UNIT I ARTIFICIAL LIFE **9**

The Artificial Life - foundations, scope, problems, and approaches of AI, reactive, deliberative, goal-driven, utility-driven, and learning agents-Behavior systems – Emergent behavior-Approaches for Designing the Behavior Programs - Modeling Adaptive Autonomous Agents - Characteristics of Agent Architectures - Example Autonomous Agents.

UNIT II INTRODUCTION TO ROBOTICS 9

Fundamentals: Classification of Robots- History of Robotics- Robot Components – Robot DOF-Joints-Coordinates- Reference Frames- Characteristics-Workspace- Collaborative Robots-Robotics and programmable automation - Human systems and Robotics - Machine Intelligence Computer and Robotics-Future Trends.

UNIT III ROBOTIC SENSORS AND TRAJECTORY PLANNING 9

Sensors - Characteristics – Sensor Utilization- Types of Sensors-Position Sensors- Velocity Sensors- Acceleration Sensors- Proximity Sensors- Force and Torque Sensors - Range finders - Voice recognition devices - Range Sensors - Ultrasonic sensors - Touch and Slip sensors. sensors for motion and position, Force, torque and tactile sensors, Flow sensors, Temperature sensing devices - Basics of Trajectory planning - Joint-Space Trajectory Planning - Continuous Trajectory Recording – Path Planning.

UNIT IV COMPUTER VISION IN ROBOTICS AND ROBOT PROGRAMMING 9

Vision System Devices, Image acquisition, Masking, Sampling and quantization, Image representation - Picture coding - Object recognition and categorization - Depth measurement with vision systems- Robot guidance with vision systems. Robot control sequencing - Robot programming languages - Sample programs - Smart sensors, MEMS based sensors, -Artificial Intelligence and robot programming

UNIT V ROBOTICS APPLICATIONS 9

Robotics and its applications - Robotics and automation in food Industry - Medical Robots - Artificial Intelligence Aspect of Cognitive Robotics: Vision and Action to create Cognitive humanoids- Cognitive Robotics Approach - Perceiving and Interacting with Environment – Design of Chatbots.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Design and implement an intelligent autonomous agent for problem solving.

CO2: Demonstrate and illustrate the fundamentals of Robotics.

CO3: Develop robotic design with proper navigation to solve real time problems.

CO4: Apply programmable automation in different subfields of robotics.

CO5: Develop vision-based systems for robot guidance.

CO6: Design and implement a robot for few real time applications.

REFERENCES:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
2. Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, “Robotic Engineering – An integrated approach”, PHI Publication
3. S. B. Nikku, Introduction to Robotics – Analysis, Control, Applications, 3rd edition, John Wiley & Sons Ltd., (2020)
4. Langton, C. G. (Ed.), Artificial life: An overview, 1997.
5. Caldwell, D. G. (Ed.), Robotics and automation in the food industry: current and future technologies. Elsevier,2012

6. Gomes, P. (Ed.), Medical robotics: Minimally invasive surgery. Elsevier,2012.
7. Samani, H. (Ed.), Cognitive robotics. CRC Press, 2015.
8. S. R. Ruocco, Robot Sensors & Transducers, Springer, 2013
9. Martin, F.G. Robotic explorations: a hands-on introduction to engineering. Upper Saddle River, N.J.: Prentice-Hall, 2001. ISBN 0130895687.

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

IF3057 INFORMATION RETRIEVAL L T P C
3 0 0 3

UNIT I INTRODUCTION TO INFORMATION RETRIEVAL 9

Goals and History of IR – The Impact of the Web on IR – Basic IR Models Boolean and Vector Space Retrieval Models – Ranked Retrieval – Text Metrics – TF-IDF (term frequency/inverse document frequency) Weighting – Cosine Similarity - Pre-processing: Simple tokenizing, Stop-word removal, and stemming, Basic Searching and Indexing: inverted indices and files, efficient processing with sparse vectors.

UNIT II TEXT REPRESENTATION AND QUERYING 9

Porter stemmer; Zipf's law; morphology; index term selection; using thesauri; Metadata and markup languages (SGML, HTML, XML, DTD) and schema Web linking technologies - Query Operations and Languages – Relevance Feedback – Query Expansion – Query Languages.

UNIT III CATEGORIZATION AND CLUSTERING 9

Text classification - Naive Bayes – Decision Trees and Nearest Neighbor- Vector space classification - Support vector machines, Expectation Maximization (EM) - Flat clustering, Hierarchical clustering, Matrix decompositions and latent semantic indexing - Applications to Information Filtering – Organization and Relevance Feedback.

UNIT IV INFORMATION EXTRACTION AND INTEGRATION 9

Search Engines, Spidering, Web Crawling, Meta-crawlers, Directed spidering, link analysis, Static ranking: Page Rank HITS, shopping agents, Query log analysis, Adversarial IR; Extracting data from text, XML, Ontologies, Thesauri, Semantic Web, collecting and integrating specialized information on the web.

UNIT V RECOMMENDER SYSTEMS AND IR EVALUATION 9

Recommender Systems – Collaborative Filtering – Content Based Recommendation of Documents and Products – Information Extraction and Integration – Extracting Data from Text – XML – Semantic Web – Collecting and Integrating Specialized Information on the Web.

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Experimental Evaluation of IR Performance Metrics - Recall, Precision and F Measure – Evaluations on Benchmark Text Collections.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Build an Information Retrieval system using the available tools.
CO2: Identify and design the various components of an Information Retrieval system.
CO3: Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
CO4: Analyze the Web content structure.
CO5: Analyze the approaches used for recommendation systems.
CO6: Design an efficient search engine

REFERENCES:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schütze, "Introduction to Information Retrieval", Cambridge University Press, 2008.
2. F. Ricci, L. Rokach, B. Shapira, P. B. Kantor, "Recommender Systems Handbook", Springer, 2011.
3. Peter Brusilovsky, "The Adaptive Web Methods and Strategies of Web Personalization", Springer, 2007.
4. Manu Konchady, "Building Search Applications: Lucene, LingPipe, and Gate", Mustru Publishing 2008.

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

IF3055 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 efficient 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.

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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.

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

IF3052 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. A. R. Jha, “ Theory, design and applications of Unmanned Aerial Vehicles”, 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, 2013.
7. Anthony Finn, Steve Scheding, “Development and challenges for Autonomous Unmanned Vehicles”, A compendium, Springer, 2010.

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

IF3060 **OPEN SOURCE TECHNOLOGIES** **L T P C**
3 0 0 3

UNIT I INTRODUCTION **9**

Need for Free and Open Source Software – Overview of Linux – Distributions – Licensing Schemes – Versions – Collaborative Version Control Systems – Shell Commands

UNIT II PROCEDURAL PROGRAMMING **9**

Object Oriented Programming in Python - Bank account simulations - Problems with procedural implementation - Building software with Classes, Objects and Instantiation

UNIT III WEB DEVELOPMENT WITH PYTHON 9

HTML – CSS – Bootstrap – Introduction to Flask – Templates – Models – Forms – Modules.

UNIT IV WORKING WITH DATABASES 9

Introduction to Document Databases – Working – Relational Database versus NOSQL – Modeling – Mapping Classes to MongoDB – Building Data layer with Mongo Engine.

UNIT V WORKING WITH CONTAINERS 9

Running software in containers - Installing Dockers - Working with databases such as Redis - Building Docker images - Deployment of applications with Docker

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Use shell commands for executing programs and applications.
CO2: Use Git for collaboration and maintaining different versions.
CO3: Develop a web application using the Flask framework.
CO4: Work with NoSQL structures.
CO5: Develop a server side web application using Python.
CO6: Deploy an application using containers

REFERENCES:

1. Jesus M. Gonzalez Barahona, Joaquin Seoane Pascual, Gregorio Robles, “Introduction to Free Software”, Third Edition, Free Technology Academy, 2009.
2. http://ftacademy.org/sites/ftacademy.org/files/materials/fta–m1–intro_to_FS–v1.pdf
3. Irv Kalb, Object-Oriented Python, O’Reilly, 2022
4. https://getbootstrap.com/
5. Peter Wentworth, Jeffrey Elkner, Allen B. Downey, Chris Meyers, “How to Think Like a Computer Scientist”, Open Book, 2012.
6. Scott Chacon, Ben Straub, “Pro Git”, Free ebook under Creative Commons, Second Edition, Apress, 2016.
7. Miguel Grinberg, “Flask Web Development Developing Web Applications with Python”, O’Reilly, 2014. 7. Karl Seguin, “The Little Mongo DB Book”,
8. https://github.com/karlseguin/the–little– mongodb–book.
9. Jeff Nickoloff and Stephen Kuenzli, Docker in Action, Second Edition, Manning Publications, 2020

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

IF3061 **REASONING METHODS IN COMPUTER SCIENCE** **L T P C**
3 0 0 3

UNIT I PROPOSITION LOGIC **9**

Introduction to Logic - Foundation in mathematics - Natural Deduction - Formal language Syntax and Semantics - Normal Forms - Applications in AI.

UNIT II PREDICATE LOGIC **9**

Syntax and semantics - Natural Deduction rules - Expressiveness - Micromodels of software - Inference mechanisms in AI

UNIT III MODAL LOGIC **9**

Higher order logic – Modal logic syntax – Semantics – Accessibility relation – Types of modal logic – Natural deduction.

UNIT IV TEMPORAL LOGIC **9**

Linear Temporal Logic - Syntax - Semantics - Model Checking - Computational Tree Logic - Syntax - Semantics - Application in Operating Systems and Distributed systems

UNIT V EPISTEMIC LOGIC **9**

Logic of knowledge - Syntax - Semantics - Natural Deduction - Multi-agent reasoning - Applications in Distributed systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the mathematical underpinnings of Logic
CO2: Apply Proposition Logic to Computer Science domains
CO3: Understand the reasoning process of Predicate Logic
CO4: Understand the advantages of Higher Order Logic over Lower Order Logic
CO5: Apply Temporal Logic to Distributed Systems
CO6: Design Multi agent systems using Epistemic Logic

REFERENCES:

1. Michael Huth and Mark Ryan, Logic in Computer Science, Modelling and Reasoning about Systems, 2nd edition, Cambridge University Press, 2005
2. Johan van Benthem, Hans van Ditmarsch, Jan van Eijck, Jan Jaspars, Logic in Action, an open course and e-book inhttp://www.logicinaction.org/, 2016

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	3	3	3
CO2	3		3	3	3	3
CO3	3		3	3	3	3
CO4	3		3	3	3	3
CO5	3		3	3	3	3
CO6	3		3	3	3	3

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IF3062	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 PROFILES 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 SEMANTICS OF SOCIAL NETWORK 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 developpractical 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, 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, 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, 2011.

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

IF3001 CONVERSATIONAL SYSTEMS L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF CONVERSATIONAL SYSTEMS 9

Introduction: Overview, Case studies, Explanation about different modes of engagement for a human being, History and impact of AI. Underlying technologies: Natural Language Processing, Artificial Intelligence and Machine Learning, NLG, Speech-To-Text, Text-To-Speech, Computer Vision etc. Introduction to Top players in Market – Google, MS, Amazon &Market trends. Messaging Platforms (Facebook, WhatsApp) and Smart speakers – Alexa, Google Home and other new channels. Ethical and Legal Considerations in AI Overview.

UNIT II FOUNDATIONAL BLOCKS FOR PROGRAMMING AND NATURAL LANGUAGE PROCESSING 9

Introduction: Brief history, Basic Concepts, Phases of NLP, Application of chat bots etc. General chatbot architecture, Basic concepts in chatbots: Intents, Entities, Utterances, Variables and Slots, Fulfillment. Lexical Knowledge Networks (WordNet, Verbnet, PropBank, etc). Lexical Analysis, Part-of-Speech Tagging, Parsing/Syntactic analysis, Semantic Analysis, Word Sense Disambiguation. Information Extraction, Sentiment Analysis.

UNIT III BUILDING A CHAT BOT / CONVERSATIONAL AI SYSTEMS 9

Fundamentals of Conversational Systems (NLU, DM and NLG) - Chatbot framework & Architecture, Conversational Flow & Design, Intent Classification (ML and DL based techniques),

Dialogue Management Strategies, Natural Language Generation. UX design, APIs and SDKs, Usage of Conversational Design Tools. Introduction to popular chatbot frameworks – Google Dialog flow, Microsoft Bot Framework, Amazon Lex, RASA Channels: Facebook Messenger, Google Home, Alexa, WhatsApp, Custom Apps. Overview of CE Testing techniques, A/B Testing, Introduction to Testing Frameworks - Botium /Mocha ,Chai. Security & Compliance – Data Management, Storage, GDPR, PCI.

UNIT IV ROLE OF ML/AI IN CONVERSATIONAL TECHNOLOGIES AND CONTACT CENTERS 9

Brief Understanding on how Conversational Systems uses ML technologies in ASR, NLP, Advanced Dialog management, Language Translation, Emotion/Sentiment Analysis, Information extraction ,etc. to effectively converse, Introduction to Contact centers – Impact & Terminologies. Case studies & Trends.

UNIT V CONVERSATIONAL ANALYTICS AND FUTURE 9

Conversation Analytics : The need of it - Introduction to Conversational Metrics - Summary, Robots and Sensory Applications overview - XR Technologies in Conversational Systems , XR-Commerce - Future technologies and market innovations overview.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Familiarize in the NLP tool kit and the pre-processing techniques of natural language processing.

CO2: Familiarize with the basic technologies required for building a conversational system.

CO3: Build a Chabot for any application and fundamentals needed to deploy it.

CO4: Involve AI in building conversational system and build advanced systems that can be cognitively inclined towards human behaviour.

CO5: Build a real time working conversational system for social domain that can intelligently process inputs and generate relevant replies.

CO6: Ability to identity the role of chatbot in real time environments.

REFERENCES:

1. Michael McTear, “Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots”, Second Edition, Moran and Claypool Publishers, 2020.
2. Cathy Pearl, “Designing Voice User Interfaces: Principles of Conversational Experiences”, O’REILLY, 2016.

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

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IF3002 WIRELESS SENSOR NETWORKS AND PROTOCOLS L T P C
3 0 2 4

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, Rumour Routing, 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

PRACTICAL EXERCISES: 30

1. Simulate a WSN using MatLab with a 'n' number of nodes and implement data aggregation.
2. Create a WSN and compute the distance between the nodes deployed
3. Simulate an geographical routing protocol using Omnet++
4. Build a WBAN hardware prototype for an health monitoring application using Bluetooth connectivity
5. Deploy an WBAN in hub and spoke model extend the network using Zigbee modules
6. Create WSN model to deploy data centric routing protocols using ns-3
7. Explore Contiki OS and COOJA IDE to simulate a real world application

TOTAL: 75 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.

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CO4: Apply appropriate localization techniques for different scenarios.
CO5: Manage sensor networks by synchronizing the time, locating and tracking objects.
CO6: Carry out experiments in simulators and real sensors.

REFERENCES:

1. Mohammed A. Matin, "Wireless Sensor Networks: Technology and Protocols", InTech, 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, 2019.
6. Mehmet R. Yuce, Jamil Khan , Wireless Body Area Networks: Technology, Implementation, and Applicationsll,CRC press,2012.

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

IF3003 ADVANCED COMPUTER ARCHITECTURE L T P C
3 0 2 4

UNIT I INSTRUCTION LEVEL PARALLELISM 9

Fundamentals of Computer Design - Measuring and Reporting Performance - Instruction Level Parallelism and Its Exploitation - Concepts and Challenges - Overcoming Data Hazards with Dynamic Scheduling – Dynamic Branch Prediction - Speculation - Multiple Issue Processors – Case Studies.

UNIT II THREAD-LEVEL PARALLELISM 9

Multi-threading – Multiprocessors - Centralized and Distributed Shared Memory Architectures – Cache Coherence Issues - Performance Issues – Synchronization Issues – Models of Memory Consistency

UNIT III SIMD AND GPU ARCHITECTURES 9

SIMD Extensions for Multimedia – Graphics Processing Units – GPU Computational Structures – GPU Instruction Set Architecture – GPU Memory Structures – Case Study.

UNIT IV MEMORY HIERARCHY DESIGN 9

Introduction - Optimizations of Cache Performance - Memory Technology and Optimizations – Name Mapping Implementations - Virtual Memory and Virtual Machines - Design of Memory Hierarchies - Case Studies.

UNIT V INTERCONNECT AND STORAGE 9

Interconnection Networks – Buses, Crossbar and Multi-Stage Switches – Multi-Core Processor Architectures - Case Study. Warehouse- Scale Computers - Programming Models and Workloads – Storage Architectures – Physical Infrastructure – Case Study

PRACTICAL EXERCISES: 30

1. Write a MIPS program for a simple application in MARS simulator and analyse the possibility of parallel execution.
2. Write a MIPS code to explore string based operation
3. Explore the different system call in MARS simulator for the RISC code execution
4. Consider a RISC code and simulate a compiler based static scheduling of instruction
5. Consider a RISC code and simulate(PDIWeb) instruction dynamic scheduling
6. Explore CodeApeel to simulate Pipeline Dependencies
7. Consider a RISC code and simulate(PDIWeb) instruction dynamic scheduling
8. Write a CUDA program for simple SIMD application

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Compare and evaluate the performance of various architectures.
CO2: Design a coherent and consistent memory system for multiprocessor.
CO3: Analyze the requirements of large systems to select and build the right infrastructure
CO4: Design and analyze memory and interconnection system for processor.
CO5: Distinguish and model the multiprocessor architecture styles.
CO6: Point out the hazards present in a pipeline and suggest remedies

REFERENCES:

1. John L. Hennessey and David A. Patterson, “Computer Architecture – A quantitative approach”, Morgan Kaufmann / Elsevier, sixth edition, 2017.
2. Richard Y. Kain, “Advanced Computer Architecture a Systems Design Approach”, PHI, 2011.
3. Hwang, Kai, A. Ramachandran, and R. Purushothaman. Advanced computer architecture: parallelism, scalability, programmability. Vol. 199. New York: McGraw-Hill, 1993.

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

IF3004	VIRTUALIZATION	L T P C 3 0 2 4

UNIT I INTRODUCTION TO VIRTUALIZATION 9

Importance of virtualization- virtualization software operation:virtualizing servers, virtualizing Desktops, virtualizing applications- Understanding hypervisors: types of hypervisor, role of hypervisor- understanding virtual machines-working with virtual machines

UNIT II VIRTUAL MACHINES ON THE DESKTOP 9

VM types-Installing VM tools for windows and linux-building windows VM and linux VM-Managing VMs: backing up and modifying VM configurations, copying and moving VM workstation-VM CLI administration and keyboard shortcuts-monitoring and configuring VM performance.

UNIT III VIRTUALIZE STORAGE 9

SCSI-FIbre channel-iSCSI-SAN backup and recovery techniques-RAID:The root for storage virtualization-SNIA shared storage model-Applying SNIA shared storage model- Hierarchical storage management- virtual tape libraries.

UNIT IV NETWORKING VIRTUALIZATION 9

Managing networks for a virtual machine: understanding network virtualization,configuring VM network options, tuning practices for virtual networks-copying a virtual machine-managing additional devices in virtual machines.

UNIT V APPLICATIONS 9

Understanding availability: Increasing availability, protecting a virtual machine, protecting multiple virtual machines, protecting data centers-Understanding applications in a virtual machine: virtual infrastructure performance capabilities, deploying applications in a virtual environment, understanding virtual appliances and vApps, Openstack and containers.

PRACTICAL EXERCISES: 30

1. installation of various hypervisors and instantiation of VMs with image file using open source hypervisors such as Virtual Box, VMWare Player, Xen and KVM.
2. Simple application for communications across VMs using VMware
3. Installation of OpenStack.
4. Creation of VMs and installing applications and executing simple programs in OpenStack.
5. Implementing windows and linux virtual file systems.
6. Creation of simple network topology using open source network virtualization tools (like mininet and others).
7. Building microsoft and Linux virtual machine clusters
8. Implementation of various scheduling mechanisms using an open source cloud simulator.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Analyse the virtualization concepts and Hypervisor

CO2: Work with virtual machines on windows and linux.

CO3: Setup, Configure and manage virtual storage with RAID and Intelligent storage systems.

CO4: manage networks for VM and additional devices in virtual machine
CO5: gain knowledge on availability and deploy application VM environments.
CO6: Apply the Virtualization for real-world applications and Experiment with the VM with various software

REFERENCES:

1. Matthew Portnoy,"virtualization essentials" second edition, sybex 2016.
2. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", APress, 2005.
3. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
4. David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", Auerbach Publications, 2006.

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

IF3005 ADVANCED OPERATING SYSTEM TECHNIQUES L T P C
3 0 2 4

UNIT I OPERATING SYSTEM BASICS 6

Overview – Synchronization Mechanisms – Process and Threads– Critical Section Problem Synchronization Problems: Dining Philosophers, Producer consumer – Language Mechanism for Synchronization: Monitors, Serializers, Path Expressions, Communicating Sequential Processes – Process Deadlocks – Deadlock Detection – Deadlock Prevention – Recovery – Models of Resources.

UNIT II DISTRIBUTED OPERATING SYSTEM 11

Issues in Distributed Operating System – Communication Primitives – Lamport"s Logical clocks – Vector Clocks – Causal Ordering of Messages – Distributed Mutual Exclusion Algorithms: Lamport's Algorithm – The Ricart-Agarwala Algorithm – Maekawa's Algorithm – Centralized and Distributed Deadlock Detection Algorithms.-Agreement Protocols-A Classification of Agreement Problems-A Classification of Agreement Problems.

UNIT III DISTRIBUTED RESOURCE MANAGEMENT 10

Distributed File System – Mechanisms for Building Distributed File Systems-Design Issues - Distributed Shared Memory – Algorithms for Implementing Distributed Shared memory– Issues in Load Distributing – Components of a Load Distributing Algorithm- Stability-Load Distributing Algorithm.

UNIT IV FAILURE RECOVERY AND REAL TIME OPERATINGSYSTEMS 9

Failure Recovery: Synchronous and Asynchronous Check Pointing and Recovery – Algorithm for Check pointing in a DDBS- Algorithm for Site Recovery- Fault Tolerance: Two-Phase Commit Protocol – Non-blocking Commit Protocol – Security and Protection. Basic Model of Real Time Systems – Characteristics– Applications of Real Time Systems – Real Time Task Scheduling – Handling Resource Sharing

UNIT V CASE STUDIES 9

The FreeBSD System: Design principle – Interface – Process Management– Memory Management – File System – Interprocess Communication – iphone Ios4: Architecture and SDK Framework – Media Layer – Services Layer – Core OS Layer – File System.

PRACTICAL EXERCISES: 30

1. Introduction to Linux and shell programming. (4 hours)
2. Write a program to implement a distributed chat server using TCP socket.
3. Write a program to implement client server RPC and client server based program using RMI.
4. Write a multi threaded client server program.
5. Write a program to simulate the functioning of lamports logical clock and lamports vector clock.
6. Write a program to implement Christian's algorithm and Berkeley algorithm.
7. Write a program to check grep and pipe commands in FreeBSD.
8. Write a program to do file permission and directory file permission in free BSD.
9. Write a program to building multi-threaded and multi-process application.

TOTAL: 75 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: Analyze the structure and basic architectural components of OS.
CO3: Have an understanding of high-level OS kernel structure.
CO4: Used gained insight into hardware-software interactions for compute and I/O.
CO5: Acquire practical skills in system tracing and performance analysis.
CO6: Explore research ideas in system structure and behaviour.

REFERENCES:

1. Mukesh Singhal, Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001.
2. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, "Operating System Concepts", Ninth Edition, John Wiley, 2012.
3. Andrew S. Tanenbaum, "Modern Operating System", Third Edition, Prentice Hall, 2008.
4. Rajib Mall, "Real-Time Systems: Theory and Practice", Pearson Education, 2006.
5. H. M. Deitel, P. J. Deitel, D. R. Choffnes, "Operating Systems", Pearson Education, 2004.
6. Neil Smyth, "iPhone Ios 4 Development Essentials – Xcode", Fourth Edition, Payload Media, 2011.
7. Neil Smyth, "Android 4.4 for App Development Essentials", Payload Media, 2014.

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

IF3006 **DEEP LEARNING** **L T P C**
3 0 2 4

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 ADVANCED 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.

PRACTICAL EXERCISES: **30**

1. Implement Simple Programs like vector addition in TensorFlow.
2. Implement a simple problem like regression model in Keras.
3. Implement a perceptron in TensorFlow/Keras Environment.
4. Implement a Feed-Forward Network in TensorFlow/Keras.
5. Implement an Image Classifier using CNN in TensorFlow/Keras.
6. Implement a Transfer Learning concept in Image Classification.
7. Implement an Autoencoder in TensorFlow/Keras.
8. Implement a SimpleLSTM using TensorFlow/Keras.
9. Implement an Opinion Mining in Recurrent Neural network.
10. Implement an Object Detection using CNN.
11. Mini Project

TOTAL: 75 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, 2018.
3. T.V.Geetha and S.Sendhilkumar, Machine Learning: Concepts,Techniques and Applications, 1 st Edition, CRC Press, Taylor and Franics, 2023.
4. Phil Kim, "Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress , 2017.
5. Jon Krohn," Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence," Addison-Wesley, 2020.
6. Andrew Glassner, "Deep Learning – A visual Approach," No Starch Press, 2021.

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

IF3059 MOBILE APPLICATION DEVELOPMENT AND DEPLOYMENT L T P C

3 0 2 4

UNIT I INTRODUCTION 9

Introduction to Mobile Computing – Characteristics and benefits – Mobile Software Engineering – Mobile application development Environment –– Application models – Infrastructure and managing resources – Mobile device profiles – Frameworks and tools.

UNIT II USER INTERFACE 9

Generic UI development – UI Components – Event Handling – Designing the right UI – Multimodal and multichannel UI -Gesture based UI – Screen Elements and Layouts – Voice XML

UNIT III APPLICATION DESIGN 9

Memory Management – Design Patterns for Limited Memory - Work Flow for Application development – Java API - Dynamic Linking - Plugins and rule of thumb for using DLLs - Concurrency and resource management – File Management – Data Base Management: SQLite.

UNIT IV APPLICATION DEVELOPMENT I **9**

Mobile OS: Android, iOS – Android Application Architecture - Android basic components- Intents and Services – Storing and Retrieving data – Packaging and Deployment – Security and Hacking.

UNIT V APPLICATION DEVELOPMENT II **9**

Communication via the Web – Notification and Alarms – Graphics and Multimedia: Layer Animation, Event handling and Graphics services – Telephony – Location based services – Cloud Database Connectivity: Firebase, AWS, Google Cloud.

PRACTICAL EXERCISES: **30**

1. Install and configure java development kit (JDK), android studio and android SDK.
2. Develop an application that uses GUI components, fonts and colors.
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: 75 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 is aware of the resource constraints of mobile devices
CO4: Develop web based mobile application that accesses internet and location data
CO5: Implement android application to use telephony for SMS communication
CO6: Implement android application with multimedia support

REFERENCES:

1. Reto Meier, Professional Android 4 Application Development, Wiley India Pvt Ltd, 2012.
2. Zigurd Mednieks, Laird Dornin, G, Blake Meike and Masumi Nakamura, Programming Android, O"Reilly, 2011.
3. Alasdair Allan, iPhone Programming, O"Reilly, 2010.
4. Reza B'Far, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML", Cambridge Press University, 2009.
5. Neil Smyth, “iPhone iOS 4 Development Essentials – Xcode”, 4 Edition, Payload media, 2011.
6. Ben Shneiderman and Catherine Plaisant, “Designing the User Interface: Strategies for Effective Human Computer Interaction”, Addison– Wesley, 5th Edition, 2009.

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

IF3053 **BLOCKCHAIN TECHNOLOGIES** **L T P C**
3 0 2 4

UNIT I INTRODUCTION TO BLOCKCHAIN 9

History of Blockchain – Blockchain Architecture - Distributed Ledger Technology (DLT); Blocks and Chain Structure; Types of Blockchain – Consensus – Consensus algorithms- Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.

UNIT II BITCOIN AND CRYPTOCURRENCIES 9

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

UNIT III ETHEREUM 9

Ethereum and its features ; Ethereum Architecture : Ethereum Virtual Machine (EVM) -The Ethereum Network –Runtime Byte Code, Blocks and Blockchain, Fee Schedule– Ethereum Programming Languages, Smart Contracts Development ; Ethereum Scaling Solutions, Ethereum DApps and Use Cases; Ethereum Community and Ecosystem

UNIT IV WEB3 AND HYPERLEDGER 9

Web3 – Web3 concepts and Architecture- Benefits and Features of Web3- Web3 Development Tools and Frameworks –Hyperledger Projects and Frameworks - Hyperledger Fabric, Hyperledger Sawtooth, Hyperledger Indy, Hyperledger Iroha, Hyperledger Besu- 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 - Cryptocurrency Regulations and Legal Frameworks; Cryptocurrency Use Cases-Notable Projects – Miscellaneous tools.

PRACTICAL EXERCISES: 30

1. Construct the simple blockchain based application to store and retrieve the crypto-currencies.
2. Create the wallet to send the digital currencies from one account to another account.

Attested

3. Understand the technology components of Blockchain and how it works behind – the scenes.
4. Be aware of different approaches to developing decentralized applications.
5. Perform bitcoin transactions using Python - bitcoinlib.
6. Understand the Bitcoin and its limitations by comparing with other alternative coins.
7. Develop the environment for Ethereum by using Ganache.
8. Create the nodes on Ethereum blockchain and mine the blockchain.
9. Establish deep understanding of the Ethereum model, its consensus model and code execution.
10. Learn Solidity programming language and develop simple Ethereum based applications.
11. Build the decentralized app and deploy it to provide Ethereum environment.
12. Build a simple application using hyperledger in blockchain environment.
13. Understand the architectural components of a Hyperledger and its development framework.
14. Design a smart contract and test it in a Ethereum environment.
15. Develop a block chain based applications which is suitable for your online shopping services.
16. Aware of the Alternative blockchains and emerging trends in blockchain.

TOTAL: 75 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.
2. Arshdeep Bahga, Vijay Madisetti, “Blockchain Applications: A Hands-On Approach”, VPT, 2017.
3. Andreas Antonopoulos, Satoshi Nakamoto, “Mastering Bitcoin”, O’Reilly Publishing, 2014.
4. Roger Wattenhofer, “The Science of the Blockchain” CreateSpace Independent Publishing Platform, 2016.
5. A. 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.

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

Attested

DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025

IF3054	BUILDING IOT SYSTEMS	L T P C 3 0 2 4

UNIT I INTRODUCTION **9**

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 **9**

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 – Emerging Microcontrollers and platforms for building IoT systems

UNIT III DEVELOPING IOT SYSTEMS **9**

Requirements and Process specifications – Domain model and Information model – Service and Level specifications – Functional view and operational view – Device-component integration – Application development – Models of communication – HTTP, CoAP, MQTT and WebSocket protocols – SDN and NFV for IoT

UNIT IV CLOUD OFFERINGS AND ANALYTICS **9**

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 **9**

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

PRACTICAL EXERCISES: **30**

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, 2015.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, 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

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

IF3063 VISUALIZATION METHODS AND TECHNIQUES L T P C
3 0 2 4

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.

PRACTICAL EXERCISES: 30

1. Representing data in different visualization chart (bar, pie, etc) R language
2. Exploring various Visualization tools (Open Source)
3. Implementation of the interactive forms.
4. Implementing various types of data representation.
5. Creating Interoperable Web Visualization Components using Candela tool.
6. Implementing Line and Stacked charts with Labels and Notes using Data wrapper tool.
7. Creating Interactive Charts using Google Chart tool.
8. Working with animation using Chartist.js tool.
9. Analyzing data in Tableau.
10. Creating Mobile Friendly Interactive Maps using Leaflet tool.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, students will 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

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

IF3056 IMAGE PROCESSING AND COMPUTER VISION L T P C
3 0 2 4

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 distance-parallopiped-Support Vector Machines, Image Clustering – Unsupervised Learning – kMeans-Hierarchical and Partition based Clustering Algorithms –ANN-Deep learning image classifier

PRACTICAL EXCERCISES: 30

1. Implementation of Reading and Writing of Images in Matlab and OpenCV/Octave/SciLab.
2. Implementation of simple spatial filters like Low Pass Filters and High Pass Filters in Matlab/OpenCV.
3. Implementation of Histogram Techniques in Matlab/Octave/OpenCV.
4. Implementation of noise modelling in Matlab/Octave/SciLab.

5. Implementation of Fourier and Wavelet Transforms in Matlab/Octave.
6. Implementation of SIFT, SURF in Matlab/Octave/SciLab/opencv.
7. Implementation of PCA in Matlab/Octave/opencv.
8. Implementation of Image Classifier using SVM in Matlab/Octave/ OpenCV..
9. Implementation of Image Clustering algorithms in Matlab/Octave/opencv.
10. Implementation of Feature extraction in images using Matlab/Octav/opencv

TOTAL: 75 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: To 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.
5. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing Analysis and Machine Vision”, Fourth Edition, Cengage India, 2017

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

IF3058 MIXED REALITY TECHNIQUES L T P C

3 0 2 4

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 usability of 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

PRACTICAL EXERCISES: **30**

1. Design and implement an interactive MR application with gesture or motion controller input for interacting with virtual objects.
2. Create a virtual tour MR application for exploring historical sites or museum exhibits with informative content.
3. Develop an AR experience using marker-based tracking for scanning physical markers to reveal interactive virtual content.
4. Design and implement a collaborative MR application for multiple users to interact and collaborate in a shared virtual space.
5. Create an MR puzzle game where users solve virtual puzzles and challenges using interactions with virtual objects and the real-world environment.
6. Develop an MR application for visualizing and interacting with virtual product models in the real-world environment.
7. Design an AR educational experience that reveals interactive 3D models and additional information when scanning textbook pages or learning materials.
8. Create an immersive MR storytelling experience where users interact with characters and objects to progress through a narrative.
9. Develop an MR training simulation for practicing specific tasks or skills in a safe and controlled environment.
10. Design and implement an AR wayfinding application for overlaying navigation instructions and points of interest onto the real-world environment.

TOTAL: 75 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).

Attested

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”. Pearson Education Limited, 2013

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

IF3007 GPU ARCHITECTURE AND PROGRAMMING L T P C
3 0 2 4

UNIT I GPU ARCHITECTURE 9

Evolution of GPU Architectures – Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators - Understanding Parallelism with GPU – Typical GPU Architecture – CUDA Hardware Overview – Threads, Blocks, Grids, Warps, Scheduling – Memory Handling with CUDA: Shared Memory, Global Memory, Constant Memory and Texture Memory.

UNIT II CUDA PROGRAMMING 9

CUDA Basics – Multi GPU – Multi GPU Solutions – Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions, Common Problems: CUDA Error Handling.

UNIT III OPENCL BASICS 9

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.

UNIT IV GPU PROGRAMMING: PyCUDA 9

GPU programming using PyCUDA: kernals, threads, blocks, and grids – thread synchronization and intercommunication – Parallel prefix algorithm – Streams, events, contexts, and concurrency.

UNIT V ALGORITHMS ON GPU 9

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix – Matrix Multiplication – Programming Heterogeneous Cluster.

PRACTICAL EXERCISES: **30**

1. Implement matrix multiplication using CUDA. Experiment with different matrix sizes and kernel launch options and compare the performance. (4 hours)
2. Implement vector reduction using CUDA, and check output with CUDA profiler.
3. Implement matrix multiplication with tiling and shared memory.
4. Implement various performance tuning techniques for matrix multiplication.
5. Implement matrix multiplication using OpenCL.
6. Implement vector reduction using OpenCL.
7. Implement graph traversal using CUDA
8. Implement image processing algorithms using CUDA
9. Experiment with advanced features such as dynamic parallelism
10. Mini project: Choose an application and implement using GPU and do performance analysis.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Describe GPU Architecture
CO2: Write programs using CUDA, identify issues and debug them
CO3: Program GPU using OpenCL
CO4: Program GPU using CUDA and PyCUDA
CO5: Given a problem, identify efficient parallel programming patterns to solve it
CO6: Compare different GPU programming paradigms

REFERENCES:

1. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors – A Hands-on Approach, Fourth Edition, Morgan Kaufmann, 2022.
2. Gerassimos Barlas, Multicore and GPU Programming: An Integrated Approach, Second Edition, Morgan Kaufmann, 2022.
3. Brian Tuomanen, Hands-On Gpu Programming with Python and CUDA: Explore high-performance parallel computing with CUDA, Packt Publishing Limited, 2018.
4. Shane Cook, “CUDA Programming: A Developer’s Guide to Parallel Computing with GPUs”, Morgan Kaufmann, 2013.
5. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, “Heterogeneous Computing with OpenCL 2.0”, Morgan Kauffman, 2015.
6. Nicholas Wilt, “CUDA Handbook: A Comprehensive Guide to GPU Programming”, Addison Wesley, 2013.
7. Jason Sanders, Edward Kandrot, “CUDA by Example: An Introduction to General Purpose GPU Programming”, Addison Wesley, 2011.
8. http://www.nvidia.com/object/cuda_home_new.html.
9. http://www.openCL.org.

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

IF3008 SERVICE ORIENTED ARCHITECTURE AND MICROSERVICES L T P C
3 0 2 4

UNIT I SOFTWARE ENGINEERING PRACTICES 9

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

UNIT II SOA AND MICROSERVICE ARCHITECTURE BASICS 9

SOA and MSA – Basics – Evolution of SOA & MSA – Drivers for SOA – Dimensions, Standards and Guidelines for SOA – 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 – Composite Applications – SOA Programming Models, Business Case for SOA – Stakeholder Objectives – Benefits of SOA – Cost Savings – Return on Investment(ROI)

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 – Service Enablement – Integration – Orchestration – SOA Governance – Design Time and Run Time Governance

UNIT V MICROSERVICE ARCHITECTURE 9

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

PRACTICAL EXERCISES: 30

1. Implementing a Tier – 1, Tier – 2 and Tier – 3 programs
2. UML diagrams for a business application
3. Implementation of SOAD process
4. Implementation of Strawman architecture for loan application
5. Service Oriented Model using Java EE Enterprise Application
6. Design activity services for banking application
7. Design data services for banking application
8. Design client services for banking application
9. Virtual implementation of micro services in cloud environment

TOTAL: 75 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, 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, 2013.

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

IF3009 CYBER FORENSICS L T P C
3 0 2 4

UNIT I INCIDENT AND INCIDENT RESPONSE 9

Introduction to Security Threats: Computer Crimes, Vulnerability and Intrusions, Telecommunication Fraud, Phishing, Identity Theft, Cyber Terrorism and Cyber War – Need for Security: Information Security. OS Security, Database Security, Software Development Security – Security Architecture – Incident – Incident Response Methodology – Steps – Activities in Initial Response Phase after Detection of an Incident.

UNIT II OPERATING SYSTEM FORENSICS 9

Operating System Forensics – Data Acquisition Methods of OS Forensics – Data Analysis for OS – Tools for forensic analysis, Incident – Incident Response Methodology – Steps – Activities in Initial Response Phase after Detection of an Incident.

UNIT III FILE STORAGE AND DATA RECOVERY 9

Definition and Cardinal Rules, Data Acquisition and Authentication Process, Windows Systems-FAT12, FAT16, FAT32 and NTFS, UNIX file Systems, mac file systems, computer artifacts, Internet Artifacts, OS Artifacts and their forensic applications, Forensic analysis of File systems, Initial Response and Volatile Data Collection from Windows System - Initial Response and Volatile Data Collection from UNIX System – Forensic Duplication – Tools – Discover of Electronic Evidence – Identification of Data – Reconstructing Past Events - Networks

UNIT IV MOBILE FORENSICS 9

Introduction to Mobile technologies – Functions of Bluetooth and security issues – Phone Phreaking – Call Tampering – Types of evidences present in mobile forensics – Mobile phone evidence extraction process – Mobile forensic investigation tool kit – Tracking of mobile phone location.

UNIT V IMAGE AND VIDEO FORENSICS 9

Recognizing a Graphics File – Data Compression – Locating and Recovering Graphics Files – Identifying Unknown File Formats – Copyright Issues with Graphics – Fraud using Image and Video – Detection of Fraud in Images and Video.

PRACTICAL EXERCISES: 30

1. Demonstrate some of the mechanisms used by malicious attackers as well as forensic experts to disrupt computer networks and manipulate information access.
2. Demonstrate FTK Imager to access data's evidence. It is used to quickly preview and create a forensically sound image of the disk if the preview warrants such action.
3. Demonstrate how data can be modified within a file or hidden on a disk without the data being saved as a file.
    a. Hex Workshop v4.23 hex editor (Shareware download from www.hexworkshop.com).
    b. MD5Hash (Freeware download from www.digitaldetective.co.uk/freetools/md5.asp).
    c. Text editor (Notepad is good enough).
4. Demonstrate how an attacker could exploit a machine and obtain access to a server with a filtered port by piping another unfiltered port.
    a. Quick 'n Easy FTP Server (Freeware download from http://www.pablovandermeer.nl).
    b. FPIPE (Freeware download from http://www.foundstone.com)
    c. FPORT (Freeware download from www.digitaldetective.co.uk/freetools/md5.asp).
5. Show how the encrypted Internet Explorer cache may be viewed using some freely available tools.
    a. Pasco (Freeware download from http://www.foundstone.com).
    b. Galleta (Freeware download from http://www.foundstone.com).
6. Demonstrate the typical use of steganography
7. Demonstrate mobile forensics with software:
    a. BitPim.
    b. Mobile Phone Examiner (MPE+).
    c. Trace an Email.
    d. eMailTrackerPro.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Recognize attacks on systems.

CO2: Design a counter attack incident response and incident-response methodology.
CO3: Illustrate the methods for data recovery, evidence collection and data seizure.
CO4: Understand network and email attacks and forensic investigation with tools.
CO5: Use Forensic tools and collect evidences of a computer crime.
CO6: Analyze various image encryption/decryption, steganography and fraud in image.

REFERENCES:

1. Kevin Mandia, T. Jason Luttgens, Matthew Pepe, “Incident Response and Computer Forensics”, Tata McGraw-Hill, 2014.
2. Bill Nelson, Amelia Philips, Christopher Stueart, “Guide to Computer Forensics and Investigations”, Cengage Learning, 2018.
3. John R. Vacca, “Computer Forensics”, Firewall Media, 2009.
4. Eoghan Casey, “Handbook of Computer Crime Investigation's Forensic Tools and Technology”, Academic Press, 2001.
5. Davide Cowen, “Computer Forensics: A Beginners Guide”, McGraw-Hill Education, 2011.
6. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, Auerbach Publications, 2014

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

IF3010 BIOMETRICS L T P C
3 0 2 4

UNIT I BIOMETRICS FUNDAMENTALS 9

Introduction – Benefits of biometric security – Verification and identification – Basic working of biometric matching – Accuracy – False match rate – False non-match rate – Failure to enroll rate – Derived metrics – Layered biometric solutions.

UNIT II FINGER AND FACIAL SCAN 9

Finger scan – Features – Components – Operation (Steps) – Competing finger Scan technologies Strength and weakness. Types of algorithms used for interpretation. Facial Scan - Features Components – Operation (Steps) – Competing facial Scan technologies– Strength-weakness.

UNIT III IRIS AND VOICE 9

Iris Scan - Features – Components – Operation (Steps) – Competing iris Scan technologies – Strength and weakness. Voice Scan - Features – Components – Operation (Steps) – Competing voice Scan (facial) technologies – Strength and weakness.

UNIT IV PHYSIOLOGICAL BIOMETRICS 9

Other physiological biometrics – Hand scan – Retina scan – AFIS (Automatic Finger

Print Identification Systems) – Behavioural Biometrics – Signature scan - keystroke scan. Multimodality and combining biometrics for improving performance.

UNIT V BIOMETRICS APPLICATION DEVELOPMENT 9

Biometrics Application – Biometric Solution Matrix - Bio privacy – Comparison of privacy factors in different biometrics technologies - Designing privacy sympathetic biometric systems - standards – (BioAPI , BAPI).

PRACTICAL EXERCISES: 30

Installation of Matlab / Octave / Scilab Environments.

1. Explore the Octave / Scilab open-source software.
2. Implement a Matlab/Octave program to
3. Remove the noise present in an image.
4. Implement spatial filters to enhance the quality of the image.
5. Extraction of intensity features from an image
6. Extraction of features from the face, such as fiducial points.
7. Extraction of features from Iris images.
8. Read and playing of an audio file.
9. Extraction of audio features.
10. To extract keystroke features.
11. To match two images.
12. To match two signatures using template matching.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Implement basic biometrics related algorithms

CO2: Familiar with the use of MATLAB and its equivalent open source environments

CO3: Design and implement industrial applications that incorporates different concepts of biometrics

CO4: Critically analyze different approaches to implement mini projects in industrial environment and in security related projects

CO5: To know about Biometric standards

CO6: To know about Biometrics Application development

REFERENCES:

1. Anil K. Jain, Arun A. Ross and Karthik Nandakumar, "Introduction to Biometrics", Springer, 2011.

2. James L. Wayman, Anil K. Jain, Davide Maltoni, and Dario Maio, Biometric Systems: Technology, Design and Performance Evaluation, Springer, 2004.

3. Samir Nanavati, Michael Thieme, Raj Nanavati Biometrics, " Identity Verification in a Networked World", John WILEY and Sons, 2002.

4. Stan Z. Li and Anil K. Jain, 'Handbook of Face Recognition', 2005.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	2	2	1
CO2	3	3	2	3	3	3

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

IF3011 ADVANCED COMPUTER GRAPHICS AND ANIMATION L T P C
3 0 2 4

UNIT I INTRODUCTION TO GRAPHIC TOOLS 9

Applications of Computer Animation-Creating Interactive scene using OpenGL- Blender Game Engine-Blender: Interface-Navigation-Creating and Editing Objects-Materials-Textures-World Setting-Lighting and Cameras-Raytracing and Rendering-Animation Basics-Modifiers-Particle Systems-Relationship Constraints-Armatures-Shape Key and Action Editors-Fluid Simulation-Nodes-Audio and Video Sequence Editing.

UNIT II RASTERIZATION 9

Lines-Filled Triangles-Shaded Triangles-Perspective Projection-Describing and Rendering a Scene-Clipping-Hidden Surface Removal-Shading-Textures-Extending the Rasterizer.

UNIT III RAYTRACING 9

Introductory Concepts-Basic Raytracing- Light-Shadows and Reflections- Extending the Ray tracer-shading and surface characteristics..

UNIT IV PRINCIPLE OF ANIMATION 9

Introduction-Human Development-Developing Characters-Writing structure-Story Board-Gag Writing-Dialogue-Script-Editing and rewriting-Types of Animation

UNIT V ANIMATION TECHNIQUES 9

Introduction-Technical Background-Interpolation-Based Animation-Kinematic Linkage-Motion Capture-Physically Based Animation-Fluids: Liquids and Gases, Modelling and Animating Human Figures-Facial Animation - Behavioural Animation-Crowd Animation- interactive Animation-Visual Effects

PRACTICAL EXERCISES: 30

1. Implementation of OpenGL and Blender
2. Creating simple objects in OpenGL applying color and pattern
3. Creating object in OpenGL and applying transformation to it.
4. Creating interactive Scene using OpenGL.
5. Implementing the concept of Ray tracing in OpenGL.
6. Developing Human Characters using Blender.
7. Developing Environmental Effects using Blender.
8. Developing a Speaking Human Avatar and embedding voice to it.
9. Writing Script for a interactive Game of your choice.
10. Developing an interactive animated game.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

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

CO1: Demonstrate the concepts and techniques used in Animation Tool

CO2: Design and implement algorithms and techniques applied to Rendering.

CO3: Design and implement real world effect to scene.

CO4: Understand the basic concept of animation design.

CO5: Apply the mechanics concepts to design animation.

CO6: Create an interactive animation using animation techniques

REFERENCES:

1. Gabriel Gambetta, “Computer Graphics from Scratch” , Np Starch press,2021.
2. Ann Wright, “Animation Writing and Devlopment”, Routledge, 2013.
3. Rick Parent “Computer Animation” Third Edition, Morgan Kaufmann, 2012.
4. Isaac V.Kerlow, The Art of 3D Computer Animation and Effects”, Fourth Edition,Wiley,2009 4.John M.Blain, “The Complete Guide to Blender Graphice”, CRC Press, 2012.
5. Donald D. Hearn, M. Pauline Baker, Warren Carithers, “Computer Graphics with Open GL”, Fourth Edition, Prentice Hall, 2011.

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