ANNA UNIVERSITY, CHENNAI
NON - AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.TECH. INFORMATION TECHNOLOGY

REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

To produce graduates who will be able to:

I. Provide suitable IT solutions to challenging problems in their profession by applying the best practices.
II. Apply their knowledge and skills to analyse, design, test and implement various IT support systems and be engaged in life - long learning.
III. Respond to the technological changes in Information Technologies and to foster related research to meet the needs of the society.
IV. To work collaboratively on multidisciplinary projects and exhibit high levels of professional and ethical values within the organization and society at large.
V. Become entrepreneurs and show their leadership and technical skills to develop innovative IT solutions to address the challenges of a sustainable ecosystem.

2. PROGRAM OUTCOMES (POs)

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. Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program
4. Identify, formulate and solve engineering problems by applying mathematical foundations, algorithmic principles and design techniques in IT environment to meet industrial challenges.
5. Analyse and recommend the suitable IT solutions required for the implementation of a software systems
6. Apply the known facts and use modern tools to provide innovative solutions in the domain of Information technology

ANNA UNIVERSITY, CHENNAI
NON - AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.TECH. INFORMATION TECHNOLOGY
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABI
SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA4108	Applied Probability and Statistical Analysis	FC	3	1	0	4	4
2.	RM4151	Research Methodology and IPR	RMC	2	0	0	2	2
3.	CP4151	Advanced Data Structures and Algorithms	PCC	3	0	0	3	3
4.	CP4152	Database Practices	PCC	3	0	2	5	4
5.	CP4153	Network Technologies	PCC	3	0	0	3	3
6.	CP4252	Machine Learning	PCC	3	0	2	5	4
7.		Audit Course – I*	AC	2	0	0	2	0
PRACTICALS								
8.	CP4161	Advanced Data Structures and Algorithms Laboratory	PCC	0	0	4	4	2
9.	IF4111	Applied Probability and Statistical Analysis Laboratory	PCC	0	0	2	2	1
			TOTAL	**19**	**1**	**10**	**30**	**23**

*Audit course is optional

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IF4201	Software Industrialization	PCC	3	0	0	3	3
2.	IF4291	Full stack Web Application Development	PCC	3	0	2	5	4
3.	BD4251	Big Data Mining and Analytics	PCC	3	0	0	3	3
4.	CP4291	Internet of Things	PCC	3	0	2	5	4
5.		Professional Elective I	PEC	3	0	0	3	3
6.		Professional Elective II	PEC	3	0	0	3	3
7.		Audit Course – II*	AC	2	0	0	2	0
PRACTICALS								
8.	IF4211	Term Paper Writing and seminar	EEC	0	0	2	2	1
			TOTAL	**20**	**0**	**6**	**26**	**21**

*Audit course is optional

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	IF4301	Information and Network Security	PCC	3	0	0	3	3
2.		Professional Elective III	PEC	3	0	0	3	3
3.		Professional Elective IV	PEC	3	0	2	5	4
4.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
5.	IF4311	Project Work I	EEC	0	0	12	12	6
			TOTAL	**12**	**0**	**14**	**26**	**19**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	IF4411	Project Work II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL NO. OF CREDITS: 75

PROFESSIONAL ELECTIVES
SEMESTER II, ELECTIVE I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	MU4251	Digital Image Processing	PEC	3	0	0	3	3
2.	IF4001	Game Development	PEC	3	0	0	3	3
3.	MP4152	Wireless Communications	PEC	3	0	0	3	3
4.	IF4091	Compiler Optimization Techniques	PEC	3	0	0	3	3
5.	IF4002	Multimedia Technologies	PEC	3	0	0	3	3

SEMESTER II, ELECTIVE II

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IF4092	Computer Vision	PEC	3	0	0	3	3
2.	MP4092	Human Computer Interaction	PEC	3	0	0	3	3
3.	IF4003	Cyber Forensics	PEC	3	0	0	3	3
4.	ML4151	Artificial Intelligence	PEC	3	0	0	3	3
5.	MU4153	Principles of Multimedia	PEC	3	0	0	3	3
6.	NE4071	Wireless Sensor Networks and Protocols	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE III

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	CP4093	Information Retrieval Techniques	PEC	3	0	0	3	3
2.	IF4095	Social Network Analysis	PEC	3	0	0	3	3
3.	IF4093	GPU Computing	PEC	3	0	0	3	3
4.	IF4004	Visualization Techniques	PEC	3	0	0	3	3
5.	IF4072	Design Thinking	PEC	3	0	0	3	3
6.	IF4094	Pattern Recognition	PEC	3	0	0	3	3

SEMESTER III, ELECTIVE IV

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	IF4005	Blockchain and Cryptocurrency	PEC	3	0	2	5	4
2.	IF4074	Distributed Application Development	PEC	3	0	2	5	4
3.	IF4006	Forecasting and Optimization	PEC	3	0	2	5	4
4.	IF4071	Deep Learning	PEC	3	0	2	5	4
5.	IF4073	DevOps and Microservices	PEC	3	0	2	5	4
6.	MP4292	Mobile Application Development	PEC	3	0	2	5	4
7.	CP4292	Multicore Architecture and Programming	PEC	3	0	2	5	4
8.	BC4291	Ethical Hacking	PEC	3	0	2	5	4
9.	MU4151	Advanced Graphics and Animation	PEC	3	0	2	5	4

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	AX4091	English for Research Paper Writing	2	0	0	0
2.	AX4092	Disaster Management	2	0	0	0
3.	AX4093	Constitution of India	2	0	0	0
4.	AX4094	நற்றமிழ் இலக்கியம்	2	0	0	0

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	MA4108	Applied Probability and Statistical Analysis	3	1	0	4	I

PROFESSIONAL CORE COURSES (PCC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	CP4151	Advanced Data Structures and Algorithms	3	0	0	3	I
2.	CP4152	Database Practices	3	0	2	4	I
3.	CP4153	Network Technologies	3	0	0	3	I
4.	CP4252	Machine Learning	3	0	2	4	I
5.	CP4161	Advanced Data Structures and Algorithms Laboratory	0	0	4	2	I
6.	IF4111	Applied Probability and Statistical Analysis Laboratory	0	0	2	1	I
7.	IF4201	Software Industrialization	3	0	0	3	II
8.	IF4291	Full stack Web Application Development	3	0	2	4	II
9.	BD4251	Big Data Mining and Analytics	3	0	0	3	II
10.	CP4291	Internet of Things	3	0	2	4	II
11.	IF4301	Information and Network Security	3	0	0	3	III

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM4151	Research Methodology and IPR	2	0	0	2	1

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	BD4211	Term Paper Writing and seminar	0	0	2	1	II
2.	BD 4311	Project Work I	0	0	12	6	III
3.	BD 4411	Project Work II	0	0	24	12	IV

SUMMARY

Sl. No.	NAME OF THE PROGRAMME: M.TECH. INFORMATION TECHNOLOGY					
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	04	00	00	00	04
2.	PCC	17	14	03	00	34
3.	PEC	00	06	07	00	13
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	00	01	06	12	19
7.	Non Credit/Audit Course	✓	✓	00	00	
8.	**TOTAL CREDIT**	**23**	**21**	**19**	**12**	**75**

MA4108 APPLIED PROBABILITY AND STATISTICAL ANALYSIS L T P C
3 1 0 4

COURSE OBJECTIVES :

- To provide students with basic concepts of probability theory.
- To gain knowledge about two dimensional random variable and its regression, correlations.
- To decide whether to accept or reject a specific value of the parameters.
- To provide the most appropriate interval estimator of the parameters in statistical inferences.
- To avoid or at least minimize, the problems of estimating the effects of the independent variables by experimental designs.

UNIT I PROBABILITY AND RANDOM VARIABLES 12

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

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12

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

UNIT III TESTING OF HYPOTHESIS 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 IV ESTIMATION THEORY 12

Interval estimation for population mean - Standard deviation - Difference in means, proportion ratio of standard deviations and variances.

UNIT V DESIGN OF EXPERIMENTS 12

Completely randomized design – Randomized block design – Latin square design – 2^2 Factorial design.

TOTAL: 60 PERIODS

COURSE OUTCOMES :

After completing this course, students should demonstrate competency in the following topics:

- Basic probability axioms and rules and the moments of discrete and continuous random variables and various standard distributions and their properties.
- Distributions of two dimensional variables, correlation and regression.
- Use statistical tests in testing hypotheses on data.
- Interval estimation for population parameters such as mean and standard deviation.
- List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.

REFERENCES :

1. Devore, J. L., "Probability and Statistics for Engineering and Sciences", 8th Edition, Cengage Learning, 2014.

2. Gupta S.C. and Kapoor V.K.," Fundamentals of Mathematical Statistics", 12th Edition, Sultan and Sons, New Delhi, 2020.
3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson Education, Asia, 2016.
4. Rice, J. A., "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.
5. Ross, S. M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier, 2014.

RM4151 RESEARCH METHODOLOGY AND IPR L T P C
2 0 0 2

UNIT I RESEARCH DESIGN 6

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES 6

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING 6

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V PATENTS 6

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL: 30 PERIODS

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

CP4151 ADVANCED DATA STRUCTURES AND ALGORITHMS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the usage of algorithms in computing
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications
- To select and design data structures and algorithms that is appropriate for problems
- To study about NP Completeness of problems.

UNIT I ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY ANALYSIS 9

Algorithms – Algorithms as a Technology -Time and Space complexity of algorithms- Asymptotic analysis-Average and worst-case analysis-Asymptotic notation-Importance of efficient algorithms-Program performance measurement - Recurrences: The Substitution Method – The Recursion-Tree Method- Data structures and algorithms.

UNIT II 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 -B-Trees: Definition of B - trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Heap – Heap Implementation – Disjoint Sets - Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT III GRAPHS 9

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra‘s Algorithm; Dynamic Programming - All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm

UNIT IV ALGORITHM DESIGN TECHNIQUES 9

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: – Elements of the Greedy Strategy- An Activity-Selection Problem - Huffman Coding.

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.

TOTAL: 45 PERIODS

SUGGESTED ACTIVITIES:

1. Write an algorithm for Towers of Hanoi problem using recursion and analyze the complexity (No of disc-4)
2. Write any one real time application of hierarchical data structure
3. Write a program to implement Make_Set, Find_Set and Union functions for Disjoint Set Data Structure for a given undirected graph G(V,E) using the linked list representation with simple implementation of Union operation
4. Find the minimum cost to reach last cell of the matrix from its first cell
5. Discuss about any NP completeness problem

COURSE OUTCOMES:

CO1: Design data structures and algorithms to solve computing problems.

CO2: Choose and implement efficient data structures and apply them to solve problems.

CO3: Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.

CO4: Design one's own algorithm for an unknown problem.

CO5: Apply suitable design strategy for problem solving.

REFERENCES:

1. S.Sridhar," Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2014.
2. Adam Drozdex, "Data Structures and algorithms in C++", Cengage Learning, 4th Edition, 2013.
3. T.H. Cormen, C.E.Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2012.
4. Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education, 3rd Edition, 2009.
5. E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamentals of Computer Algorithms", University Press, 2nd Edition, 2008.
6. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

CP4152 DATABASE PRACTICES L T P C

3 0 2 4

COURSE OBJECTIVES:

- Describe the fundamental elements of relational database management systems
- Explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- Understand query processing in a distributed database system
- Understand the basics of XML and create well-formed and valid XML documents.
- Distinguish the different types of NoSQL databases
- To understand the different models involved in database security and their applications in real time world to protect the database and information associated with them.

UNIT I RELATIONAL DATA MODEL 15

Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization.

Suggested Activities:

Data Definition Language

- Create, Alter and Drop
- Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints
- Creating Views

Data Manipulation Language

- Insert, Delete, Update
- Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join
- Aggregate Functions
- Set Operations

- Nested Queries

Transaction Control Language

- Commit, Rollback and Save Points

UNIT II DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY 15

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.

Suggested Activities:

- Distributed Database Design and Implementation
- Row Level and Statement Level Triggers
- Accessing a Relational Database using PHP, Python and R

UNIT III XML DATABASES 15

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

Suggested Activities:

- Creating XML Documents, Document Type Definition and XML Schema
- Using a Relational Database to store the XML documents as text
- Using a Relational Database to store the XML documents as data elements
- Creating or publishing customized XML documents from pre-existing relational databases
- Extracting XML Documents from Relational Databases
- XML Querying

UNIT IV NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS 15

NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics – NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key-Value Distributed Data Store – Wide Column NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j – Big Data – MapReduce – Hadoop – YARN.

Suggested Activities:

- Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.
- Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.

UNIT V DATABASE SECURITY 15

Database Security Issues – Discretionary Access Control Based on Granting and Revoking Privileges – Mandatory Access Control and Role-Based Access Control for Multilevel Security – SQL Injection – Statistical Database Security – Flow Control – Encryption and Public Key Infrastructures – Preserving Data Privacy – Challenges to Maintaining Database Security – Database Survivability – Oracle Label-Based Security.

Suggested Activities:
Implementing Access Control in Relational Databases

TOTAL: 75 PERIODS

COURSE OUTCOMES:
At the end of the course, the students will be able to
CO1: Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.
CO2: Understand and write well-formed XML documents
CO3: Be able to apply methods and techniques for distributed query processing.
CO4: Design and Implement secure database systems.
CO5: Use the data control, definition, and manipulation languages of the NoSQL databases

REFERENCES:

1. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Seventh Edition, Pearson Education 2016.
2. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, Seventh Edition, McGraw Hill, 2019.
3. C.J.Date, A.Kannan, S.Swamynathan, “An Introduction to Database Systems, Eighth Edition, Pearson Education, 2006
4. Raghu Ramakrishnan , Johannes Gehrke “Database Management Systems”, Fourth Edition, McGraw Hill Education, 2015.
5. Harrison, Guy, “Next Generation Databases, NoSQL and Big Data” , First Edition, Apress publishers, 2015
6. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Sixth Edition, Pearson Education, 2015

CP4153 NETWORK TECHNOLOGIES L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand the basic concepts of networks
- To explore various technologies in the wireless domain
- To study about 4G and 5G cellular networks
- To learn about Network Function Virtualization
- To understand the paradigm of Software defined networks

UNIT I NETWORKING CONCEPTS 9
Peer To Peer Vs Client-Server Networks. Network Devices. Network Terminology. Network Speeds. Network throughput, delay. Osi Model. Packets, Frames, And Headers. Collision And Broadcast Domains. LAN Vs WAN. Network Adapter. Hub. Switch. Router. Firewall, IP addressing.

UNIT II WIRELESS NETWORKS 9
Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee

UNIT III MOBILE DATA NETWORKS 9
4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless

Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modelling for 4G – Concepts of 5G – channel access –air interface -Cognitive Radio- spectrum management – C-RAN architecture - Vehicular communications-protocol – Network slicing – MIMO, mmWave, Introduction to 6G.

UNIT IV SOFTWARE DEFINED NETWORKS 9

SDN Architecture. Characteristics of Software-Defined Networking. SDN- and NFV-Related Standards. SDN Data Plane. Data Plane Functions. Data Plane Protocols. OpenFlow Logical Network Device. Flow Table Structure. Flow Table Pipeline. The Use of Multiple Tables. Group Table. OpenFlow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface. Northbound Interface. Routing. ITU-T Model. OpenDaylight. OpenDaylight Architecture. OpenDaylight Helium. SDN Application Plane Architecture. Northbound Interface. Network Services Abstraction Layer. Network Applications. User Interface.

UNIT V NETWORK FUNCTIONS VIRTUALIZATION 9

Motivation-Virtual Machines –NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV Use Cases- NFV and SDN –Network virtualization – VLAN and VPN

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Explain basic networking concepts
CO2: Compare different wireless networking protocols
CO3: Describe the developments in each generation of mobile data networks
CO4: Explain and develop SDN based applications
CO5: Explain the concepts of network function virtualization

SUGGESTED ACTIVITIES:

1: Execute various network utilities such as tracert, pathping, ipconfig
2: Implement the Software Defined Networking using Mininet
3: Implement routing in Mininet
4: Install a virtual machine and study network virtualization
5: Simulate various network topologies in Network Simulator

REFERENCES:

1. James Bernstein, “Networking made Easy”, 2018. (UNIT I)
2. HoudaLabiod, Costantino de Santis, HossamAfifi –“Wi-Fi, Bluetooth, Zigbee and WiMax”, Springer 2007 (UNIT 2)
3. Erik Dahlman, Stefan Parkvall, Johan Skold, —4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 2013 (UNIT 3)
4. Saad Z. Asif – “5G Mobile Communications Concepts and Technologies” CRC press – 2019 (UNIT 3)
5. William Stallings –“Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud” 1st Edition, Pearson Education, 2016.(Unit 4 and 5)
6. Thomas D.Nadeau and Ken Gray, “SDN – Software Defined Networks”,O"Reilly Publishers, 2013.
7. Guy Pujolle, “Software Networks”, Second Edition, Wiley-ISTE, 2020

CP4252 **MACHINE LEARNING** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
- To explore the different supervised learning techniques including ensemble methods
- To learn different aspects of unsupervised learning and reinforcement learning
- To learn the role of probabilistic methods for machine learning
- To understand the basic concepts of neural networks and deep learning

UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATIONS **9**

What is Machine Learning? Need –History – Definitions – Applications - Advantages, Disadvantages & Challenges -Types of Machine Learning Problems – Mathematical Foundations - Linear Algebra & Analytical Geometry -Probability and Statistics- Bayesian Conditional Probability -Vector Calculus & Optimization - Decision Theory - Information theory

UNIT II SUPERVISED LEARNING **9**

Introduction-Discriminative and Generative Models -Linear Regression - Least Squares -Under-fitting / Overfitting -Cross-Validation – Lasso Regression- Classification - Logistic Regression- Gradient Linear Models -Support Vector Machines –Kernel Methods -Instance based Methods - K-Nearest Neighbors - Tree based Methods –Decision Trees –ID3 – CART - Ensemble Methods –Random Forest - Evaluation of Classification Algorithms

UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING **9**

Introduction - Clustering Algorithms -K – Means – Hierarchical Clustering - Cluster Validity - Dimensionality Reduction –Principal Component Analysis – Recommendation Systems - EM algorithm. Reinforcement Learning – Elements -Model based Learning – Temporal Difference Learning

UNIT IV PROBABILISTIC METHODS FOR LEARNING- **9**

Introduction -Naïve Bayes Algorithm -Maximum Likelihood -Maximum Apriori -Bayesian Belief Networks -Probabilistic Modelling of Problems -Inference in Bayesian Belief Networks – Probability Density Estimation - Sequence Models – Markov Models – Hidden Markov Models

UNIT V NEURAL NETWORKS AND DEEP LEARNING **9**

Neural Networks – Biological Motivation- Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation-Activation and Loss Functions- Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases

45 PERIODS

SUGGESTED ACTIVITIES:

1. Give an example from our daily life for each type of machine learning problem
2. Study at least 3 Tools available for Machine Learning and discuss pros & cons of each
3. Take an example of a classification problem. Draw different decision trees for the example and explain the pros and cons of each decision variable at each level of the tree
4. Outline 10 machine learning applications in healthcare
5. Give 5 examples where sequential models are suitable.
6. Give at least 5 recent applications of CNN

PRACTICAL EXERCISES: **30 PERIODS**

1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?"(use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.
3. Classification with Nearest Neighbors. In this question, you will use the scikit-learn's KNN classifier to classify real vs. fake news headlines. The aim of this question is for you to read the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset
4. In this exercise, you'll experiment with validation sets and test sets using the dataset. Split a training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a test set to determine whether your trained model is overfitting. Detect and fix a common training problem.
5. Implement the k-means algorithm using https://archive.ics.uci.edu/ml/datasets/Codon+usage dataset
6. Implement the Naïve Bayes Classifier using https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset
7. Project - (in Pairs) Your project must implement one or more machine learning algorithms and apply them to some data.

    a. Your project may be a comparison of several existing algorithms, or it may propose a new algorithm in which case you still must compare it to at least one other approach.
    b. You can either pick a project of your own design, or you can choose from the set of pre-defined projects.
    c. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
    d. You must properly provide references to any work that is not your own in the write-up.
    e. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

List of Projects (datasets available)

1. Sentiment Analysis of Product Reviews
2. Stock Prediction
3. Sales Forecasting
4. Music Recommendation
5. Handwriting Digit Classification
6. Fake News Detection
7. Sports Prediction
8. Object Detection
9. Disease Prediction

COURSE OUTCOMES:

Upon the completion of course, students will be able to

CO1: Understand and outline problems for each type of machine learning

CO2: Design a Decision tree and Random forest for an application

CO3: Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.
CO4: Use a tool to implement typical Clustering algorithms for different types of applications.
CO5: Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.

TOTAL:75 PERIODS

REFERENCES

1. Stephen Marsland, “Machine Learning: An Algorithmic Perspective”, Chapman & Hall/CRC, 2nd Edition, 2014.
2. Kevin Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012
3. Ethem Alpaydin, “Introduction to Machine Learning”, Third Edition, Adaptive Computation and Machine Learning Series, MIT Press, 2014
4. Tom M Mitchell, “Machine Learning”, McGraw Hill Education, 2013.
5. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.
6. Shai Shalev-Shwartz and Shai Ben-David, “Understanding Machine Learning: From Theory to Algorithms”, Cambridge University Press, 2015
7. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
8. Hal Daumé III, “A Course in Machine Learning”, 2017 (freely available online)
9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning”, Springer, 2009 (freely available online)
10. Aurélien Géron , Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems 2nd Edition, o'reilly, (2017)

CP4161	ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY	L T P C 0 0 4 2

COURSE OBJECTIVES:

- To acquire the knowledge of using advanced tree structures
- To learn the usage of heap structures
- To understand the usage of graph structures and spanning trees
- To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
- To understand the necessary mathematical abstraction to solve problems.

LIST OF EXPERIMENTS:

1: Implementation of recursive function for tree traversal and Fibonacci
2: Implementation of iteration function for tree traversal and Fibonacci
3: Implementation of Merge Sort and Quick Sort
4: Implementation of a Binary Search Tree
5: Red-Black Tree Implementation
6: Heap Implementation
7: Fibonacci Heap Implementation
8: Graph Traversals
9: Spanning Tree Implementation
10: Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)
11: Implementation of Matrix Chain Multiplication

12: Activity Selection and Huffman Coding Implementation

Hardware/Software Requirements

1: 64-bit Open source Linux or its derivative

2: Open Source C++ Programming tool like G++/GCC

COURSE OUTCOMES:

CO1: Design and implement basic and advanced data structures extensively

CO2: Design algorithms using graph structures

CO3: Design and develop efficient algorithms with minimum complexity using design techniques

CO4: Develop programs using various algorithms.

CO5: Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.

TOTAL: 60 PERIODS

REFERENCES:

1. Lipschutz Seymour, “Data Structures Schaum's Outlines Series”, Tata McGraw Hill, 3rd Edition, 2014.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.
3. http://www.coursera.org/specializations/data-structures-algorithms
4. http://www.tutorialspoint.com/data_structures_algorithms
5. http://www.geeksforgeeks.org/data-structures/

IF4111 APPLIED PROBABILITY AND STATISTICAL ANALYSIS LABORATORY L T P C

0 0 2 1

COURSE OBJECTIVES:

- Apply key concepts of probability, including discrete and continuous random variables, probability distributions, conditioning, independence, expectations, and variances.
- Analyze statistical data graphically using frequency distributions and cumulative frequency distributions.
- Analyze statistical data using measures of central tendency, dispersion and location.
- Identify the type of statistical situation to which different distributions can be applied.
- Apply the concepts of interval estimation and confidence intervals.

ACTIVITIES:

1: Scrape the LivingSocial/Groupon sites for the daily deals and develop a prediction of how successful the deal will be based on location/price/type of deal. You could use either the RCurl R package or the XML R package to scrape the data.

2: Does social media presence or influence affect the performance of an employee?

3: Determine the best number of clusters from Crime Dataset.

4: Download data on state of the union speeches from here (http://stateoftheunion.onetwothree.net/texts/index.html) and use the tm package in R to analyze the patterns of word use over time

5: Analysis of all the factors that contribute to low productivity in employees.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1: Translate real-world problems into probability models.
CO2: Derive the probability density function of transformation of random variables.
CO3: Use Poisson, exponential distributions to solve statistical problems..
CO4: How to derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions.
CO5: How to translate real-world problems into probability models.

IF 4201 **SOFTWARE INDUSTRIALIZATION** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To provide students with a theoretical understanding of current best practices in software engineering and its Lifecycle Models
- To provide students with practical experience to produce high-quality software with an emphasis on design quality and technical evaluation
- To do project management and cost estimation
- To gain knowledge of the System Analysis and Design concepts
- To understand software testing approaches
- To gain knowledge about agile modelling and DSDM with DevOps practices
- To have hands on experience in developing a software project by using various software engineering principles and methods in each of the phases of software development

UNIT I SOFTWARE ENGINEERING **9**

Introduction to Software Engineering: The evolving role of software - changing nature of software - software myths. A Generic view of process: Software engineering- a layered technology - a process framework - the capability maturity model integration (CMMI) - process patterns -process assessment - personal and team process models - Process models: The waterfall model - incremental process models - evolutionary process models - the unified process.

UNIT II REQUIREMENT ANALYSIS **9**

Requirement analysis and specification – Requirements gathering - Software Requirements: Functional and non-functional requirements - user requirements - system requirements- interface specification - the software requirements document - Requirements engineering process: Feasibility studies - requirements elicitation and analysis - requirements validation - requirements management -System models: Context models - behavioural models - data models - object models - structured methods and analysis.

UNIT III SOFTWARE ARCHITECTURE **9**

Creating an architectural design: software architecture - data design - architectural styles and patterns - architectural design - conceptual model of UML, basic structural modelling, class diagrams, sequence diagrams, collaboration diagrams, use case diagrams, component diagrams.Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe model

UNIT IV SOFTWARE TESTING **9**

Testing Strategies: A strategic approach to software testing - test strategies for conventional

software - black-box and white-box testing - validation testing - system testing - the art of debugging - Product metrics: Software quality - metrics for analysis model - metrics for design model - metrics for source code - metrics for testing - metrics for maintenance.

UNIT V SOFTWARE METHODOLOGIES 9

Agile Modelling with XP- Introduction, Agile Modelling – Principles, Comparing XP and Agile Modelling, Scrum Methodology- The roles of Scrum, Advantages of Scrum. Dynamic Systems Development Methodology- Introduction, Overview of DSDM, the Principles of DSDM, Phases of DSDM, Core Techniques Used in DSDM. XP Tools- Introduction, JAVA and XP, Tools and Philosophies, Open-source Toolkit. DevOps : Motivation-Cloud as a platform-Operations-Deployment

SUGGESTED ACTIVITIES:

1: Development of problem statement
2: Preparation of Software Requirement Specification Document, Design Documents and Testing Phase related documents
3: Preparation of Software Configuration Management and Risk Management related documents
4: Study and usage of any Design phase CASE tool
5: Performing the Design by using any Design phase CASE tools
6: Develop test cases for unit testing and integration testing
7: Develop test cases for various white box and black box testing techniques

SAMPLE PROJECTS:

1. Passport automation System
2. Book Bank
3. Online Exam Registration
4. Stock Maintenance System
5. Online course reservation system
6. E-ticketing
7. Software Personnel Management System
8. Credit Card Processing
9. E-book management System.
10. Recruitment system.

COURSE OUTCOMES:

CO1: Understand the advantages of various Software Development Lifecycle Models
CO2: Compare project management approaches as well as cost and schedule estimation strategies
CO3: Translate end-user requirements into system and software requirements and generate a high-level design of the system from the software requirements
CO4: Use UML diagrams for analysis and design
CO5: Understand the advantages Agile methodologies and of DevOps practices
CO6: Develop a simple testing report.

TOTAL :45 PERIODS

REFERENCES

1. Software Engineering, A practitioner's Approach- Roger S. Pressman, 8th edition, McGraw Hill International Edition

2. Software Engineering, Ian Sommerville, , Pearson Education, 10th edition, 2017
3. The unified modelling language user guide, 1e Grady Booch, James Rambaugh, Ivar Jacobson, Pearson Education, 2002
4. Bernd Bruegge, Alan H Dutoit, Object-Oriented Software Engineering, 3rd edition, Pearson Education, 2009
5. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, Fundamentals of Software Engineering, 2 nd edition, PHI Learning Pvt. Ltd., 2010
6. Craig Larman, Applying UML and Patterns, 3rd edition, Pearson Education, 2015
7. Len Bass, Ingo Weber and Liming Zhu, —DevOps: A Software Architect‘s Perspectivell, 1st edition, Pearson Education, 2016
8. Rajib Mall, Fundamentals of Software Engineering, 3 rd edition, PHI Learning Pvt. Ltd., 2009
9. Stephen Schach, Software Engineering 8th edition, McGraw-Hill, 2020
10. Agile Project Management: Creating Innovative Products (Agile Software Development Series) 2nd Edition, by Jim Robert High smith, 2009

IF4291 FULL STACK WEB APPLICATION DEVELOPMENT L T P C
3 0 2 4

COURSE OBJECTIVES:

- Develop TypeScript Application
- Develop Single Page Application (SPA)
- Able to communicate with a server over the HTTP protocol
- Learning all the tools need to start building applications with Node.js
- Implement the Full Stack Development using MEAN Stack

UNIT I FUNDAMENTALS & TYPESCRIPT LANGUAGE 10

Server-Side Web Applications. Client-Side Web Applications. Single Page Application. About TypeScript. Creating TypeScript Projects. TypeScript Data Types. Variables. Expression and Operators. Functions. OOP in Typescript. Interfaces. Generics. Modules. Enums. Decorators. Enums. Iterators. Generators.

UNIT II ANGULAR 10

About Angular. Angular CLI. Creating an Angular Project. Components. Components Interaction. Dynamic Components. Angular Elements. Angular Forms. Template Driven Forms. Property, Style, Class and Event Binding. Two way Bindings. Reactive Forms. Form Group. Form Controls. About Angular Router. Router Configuration. Router State. Navigation Pages. Router Link. Query Parameters. URL matching. Matching Strategies. Services. Dependency Injection. HttpClient. Read Data from the Server. CRUD Operations. Http Header Operations. Intercepting requests and responses.

UNIT III NODE.Js 10

About Node.js. Configuring Node.js environment. Node Package Manager NPM. Modules. Asynchronous Programming. Call Stack and Event Loop. Callback functions. Callback errors. Abstracting callbacks. Chaining callbacks. File System. Synchronous vs. asynchronous I/O. Path and directory operations. File Handle. File Synchronous API. File Asynchronous API. File Callback API. Timers. Scheduling Timers. Timers Promises API. Node.js Events. Event Emitter. Event

Target and Event API. Buffers. Buffers and TypedArrays. Buffers and iteration. Using buffers for binary data. Flowing vs. non-flowing streams. JSON.

UNIT IV EXPRESS.Js **7**

Express.js. How Express.js Works. Configuring Express.js App Settings. Defining Routes. Starting the App. Express.js Application Structure. Configuration, Settings. Middleware. body-parser. cookie-parser. express-session. response-time. Template Engine. Jade. EJS. Parameters. Routing. router.route(path). Router Class. Request Object. Response Object. Error Handling. RESTful.

UNIT V MONGODB **8**

Introduction to MongoDB. Documents. Collections. Subcollections. Database. Data Types. Dates. Arrays. Embedded Documents. CRUD Operations. Batch Insert. Insert Validation. Querying The Documents. Cursors. Indexing. Unique Indexes. Sparse Indexes. Special Index and Collection Types. Full-Text Indexes. Geospatial Indexing. Aggregation framework.

LIST OF EXPERIMENTS : **30**

1: Accessing the Weather API from Angular
2: Accessing the Stock Market API from Angular
3: Call the Web Services of Express.js From Angular
4: Read the data in Node.js from MongoDB
5: CRUD operation in MongoDB using Angular

COURSE OUTCOMES:

CO1: Develop basic programming skills using Javascript
CO2: Implement a front-end web application using Angular.
CO3: Will be able to create modules to organise the server
CO4: Build RESTful APIs with Node, Express and MongoDB with confidence.
CO5: Will learn to Store complex, relational data in MongoDB using Mongoose

TOTAL : 45 + 30=75 PERIODS

REFERENCES

1. Adam Freeman, Essential TypeScript, Apress, 2019
2. Mark Clow, Angular Projects, Apress, 2018
3. Alex R. Young, Marc Harter,Node.js in Practice, Manning Publication, 2014
4. Pro Express.js, Azat Mardan, Apress, 2015
5. MongoDB in Action, Kyle Banker, Peter Bakkum, Shaun Verch, Douglas Garrett, Tim Hawkins, Manning Publication, Second edition, 2016

BD4251 BIG DATA MINING AND ANALYTICS **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand the computational approaches to Modeling, Feature Extraction
- To understand the need and application of Map Reduce
- To understand the various search algorithms applicable to Big Data
- To analyse and interpret streaming data

- To learn how to handle large data sets in main memory and learn the various clustering techniques applicable to Big Data

UNIT I DATA MINING AND LARGE SCALE FILES 9

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques.

UNIT II SIMILAR ITEMS 9

Nearest Neighbor Search – Shingling of Documents – Similarity preserving summaries – Locality sensitive hashing for documents – Distance Measures – Theory of Locality Sensitive Functions – LSH Families – Methods for High Degree of Similarities.

UNIT III MINING DATA STREAMS 9

Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.

UNITIV LINK ANALYSIS AND FREQUENT ITEMSETS 9

Page Rank –Efficient Computation - Topic Sensitive Page Rank – Link Spam – Market Basket Model – A-priori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.

UNIT V CLUSTERING 9

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non -– Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to

CO1: Design algorithms by employing Map Reduce technique for solving Big Data problems.

CO2: Design algorithms for Big Data by deciding on the apt Features set .

CO3: Design algorithms for handling petabytes of datasets

CO4: Design algorithms and propose solutions for Big Data by optimizing main memory consumption

CO5: Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

REFERENCES:

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 3rd Edition, 2020.
2. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2012.
3. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT PRESS, 2001

WEB REFERENCES:

1. *https://swayam.gov.in/nd2_arp19_ap60/preview*
2. *https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/106104189/lec1.pdf*

ONLINE RESOURCES:

1. *https://examupdates.in/big-data-analytics/*
2. *https://www.tutorialspoint.com/big_data_analytics/index.htm*
3. *https://www.tutorialspoint.com/data_mining/index.htm*

CP4291	INTERNET OF THINGS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To Understand the Architectural Overview of IoT
- To Understand the IoT Reference Architecture and Real World Design Constraints
- To Understand the various IoT levels
- To understand the basics of cloud architectue
- To gain experience in Raspberry PI and experiment simple IoT application on it

UNIT I INTRODUCTION **9+6**

Internet of Things- Domain Specific IoTs - IoT and M2M-Sensors for IoT Applications–Structure of IoT– IoT Map Device- IoT System Management with NETCONF-YANG

UNIT II IoT ARCHITECTURE, GENERATIONS AND PROTOCOLS **9+6**

IETF architecture for IoT - IoT reference architecture -First Generation – Description & Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics

UNIT III IoT PROTOCOLS AND TECHNOLOGY **9+6**

SCADA and RFID Protocols - BACNet Protocol -Zigbee Architecture - 6LowPAN - CoAP -Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module

UNIT IV CLOUD ARCHITECTURE BASICS **9+6**

The Cloud types; IaaS, PaaS, SaaS.- Development environments for service development; Amazon, Azure, Google Appcloud platform in industry

UNIT V IOT PROJECTS ON RASPBERRY PI **9+6**

Building IOT with RASPBERRY PI- Creating the sensor project - Preparing Raspberry Pi - Clayster libraries – Hardware Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values - Exporting sensor data

SUGGESTED ACTIVITIES:

1. Develop an application for LED Blink and Pattern using arduino or Raspberry Pi
2. Develop an application for LED Pattern with Push Button Control using arduino or Raspberry Pi
3. Develop an application for LM35 Temperature Sensor to display temperature values using arduino or Raspberry Pi
4. Develop an application for Forest fire detection end node using Raspberry Pi device and sensor
5. Develop an application for home intrusion detection web application
6. Develop an application for Smart parking application using python and Django for web

application

COURSE OUTCOMES:

CO1: Understand the various concept of the IoT and their technologies
CO2: Develop the IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing
CO5: Develop and deploy the IoT application into cloud environment

TOTAL: 75 PERIODS

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things: A hands-on approach, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Florian Michahelles (Eds), Architecting the Internet of Things, Springer, 2011
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
4. Ovidiu Vermesan Peter Friess, 'Internet of Things – From Research and Innovation to Market Deployment', River Publishers, 2014
5. N. Ida, Sensors, Actuators and Their Interfaces: A Multidisciplinary Introduction, 2nd EditionScitech Publishers, 202014
6. Reese, G. (2009). Cloud Application Architectures: Building Applications and Infrastructure in the Cloud. Sebastopol, CA: O'Reilly Media, Inc. (2009)

IF4211 **TERM PAPER WRITING AND SEMINAR** **L T P C**
0 0 2 1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.
Activities to be carried out

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for papers (CFP) from your area.	3rd week	**3%** (the selected information must be area specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them, • Favour papers from well-known journals and conferences, • Favour "first" or "foundational" papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered	4th week	**6%** (the list of standard papers and reason for selection)
Reading and notes for first 5	Reading Paper Process • For each paper form a Table	5th week	**8%** (the table given

papers	answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	**8%** (this component will be evaluated based on the

			linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	**5%** (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%** (formatting, English, Clarity and linking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	**10%** (based on presentation and Viva-voce)

TOTAL: 30 PERIODS

IF4301 INFORMATION AND NETWORK SECURITY L T P C
3 0 0 3

COURSE OBJECTIVES:

- To introduce the concepts and models of security.
- To understand the risk assessment and security standard.
- To plan for business continuity and incident response plan.
- To estimate the level of security risk faced by an organisation and the countermeasures to handle the risk.
- To understand potential vulnerabilities and to develop a security blueprint.

UNIT I INFORMATION SECURITY 8

Introduction to Information Security - Security Issues - CIA Triad - Parkerian Hexad - Introduction

to Security Attacks - Types of Attacks - Threats, Vulnerabilities, and Risk - Risk Management - Incident Response Identification - Access Controls - Identity Verification - Authentication - Multifactor Authentication - Mutual Authentication - Passwords - Biometrics - Hardware Tokens.

UNIT II FUNDAMENTALS OF CRYPTOGRAPHY 10

Foundations of Cryptology - Cipher Methods - Cryptographic Algorithms - Kerckhoffs's Principles. Keyword Ciphers - One-Time Pads - Symmetric and Asymmetric Cryptography Techniques - Hash Functions - SHA - MD5 - Digital Signatures - Certificates - Modern Cryptographic Tools.

UNIT III INTRUSION DETECTION 9

Threat Models - Secure Communications - Intrusion Detection Systems - Intrusion Detection and Prevention Systems - Honeypots - Scanning and Analysis Tools - Traditional Reconnaissance and Attacks - Malicious Software - Preventive Measures - Intrusion Monitoring and Detection - Reactive Measures - Network-Based Intrusion Protection.

UNIT IV NETWORK SECURITY 9

Kerberos - IP Security - IP Security architecture - Key Management - Email Security - Pretty Good Privacy, S/MIME - Public Key Infrastructure - Traffic flow security - Firewalls – Design and Types of Firewalls - Personal Firewalls

UNIT V APPLICATION SECURITY 9

Software Development Vulnerabilities - Buffer Overflows - Race Conditions - Input Validation Attacks - Authentication Attacks - Authorization Attacks - Cryptographic Attacks - Web Security - Client-Side Attacks - Server-Side Attacks - Database Security - Protocol Issues - Unauthenticated Access - Arbitrary Code Execution - Privilege Escalation - Application Security Tools - Sniffers - Web Application Analysis Tools - Fuzzers

SUGGESTED ACTIVITIES:

1: In-class activity to learn about various security services and attacks.
2: Analyse risk for any real time applications and prepare a blueprint for security to control the risk.
3: Develop an attack success scenario and assess the potential damage.
4: Prepare the contingency planning documents for business continuity.
5: Discussion on scanning and analysis tools for identifying the vulnerabilities.

COURSE OUTCOMES:

After completing the course students will be able to

CO1: Apply the basic security models and policies required by the computing system.
CO2: Apply a cryptographic algorithm to build a secure application.
CO3: Monitor, detect and prevent intrusions in a network.
CO4: Predict the vulnerabilities in any computing system and propose a security solution.
CO5: Understand the importance of network security and risk management of an organization.

TOTAL :45 PERIODS

REFERENCES

1. Cryptography and Network Security : William Stallings, Pearson Education, 7th Edition
2. Security in Computing, Fifth Edition, by Charles P. Pfleeger, Pearson Education
3. Foundations of Information Security: A Straightforward Introduction, Jason Andress. No Starch Press, 2019

4. Fundamentals of information systems security, Kim, David, Solomon, and Michael G. Jones & Bartlett Learning, third edition, 2018
5. Information Security: Foundations, technologies and applications, Ali Ismail Awad, Michael Fairhurst. Institution of Engineering & Technology, 2018
6. Computer and Information Security Handbook, John R. Vacca. Morgan Kaufmann, 2017
7. Software-Defined Networking and Security, Dijiang Huang, Ankur Chowdhary, and Sandeep Pisharody. CRC Press, 2018

MU4251 DIGITAL IMAGE PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study fundamental concepts of digital image processing.
- To understand and learn image processing operations and restoration.
- To use the concepts of Feature Extraction
- To study the concepts of Image Compression.
- To expose students to current trends in the field of image segmentation.

UNIT I INTRODUCTION 9

Examples of fields that use digital image processing, fundamental steps in digital image processing, components of image processing system. Digital Image Fundamentals: A simple image formation model, image sampling and quantization, basic relationships between pixels. Image enhancement in the spatial domain: Basic gray-level transformation, histogram processing, enhancement using arithmetic and logic operators, basic spatial filtering, smoothing, and sharpening spatial filters, combining the spatial enhancement methods.

Suggested Activities:

- Discussion of Mathematical Transforms.
- Numerical problem solving using Fourier Transform.
- Numerical problem solving in Image Enhancement.
- External learning – Image Noise and its types.

Suggested Evaluation Methods:

- Tutorial – Image transforms.
- Assignments on histogram specification, histogram equalization and spatial filters.
- Quizzes on noise modeling.

UNIT II IMAGE RESTORATION 9

A model of the image degradation/restoration process, noise models, restoration in the presence of noise–only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the Fourier transform and the frequency domain, estimating the degradation function. Color Image Processing: Color fundamentals, color models, pseudo color image processing, basics of full–color image processing, color transforms, smoothing and sharpening, color segmentation

Suggested Activities:

- Discussion on Image Artifacts and Blur.
- Discussion of Role of Wavelet Transforms in Filter and Analysis.
- Numerical problem solving in Wavelet Transforms.
- External learning – Image restoration algorithms.

Suggested Evaluation Methods:

- Tutorial – Wavelet transforms.
- Assignment problems on order statistics and multi-resolution expansions.
- Quizzes on wavelet transforms.

UNIT III FEATURE EXTRACTION 9

Detection of discontinuities – Edge linking and Boundary detection- Thresholding- -Edge based segmentation-Region based Segmentation- matching-Advanced optimal border and surface detection- Use of motion in segmentation. Image Morphology – Boundary descriptors- Regional descriptors**.**

Suggested Activities:

- External learning – Feature selection and reduction.
- External learning – Image salient features.
- Assignment on numerical problems in texture computation.

Suggested Evaluation Methods:

- Assignment problems on feature extraction and reduction.
- Quizzes on feature selection and extraction.

UNIT IV IMAGE COMPRESSION 9

Fundamentals, image compression models, error-free compression, lossy predictive coding, image compression standards Morphological Image Processing: Preliminaries, dilation, erosion, open and closing, hit or miss transformation, basic morphological algorithms

Suggested Activities:

- Flipped classroom on different image coding techniques.
- Practical – Demonstration of EXIF format for given camera.
- Practical – Implementing effects quantization, color change.
- Case study of Google's WebP image format.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Assignment on image file formats

UNIT V IMAGE SEGMENTATION 9

Detection of discontinuous, edge linking and boundary detection, thresholding, region–based segmentation. Object Recognition: Patterns and patterns classes, recognition based on decision–theoretic methods, matching, optimum statistical classifiers, neural networks, structural methods – matching shape numbers, string matching.

Suggested Activities:

- Flipped classroom on importance of segmentation.

Suggested Evaluation Methods:

- Tutorial – Image segmentation and edge detection.

COURSE OUTCOMES:

CO1: Apply knowledge of Mathematics for image processing operations

CO2: Apply techniques for image restoration.

CO3: Identify and extract salient features of images.

CO4: Apply the appropriate tools (Contemporary) for image compression and analysis.

CO5:Apply segmentation techniques and do object recognition.

TOTAL: 45 PERIODS

REFERENCES

1. Digital Image Processing, Rafeal C.Gonzalez, Richard E.Woods, Second Edition, Pearson Education/PHI., 2002
2. Digital Image Processing, Sridhar S, Second Edition, Oxford University Press, 2016
3. Introduction to Digital Image Processing with Matlab, Alasdair McAndrew, Thomson Course Technology, .Brooks/Cole 2004
4. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision", Second Edition, Thompson Learning, 2007.
5. Digital Image Processing using Matlab, Rafeal C.Gonzalez, Richard E.Woods, Steven L. Eddins, Pearson Education.Second Edition, 2017

IF4001 GAME DEVELOPMENT L T P C

3 0 0 3

COURSE OBJECTIVES:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and toolkits.
- To learn and develop simple games using the Pygame environment.

UNIT I 3D GRAPHICS FOR GAME PROGRAMMING 9

Game – Definition – Genres of Games, Basics of 2D and 3D Graphics, Game Objects Design – 2D and 3D Transformations – Projections – Colour Models – Illumination and Shader Models – Animation – Controller based Animation.

UNIT II GAME DESIGN PRINCIPLES 8

Character Development, Storyboard Development for Gaming – Script Design – Script Narration – Game Balancing –Core Mechanics – Principles of Level Design – Proposals – Writing for Pre-production, Production and Post-Production

UNIT III GAME ENGINE DESIGN 8

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms – Algorithms for Game Engine – Collision Detection – Game Logic – Game AI – Path Finding

UNIT IV OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS 10

Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity –Single player and Multiplayer games.

UNIT V GAME DEVELOPMENT USING PYGAME 10

Developing 2D and3D Interactive Games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating Music and Sound – Asset Creations – Game Physics Algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based Games – Overview of Puzzle Games.

SUGGESTED ACTIVITIES:

1: External learning - Writing Unity scripts and assets.
2: Practical - Implementation of simple games.

3: External learning on Unity Game Engine.
4: Practical - Installation of Unity and scripts.
5: Practical - Pygame routines for character rendering, transformations and sound processing.

COURSE OUTCOMES:

CO1: To have a fundamental understanding of the concepts of 2D and 3D graphics.
CO2: Apply design and development principles in the construction of games.
CO3: Understand the implementation of gaming engines.
CO4: Understand foundational language and platforms of game development technology.
CO5: Will gain experience with various game developments like Pygame and Unity.

TOTAL : 45 PERIODS

REFERENCES

1. Jung Hyun Han, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 2011.
2. Ernest Adams, “Fundamentals of Game Design”, 3rd Edition, New Riders Press, 2013.
3. David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, Second Edition, CRC Press, 2006.
4. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, Apress Publishers, 2007.
5. Paul Craven, “Python Arcade games”, Apress Publishers, 2016.
6. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, Addison-Wesley Professional, 1st Edition, 2013.
7. Tracy Fullerton, Game Design Workshop: A Playcentric Approach to Creating Innovative Games, A K Peters/CRC Press, 4th Edition,2018.
8. Paris Buttfield-Addison, Jon Manning, Tim Nugent, “Unity Game Development Cookbook: Essentials for Every Game”, OReilly, 1st edition, 2019.
9. Jesse Schell, “The Art of Game Design: A Book of Lenses”, 3rd Edition, CRC Press, 2019

MP4152 WIRELESS COMMUNICATIONS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basic concepts in cellular communication.
- To learn the characteristics of wireless channels.
- To understand the impact of digital modulation techniques in fading.
- To get exposed to diversity techniques in wireless communication.
- To acquire knowledge in multicarrier systems.

UNIT I CELLULAR CONCEPTS 9

Frequency Reuse – Channel Assignment Strategies – Handoff Strategies – Interference and system capacity- Co-Channel Interference- Adjacent Channel Interference – Trunking and Grade of service – Improving coverage & capacity in cellular systems-Cell Splitting- Sectoring- Repeaters for Range Extension-Microcell Zone Concept.

UNIT II THE WIRELESS CHANNEL 9

Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Side Information at Receiver – Channel Side Information at Transmitter and

Receiver –Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT III PERFORMANCE OF DIGITAL MODULATION OVER WIRELESS CHANNELS **9**

Performance of flat fading and frequency selective fading – Impact on digital modulation techniques –- Outage Probability– Average Probability of Error –– Combined Outage and Average Error Probability – Doppler Spread – Inter symbol Interference.

UNIT IV DIVERSITY TECHNIQUES **9**

Realization of Independent Fading Paths – Receiver Diversity – Selection Combining – Threshold Combing – Maximal-Ratio Combining – Equal - Gain Combining – Capacity with Receiver diversity – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme– Transmit & Receive Diversity-MIMO Systems.

UNIT V MULTICARRIER MODULATION **9**

Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation – Peak to average Power Ratio- Frequency and Timing offset.

SUGGESTED ACTIVITIES:

1: Survey on various features of cellular networks
2: Study the nature of cellular networks
3: A comparative study on the performance of different digital modulation techniques
4: Perform a review of various diversity techniques in wireless communication
5: Presentation on design of multicarrier systems for 5G

COURSE OUTCOMES:

CO1: Design solutions for cellular communication
CO2: Determine the capacity of wireless channels
CO3: Analyze the performance of the digital modulation techniques in fading channels
CO4: Apply various diversity techniques in wireless communication
CO5: Design multicarrier systems in wireless communication

TOTAL: 45 PERIODS

REFERENCES:

1. Theodore.S. Rappaport, “Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, India, 2010.
2. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.
3. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Wiley Series in Telecommunications, Cambridge University Press, 2005.
4. Saad Z. Asif, “5G Mobile Communications Concepts and Technologies” CRC press – 2019.
5. Keith Q. T. Zhang, “Wireless Communications: Principles, Theory and Methodology” 1st edition, John Wiley & Sons, 2016.
6. Ramjee Prasad, "OFDM for Wireless Communication Systems", Artech House, 2004.

IF4091 COMPILER OPTIMIZATION TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the optimization techniques used in compiler design.
- To be aware of the various computer architectures that support parallelism.
- To become familiar with the theoretical background needed for code optimization.
- To understand the techniques used for identifying parallelism in a sequential program.
- To learn the various optimization algorithms.

UNIT I INTRODUCTION 9

Language Processors - The Structure of a Compiler – The Evolution of Programming Languages- The Science of Building a Compiler – Applications of Compiler Technology Programming Language Basics - The Lexical Analyzer Generator -Parser Generator - Overview of Basic Blocks and Flow Graphs - Optimization of Basic Blocks - Principle Sources of Optimization.

UNIT II INSTRUCTION-LEVEL PARALLELISM 9

Processor Architectures – Code-Scheduling Constraints – Basic-Block Scheduling –Global Code Scheduling – Advanced code motion techniques – Interaction with Dynamic Schedulers- Software Pipelining.

UNIT III OPTIMISING FOR PARALLELISM AND LOCALITY-THEORY 9

Basic Concepts – Matrix-Multiply: An Example - Iteration Spaces - Affine Array Indexes – Data Reuse- Array data dependence Analysis.

UNIT IV OPTIMISING FOR PARALLELISM AND LOCALITY – APPLICATION 9

Finding Synchronisation - Free Parallelism – Synchronisation Between Parallel Loops – Pipelining – Locality Optimizations – Other Uses of Affine Transforms.

UNIT V INTERPROCEDURAL ANALYSIS 9

Basic Concepts – Need for Interprocedural Analysis – A Logical Representation of Data Flow – A Simple Pointer-Analysis Algorithm – Context Insensitive Interprocedural Analysis - Context-Sensitive Pointer-Analysis - Datalog Implementation by Binary Decision Diagrams.

COURSE OUTCOMES:

CO1: Design and implement techniques used for optimization by a compiler.
CO2: Modify the existing architecture that supports parallelism.
CO3: Modify the existing data structures of an open source optimising compiler.
CO4: Design and implement new data structures and algorithms for code optimization.
CO5: Critically analyse different data structures and algorithms used in the building of an optimising compiler.

TOTAL : 45 PERIODS

REFERENCES

1. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman, “Compilers:Principles, Techniques and Tools”, Second Edition, Pearson Education,2008.
2. Randy Allen, Ken Kennedy, “Optimizing Compilers for Modern Architectures: A

Dependence-based Approach", Morgan Kaufmann Publishers, 2002.
3. Steven S. Muchnick, "Advanced Compiler Design and Implementation",Morgan Kaufmann Publishers - Elsevier Science, India, 2007
4. John Hopcroft, Rajeev Motwani, Jeffrey Ullman, "Introduction To Automata Theory Languages, and Computation", Third Edition, Pearson Education, 2007.
5. Torbengidius Mogensen, "Basics of Compiler Design", Springer, 2011.
6. Charles N, Ron K Cytron, Richard J LeBlanc Jr., "Crafting a Compiler", Pearson Education, 2010.

IF4002 **MULTIMEDIA TECHNOLOGIES** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To enrich student learning in multimedia systems.
- To train the students to acquire knowledge in multimedia related technologies.
- To acquire knowledge about multimedia techniques to enhance quality of service.
- To acquire knowledge in the development of multimedia systems.
- To learn about multimedia elements in a comprehensive way.

UNIT I INTRODUCTION TO MULTIMEDIA ELEMENTS 9

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

UNIT II MULTIMEDIA COMPRESSION 9

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

UNIT III MULTIMEDIA ARCHITECTURES 8

User Interfaces – OS Multimedia Support – Multimedia Extensions – Hardware Support – Distributed Multimedia Applications – Real Time Protocols – Play Back Architectures – Synchronisation – Document and Document Architecture – Hypermedia Concepts – Hypermedia Design – Digital Copyrights – Digital Library – Multimedia Archives.

UNIT IV MULTIMEDIA OPERATING SYSTEM AND DATABASES 10

Real Time – Resource Management – Process Management – File Systems – Interprocess Communication and Synchronisation – Memory Management – Device Management – Characteristics of MDBMS – Data Analysis – Data Structures – Operations on Data – Integration in a Database Model.

UNIT V MULTIMEDIA COMMUNICATION & APPLICATIONS 9

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

SUGGESTED ACTIVITIES:

1: Assignments on creativity and visual appearance.
2: Practical - Creating and editing visual elements using tools like Audacity, Fontographer, Blender, Photoshop and flash.
3: Flipped classroom on different compression techniques.
4: Flipped classroom on concepts of Multimedia hardware architectures.
5: Flipped classroom on multimedia database and indexing structures.

COURSE OUTCOMES:

CO1: Use the multimedia elements effectively.
CO2: Encode and decode the multimedia elements.
CO3: Understand the underlying multimedia computing architectures used for media development.
CO4: Develop effective strategies to deliver quality-of-experience in multimedia applications.
CO5: Design and implement algorithms and techniques related to multimedia objects.

TOTAL :45 PERIODS

REFERENCES

1. Ralf Steinmetz, Klara Nahrstedt, “Multimedia Computing, Communications, and Applications”, Pearson India, 2009.
2. Ranjan Parekh, “Principles of Multimedia”, Second Edition, McGraw Hill Education, 2017.
3. Ralf Steinmetz, Klara Nahrstedt, “Multimedia Systems”, Springer, 2004.
4. Tay Vaughan, “Multimedia: Making it Work”, McGraw – Hill Education, Ninth Edition, 2014.
5. Jerry D. Gibson, Toby Berger, Tom Lookabaugh, Dave Lindergh, Richard L. “Baker Digital Compression for Multimedia: Principles and Standards”, Elsevier, 2006.

IF4092 COMPUTER VISION L T P C
3 0 0 3

COURSE OBJECTIVES:

- Articulate & apply standard computer vision concepts
- Implement standard image processing tasks
- Applying Clustering concept for Image Classification
- Identify practical constraints in computer vision application
- Architecture of an existing computer vision pipeline based on deep learning models

UNIT I COMPUTER VISION 8

About Computer Vision. Components of an Image Processing System. Image Resolution. Image Formats. Colour Spaces. Fundamental of Image Processing. Visual Inspection System. Biomedical Imaging Methods. Image Thresholding. Based Image Retrieval. Human Visual Inception. Image Formation. Geometric Properties. 3D Imaging. Stereo Images.

UNIT II PIXEL-BASED MANIPULATIONS & TRANSFORMATION 8

Visual properties. Pixel colour manipulation. Colour Change with Pixel Position. Colour Change with Pixel Distance. Colour Change with Trigonometric Functions. Randomness. Drawing with existing images. Blending multiple images. Image transformation. Image orientation. Image resizing. Affine transform. Known Affine Transformations. Unknown Affine Transformations.

Perspective transform. Linear vs. polar coordinates. Three-dimensional space. General pixel mapping.

UNIT III STRUCTURE IDENTIFICATION 11

Image preparation. Conversion to grayscale. Conversion to a black-and-white image. Morphological operations (erode, dilate). Blur operations (smoothing)Edge detection. First Derivative Edge Detectors. Second Derivative Edge Detectors. Multispectral Edge Detection. Line detection. Circle detection. Contours processing. Finding the contours. Bounding box. Minimum area rectangle. Convex hull. Polygon approximation. Testing a point in contour. Checking intersection. Shape detection. Moravec Corner Detection. Harris Corner Detection. FAST Corner Detection. SIFT.

UNIT IV CLUSTERING IMAGES & IMAGE RETRIEVAL 9

About Transfer Learning. Extract features. SciPy Clustering Package. K-Means Clustering. Clustering Images. Principal Components. Clustering Pixels. Hierarchical Clustering. Spectral Clustering. Fast Fourier Transforms. -Based Image Retrieval. Indexing Images. Searching the Database for Images. Querying with an Image. Benchmarking and Plotting the Results. Ranking Results Using Geometry.

UNIT V IMAGE CLASSIFICATION USING DEEP LEARNING 9

Working with Image Datasets. k-NN: A Simple Classifier. k-NN Hyperparameters. Gradient Descent. Loss Functions. Stochastic Gradient Descent (SGD). Regularisation. The Perceptron Algorithm. Backpropagation and Multi-layer Networks. Weight Initialization. Constant Initialization. Uniform and Normal Distributions. CNN Building Blocks. Image Classification.

SUGGESTED ACTIVITIES:

1: Identify and List various noises in the Image.
2: Identify Image Manipulation
3: Add colour descriptors and improve the search results.
4: Hierarchical k-means is a clustering method that applies k-means recursively to the clusters to create a tree of incrementally refined clusters
5: Image Classification using CNN

TOTAL:45 PERIODS

COURSE OUTCOMES:

CO1: Understand the basic knowledge, theories and methods of computer vision.
CO2: to understand the essentials of image processing concepts through mathematical interpretation.
CO3: Demonstrate a knowledge of a broad range of fundamental image processing and image analysis techniques
CO4: Apply Clustering algorithms for clustering.
CO5: Analyse cognitive tasks including image classification, recognition and detection through deep learning.

REFERENCES

1. Pro Processing for Images and Computer Vision with OpenCV, Bryan WC Chung, Apress, 2017
2. Programming Computer Vision with Python, Jan Erik Solem, O'Reilly Media, 2012
3. A PRACTICAL INTRODUCTION TO COMPUTER VISION WITH OPENCV, Kenneth Dawson-Howe, Wiley, 2014

4. Practical Computer Vision Applications Using Deep Learning with CNNs: With Detailed Examples in Python Using TensorFlow and Kivy, Ahmed Fawzy Gad, Apress. 2018
5. Computer Vision Principles, Algorithms, Applications, Learning E.R. Davies, Academic Press, 5th edition, 2017

MP4092 HUMAN COMPUTER INTERACTION L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn the foundations of Human Computer Interaction.
- Understanding Interaction Styles and to become familiar with the design technologies for individuals and persons with disabilities.
- To understand the process of Evaluation of Interaction Design.
- To clarify the significance of task analysis for ubiquitous computing
- To get insight on web and mobile interaction.

UNIT I FOUNDATIONS OF HCI 9

Context of Interaction –Ergonomics - Designing Interactive systems – Understanding Users-cognition and cognitive frameworks, User Centred approaches Usability, Universal Usability, Understanding and conceptualizing interaction, Guidelines, Principles and Theories Importance of User Interface: Definition-Importance of good design-Benefits of good design-Human-centered development and Evaluation-Human Performance models-A Brief history of screen design.

UNIT II INTERACTION STYLES 9

GUI: Popularity of graphics - The concept of direct manipulation - Graphical system -Characteristics - Web user - Interface Popularity - Characteristics and Principles of User Interface.
Understanding interaction styles, Direct Navigation and Immersive environments, Fluid navigation, Expressive Human and Command Languages, Communication and Collaboration Advancing the user experience, Timely user Experience, Information search, Data Visualization Design process: Human Interaction with computers - Importance of Human Characteristics - Human Consideration - Human Interaction Speeds and Understanding Business Junctions.

UNIT III VALUATION OF INTERACTION 9

Evaluation Techniques- assessing user experience- usability testing – Heuristic evaluation and walkthroughs, analytics predictive models. Cognitive models, Socio-organizational issues and stakeholder requirements, Communication and collaboration models

UNIT IV MODELS AND THEORIES 9

Task analysis, dialog notations and design, Models of the system, Modeling rich interaction, Ubiquitous computing

UNIT V WEB AND MOBILE INTERACTION 9

Hypertext, Multimedia and WWW, Designing for the web Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow. Use Transitions-Lookup patterns-Feedback patterns Mobile apps, Mobile navigation, content and control idioms, Multi-touch gestures, Inter-app integration, Mobile web

COURSE OUTCOMES:

CO1: Understand the basics of human computer interactions via usability engineering and cognitive modeling.

CO2: Understand the basic design paradigms, complex interaction styles.

CO3: Understand the models and theories for user interaction

CO4: Examine the evaluation of interaction designs and implementations.

CO5: Elaborate the above issues for web and mobile applications.

TOTAL: 45 PERIODS

REFERENCES

1. Ben Shneiderman, Catherine Plaisant, Maxine Cohen, Steven Jacobs, NiklasElmqvist,"Designing the User Interface: Strategies for Effective Human-Computer Interaction",Sixth Edition, Pearson Education, 2016.
2. Alan Dix, Janet Finlay, G D Abowd and Russel Beale, "Human Computer Interaction", Pearson Education, Third Edition, 2004.
3. Helen Sharp Jennifer Preece Yvonne Rogers, "Interaction Design: Beyond Human-Computer Interaction", Wiley, 5th Edition, 2019.
4. Alan Cooper,RobertReimann, David Cronin, Christopher Noessel,"About Face: The Essentials of Interaction Design", 4th Edition, Wiley, 2014.
5. Donald A. Norman, "Design of Everyday Things", MIT Press, 2013.
6. Wilbert O Galitz, "The Essential Guide to User Interface Design", Third Edition, Wiley India Pvt., Ltd., 2007.

IF4003 **CYBER FORENSICS** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- Emphasise the importance of digital forensics
- Can conduct a digital investigation in an organised and systematic way
- Understand the in-depth concept of Network Forensics
- Understand the in-depth concept of Mobile and Cloud Forensics
- Understand and perform basic static and dynamic malware analysis

UNIT I **FORENSIC FUNDAMENTALS** **9**

Legal aspects. Laws and regulations. Rules of evidence. Digital forensic fundamentals. A brief history. The digital forensic process. Identification. Preservation. Collection. Proper evidence handling. Chain of custody. Examination. Analysis. Presentation. Digital forensic lab. Physical security. Tools. Hardware. Forensics Investigation Process. Incident. Identification. Seizure. Imaging. Hashing. Analysis. Reporting. Preservation. Forensic Protocol for Evidence Acquisition. Digital Forensics Standards and Guidelines. Digital Evidence. Write Blockers. What Is a Forensic Triage?. What Is a Cybercrime?.

UNIT II **NETWORK FORENSICS** **9**

Network Evidence – Types of Network Monitoring – Setting Up a Network Monitoring System –

Network Data Analysis – Email Clients – Email Tracing – Internet Fraud – Spam Investigations, Network Security and Forensic Techniques - Reconnaissance techniques, Recovery of protected data - Encrypted media - Password cracking, Reporting.

UNIT III MOBILE FORENSICS 9

Acquisition Protocol- Unlocking with Face ID or Touch ID - Android Operating System. Rooting an Android Device - Android Debug Bridge- Methods for Screen Lock Bypass- Manual Extraction - Physical Acquisition. Tools for Image Extraction - Image Extraction of an Android Device - JTAG-Chip-Off - Micro-read -Challenges in Mobile Forensics- iOS Operating System-iOS Device Boot Process-Jailbreak vs. No Jailbreak-iOS File System and Architecture- iTunes.

UNIT IV CLOUD FORENSICS 9

Cloud Forensics. Cloud Computing Models. Defining Cloud Forensics. Server-Side Forensics. Client-Side Forensics. Challenges in Cloud Forensics. Artifacts in Cloud Forensics. Log Files of Browsers. Physical Memory. Registry. For Mobile Devices. Use of Cloud Forensics.

UNIT V MALWARE FORENSICS 9

Malware analysis overview. Types of Malware. Viruses. Worms. Trojan. Rootkits. Spyware. Adware. Exploits. Ransomware. Bot. Static analysis. Dynamic analysis. Analysing malware. Static analysis. Pestudio. Remnux. Dynamic analysis. Process Explorer.

SUGGESTED ACTIVITIES:

1: Analysis Network Forensics
2: Implement forensics trace from mobile phone
3: Implement Forensics on Android and iPhone Mobiles
4: Implement Cloud Forensics on AWS and Azure
5: Implement Static and Dynamic Malware Forensics

COURSE OUTCOMES:

CO1: Can explain and properly document the process of digital forensics analysis.
CO2: Understand the network attacks and forensic tools used for network forensics.
CO3: understand and analyse the different methods used for data recovery, evidence collection and data seizure from the mobile devices
CO4: Analyzes the principles, theories, and practice of cloud forensics.
CO5: Understand and analyse malware behaviour, including launching, encoding, and network signatures.

TOTAL: 45 PERIODS

REFERENCES

1. Practical Cyber Forensics, Niranjan Reddy. Apress, First Edition, 2019
2. Digital Forensics and Incident Response, Gerard Johansen. Packt Publishing, Second Edition, 2020
3. Fundamentals of Digital Forensics, Kävrestad and Joakim. Springer, First Edition 2018
4. The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics by John Sammons, Second Edition, 2012
5. Digital Forensics, André Årnes. Wiley, 2017

ML4151 **ARTIFICIAL INTELLIGENCE** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To understand basic problem solving strategies.
- To outline game theory based search and constraint satisfaction
- To study knowledge representation techniques
- To explore reasoning and planning associated with AI.
- To study the techniques of knowledge representation.
- To understand probabilistic and other types of reasoning
- To discuss ethical and safety issues associated with AI

UNIT I INTRODUCTION AND PROBLEM SOLVING 9

Artificial Intelligence -Introduction - Problem-solving -Solving Problems by Searching – Uninformed Search Strategies -Informed (Heuristic) Search Strategies - Local Search - Search in Partially Observable Environments

UNIT II ADVERSARIAL SEARCH AND CONSTRAINT SATISFACTION PROBLEMS 9

Game Theory- Optimal Decisions in Games - Heuristic Alpha--Beta Tree Search- Monte Carlo Tree Search - Stochastic Games - Partially Observable Games - Limitations of Game Search Algorithms Constraint Satisfaction Problems (CSP)– Examples - Constraint Propagation-Backtracking Search for CSPs - Local Search for CSPs

UNIT III KNOWLEDGE, REASONING AND PLANNING 9

First Order Logic – Inference in First Order Logic -Using Predicate Logic - Knowledge Representation - Issues -Ontological Engineering - Categories and Objects – Reasoning Systems for Categories - Planning -Definition -Algorithms -Heuristics for Planning -Hierarchical Planning

UNIT IV UNCERTAIN KNOWLEDGE AND REASONING 9

Quantifying Uncertainty - Probabilistic Reasoning - Probabilistic Reasoning over Time Probabilistic Programming -Making Simple Decisions - Making Complex Decisions - Case Based Reasoning –Explanation-Based Learning – Evolutionary Computation

UNIT V PHILOSOPHY, ETHICS AND SAFETY OF AI 9

The Limits of AI – Knowledge in Learning –Statistical Learning Methods – Reinforcement Learning - Introduction to Machine Learning and Deep Learning -Can Machines Really Think? - Distributed AI Artificial Life-The Ethics of AI - Interpretable AI- Future of AI - AI Components -AI Architectures

TOTAL : 45 PERIODS

SUGGESTED ACTIVITIES:

1. Solve puzzles with uninformed and informed searches.
2: Reasoning methods through puzzles and real life scenarios
3: Ontology creation using Protégé
4: Give example scenarios where probabilistic reasoning and case based reasoning can be applied
5: Discuss some case studies and their ethical issues

COURSE OUTCOMES:

CO1: Implement any three problem solving methods for a puzzle of your choice
CO2: Understand Game playing and implement a two player game using AI techniques
CO3: Design and Implement an example using predicate Logic
CO4: Implement a case based reasoning system
CO5: Discuss some methodologies to design ethical and explainable AI systems

REFERENCES:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence: A Modern Approach”, Pearson, 4th Edition, 2020.
2. Zhongzhi Shi “Advanced Artificial Intelligence”, World Scientific; 2019.
3. Kevin Knight, Elaine Rich, Shivashankar B. Nair, “Artificial Intelligence”, McGraw Hill Education; 3rd edition, 2017
4. Richard E. Neapolitan, Xia Jiang, “Artificial Intelligence with an Introduction to Machine Learning”, Chapman and Hall/CRC; 2nd edition, 2018
5. Dheepak Khemani, “A first course in Artificial Intelligence”, McGraw Hill Education Pvt Ltd., NewDelhi, 2013.
6. Nils J. Nilsson, “Artificial Intelligence: A New Synthesis”, Morgan Kaufmann Publishers Inc; Second Edition, 2003.

MU4153 PRINCIPLES OF MULTIMEDIA L T P C
3 0 0 3

COURSE OBJECTIVES:

- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION 9

Introduction to Multimedia – Characteristics of Multimedia Presentation – Multimedia Components – Promotion of Multimedia Based Components – Digital Representation – Media and Data Streams – Multimedia Architecture – Multimedia Documents, Multimedia Tasks and Concerns, Production, sharing and distribution, Hypermedia, WWW and Internet, Authoring, Multimedia over wireless and mobile networks.

Suggested Activities:

1. Flipped classroom on media Components.
2. External learning – Interactive presentation.

Suggested Evaluation Methods:

1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

UNIT II ELEMENTS OF MULTIMEDIA 9

Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:

1. Flipped classroom on different file formats of various media elements.
2. External learning – Adobe after effects, Adobe Media Encoder, Adobe Audition.

Suggested Evaluation Methods:

1. Demonstration on after effects animations.
2. Quizzes on file formats and color models.

UNIT III MULTIMEDIA TOOLS 9

Authoring Tools – Features and Types – Card and Page Based Tools – Icon and Object Based Tools – Time Based Tools – Cross Platform Authoring Tools – Editing Tools – Painting and Drawing Tools – 3D Modeling and Animation Tools – Image Editing Tools – Sound Editing Tools – Digital Movie Tools.

Suggested Activities:

1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.

Suggested Evaluation Methods:

1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.

UNIT IV MULTIMEDIA SYSTEMS 9

Compression Types and Techniques: CODEC, Text Compression: GIF Coding Standards, JPEG standard – JPEG 2000, basic audio compression – ADPCM, MPEG Psychoacoustics, basic Video compression techniques – MPEG, H.26X – Multimedia Database System – User Interfaces – OS Multimedia Support – Hardware Support – Real Time Protocols – Play Back Architectures – Synchronization – Document Architecture – Hypermedia Concepts: Hypermedia Design – Digital Copyrights, Content analysis.

Suggested Activities:

1. Flipped classroom on concepts of multimedia hardware architectures.
2. External learning – Digital repositories and hypermedia design.

Suggested Evaluation Methods:

1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

UNIT V MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS 9

ADDIE Model – Conceptualization – Content Collection – Storyboard–Script Authoring Metaphors – Testing – Report Writing – Documentation. Multimedia for the web and mobile platforms. Virtual

Reality, Internet multimedia content distribution, Multimedia Information sharing – social media sharing, cloud computing for multimedia services, interactive cloud gaming. Multimedia information retrieval.

Suggested Activities:

1. External learning – Game consoles.
2. External learning – VRML scripting languages.

Suggested Evaluation Methods:

1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.
CO4: Design and implement algorithms and techniques applied to multimedia objects.
CO5: Design and develop multimedia applications following software engineering models.

REFERENCES:

1. Li, Ze-Nian, Drew, Mark, Liu, Jiangchuan, “Fundamentals of Multimedia”, Springer, Third Edition, 2021.
2. Prabhat K.Andleigh, Kiran Thakrar, “MULTIMEDIA SYSTEMS DESIGN”, Pearson Education, 2015.
3. Gerald Friedland, Ramesh Jain, “Multimedia Computing”, Cambridge University Press, 2018. (digital book)
4. Ranjan Parekh, “Principles of Multimedia”, Second Edition, McGraw-Hill Education, 2017

NE4071 WIRELESS SENSOR NETWORKS AND PROTOCOLS L T P C
3 0 0 3

COURSE OBJECTIVES:

- To learn about the issues in the design of wireless ad hoc networks
- To understand the working of protocols in different layers of mobile ad hoc and sensor networks
- To expose the students to different aspects in sensor networks
- To understand various security issues in ad hoc and sensor networks and solutions to the issues

UNIT I WIRELESS SENSOR NETWORK ARCHITECTURE **9**

Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards - Physical layer and transceiver design considerations.

UNIT II MAC & ROUTING IN WIRELESS SENSOR NETWORKS 9

Introduction – Applications – Challenges – Sensor network architecture – MAC Protocols for wireless sensor networks – Low duty cycle protocols and wakeup concepts – Contention-Based protocols – Schedule-Based protocols – IEEE 802.15.4 Zig bee – Topology Control – Routing

Protocols

UNIT III TRANSPORT & QOS IN WIRELESS SENSOR NETWORKS 9

Data-Centric and Contention-Based Networking – Transport Layer and QoS in Wireless Sensor Networks – Congestion Control – In-network processing – Operating systems for wireless sensor networks – Examples

UNIT IV SECURITY IN AD HOC AND SENSOR NETWORKS 9

Security Attacks – Key Distribution and Management – Intrusion Detection – Software based Antitamper techniques – Watermarking techniques – Defense against routing attacks - Secure Ad hoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS

UNIT V TOOLS FOR WSN 9

TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming.

COURSE OUTCOMES:

CO1: Identify different issues in wireless ad hoc and sensor networks
CO2: To analyze protocols developed for ad hoc and sensor networks
CO3: To identify and understand security issues in ad hoc and sensor networks
CO4: To learn the significance of Transport layer and QoS in wireless sensor networks.
CO5: To analyze the tools used for Wireless Sensor Networks

TOTAL: 45 PERIODS

REFERENCES

1. Anna Hac, Wireless Sensor Network Designll, John Wiley & Sons, 2003.
2. Holger Karl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, Inc., 2007.
3. Erdal Çayırcı , Chunming Rong, “Security in Wireless Ad Hoc and Sensor Networks”, John Wiley and Sons, 2009.
4. C.Siva Ram Murthy and B.S.Manoj, “Ad Hoc Wireless Networks – Architectures and Protocols, 1e”, Pearson Education, 2006.
5. Carlos De Morais Cordeiro, Dharma Prakash Agrawal, “Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition)”, World Scientific Publishing, 2011.
6. Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley and Sons, 2010
7. Adrian Perrig, J. D. Tygar, "Secure Broadcast Communication: In Wired and Wireless Networks", Springer, 2006.

CP4093 INFORMATION RETRIEVAL TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of information retrieval with pertinence to modeling, query operations and indexing
- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the various applications of information retrieval giving emphasis

to multimedia IR, web search

- To get an understanding of machine learning techniques for text classification and clustering.
- To understand the concepts of digital libraries

UNIT I INTRODUCTION: MOTIVATION 9

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval –Retrieval Evaluation – Open-Source IR Systems–History of Web Search – Web Characteristics–The impact of the web on IR ––IR Versus Web Search–Components of a Search engine.

UNIT II MODELING 9

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

UNIT III INDEXING 9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency

UNIT IV EVALUATION AND PARALLEL INFORMATION RETRIEVAL 9

Traditional Effectiveness Measures – Statistics in Evaluation – Minimizing Adjudication Effect – Nontraditional Effectiveness Measures – Measuring Efficiency – Efficiency Criteria –Queueing Theory – Query Scheduling – Parallel Information Retrieval – Parallel Query Processing – MapReduce

UNIT V SEARCHING THE WEB 9

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.

COURSE OUTCOMES:

CO1: Build an Information Retrieval system using the available tools.
CO2: Identify and design the various components of an Information Retrieval system.
CO3: Categorize the different types of IR Models.
CO4: Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
CO5: Design an efficient search engine and analyze the Web content structure.

TOTAL: 45 PERIODS

REFERENCES

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, “Introduction to Information Retrieval, Cambridge University Press, First South Asian Edition, 2008.
2. Stefan Buttcher, Implementing and Evaluating Search Engines, The MIT Press, Cambridge, Massachusetts London, England, 2016.
3. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, “Modern Information Retrieval: The

concepts and Technology behind Search (ACM Press Books), Second Edition, 2011.
4. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, “Information Retrieval

IF4095 SOCIAL NETWORK ANALYSIS L T P C
3 0 0 3

COURSE OBJECTIVES:

- Formalise different types of entities and relationships as nodes and edges and represent this information as relational data.
- Understand the fundamental concepts in analyzing the large-scale data that are derived from social networks
- Understand the basic concepts and principles of different theoretical models of social networks analysis.
- Transform data for analysis using graph-based and statistics-based social network measures
- Choose among social network designs based on research goals

UNIT I GRAPH THEORY AND STRUCTURE 10

Breadth First Search (BFS) Algorithm. Strongly Connected Components (SCC) Algorithm. Weakly Connected Components (WCC) Algorithm. First Set of Experiments—Degree Distributions. Second Set of Experiments—Connected Components. Third Set of Experiments—Number of Breadth First Searches. Rank Exponent R. Out-Degree Exponent O. Hop Plot Exponent H. Eigen Exponent E. Permutation Model. Random Graphs with Prescribed Degree Sequences. Switching Algorithms. Matching Algorithm. “Go with the Winners” Algorithm. HyperANF Algorithm. Iterative Fringe Upper Bound (iFUB) Algorithm. Spid. Degree Distribution. Path Length. Component Size. Clustering Coefficient and Degeneracy. Friends-of-Friends. Degree Assortativity. Login Correlation.

UNIT II SOCIAL NETWORK GRAPH ANALYSIS 9

Social network exploration/ processing and properties: Finding overlapping communities, similarity between graph nodes, counting triangles in graphs, neighborhood properties of graphs. Pregel paradigm and Apache Giraph graph processing system.

UNIT III INFORMATION DIFFUSION IN SOCIAL NETWORKS 9

Strategic network formation: game theoretic models for network creation/ user behavior in social networks. Information diffusion in graphs: Cascading behavior, spreading, epidemics, heterogeneous social network mining, influence maximization, outbreak detection. Opinion analysis on social networks: Contagion, opinion formation, coordination and cooperation.

UNIT IV CASCADING IN SOCIAL NETWORKS 8

Cascading in Social Networks. Decision Based Models of Cascade. Collective Action. Cascade Capacity. Co-existence of Behaviours. Cascade Capacity with Bilinguality. Probabilistic Models of Cascade. Branching Process. Basic Reproductive Number. SIR Epidemic Model. SIS Epidemic Model. SIRS Epidemic Model. Transient Contact Network. Cascading in Twitter.

UNIT V LINK ANALYSIS & COMMUNITY DETECTION 9

Search Engine. Crawling. Storage. Indexing. Ranking. Google. Data Structures. Crawling.

Searching. Web Spam Pages Strength of Weak Ties. Triadic Closure. Detecting Communities in a Network. Girvan-Newman Algorithm. Modularity. Minimum Cut Trees. Tie Strengths in Mobile Communication Network. Exact Betweenness Centrality. Approximate Betweenness Centrality.

SUGGESTED ACTIVITIES:

1: Twitter Intelligence project performs tracking and analysis of the Twitter
2: Large-Scale Network Embedding as Sparse Matrix Factorization
3: Implement how Information Propagation on Twitter
4: Social Network Analysis and Visualization software application.
5: Implement the Structure of Links in Networks

COURSE OUTCOMES:

CO1: Plan and execute network analytical computations.
CO2: Implement mining algorithms for social networks
CO3: Analyze and evaluate social communities.
CO4: Use social network analysis in behavior analytics
CO5: Perform mining on large social networks and illustrate the results.

TOTAL : 45 PERIODS

REFERENCES

1. Practical Social Network Analysis with Python, Krishna Raj P. M. Ankith Mohan and K. G. Srinivasa. Springer, 2018
2. SOCIAL NETWORK ANALYSIS: METHODS AND APPLICATIONS, STANLEY WASSERMAN, and KATHERINE F' AUST. CAMBRIDGE UNIVERSITY PRESS, 2012
3. Social Network Analysis: History, Theory and Methodology by Christina Prell, SAGE Publications, 1st edition, 2011
4. Sentiment Analysis in Social Networks, Federico Alberto Pozzi, Elisabetta Fersini, Enza Messina, and Bing. LiuElsevier Inc, 1st edition, 2016
5. Social Network Analysis, John Scott. SAGE Publications, 2012

IF4093 GPU COMPUTING L T P C
3 0 0 3

COURSE OBJECTIVES:

- To understand the basics of GPU architectures
- To understand CPU GPU Program Partitioning
- To write programs for massively parallel processors
- To understand the issues in mapping algorithms for GPUs
- To introduce different GPU programming models

UNIT I GPU ARCHITECTURE 9

Evolution of GPU architectures - 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

Using CUDA - Multi GPU - Multi GPU Solutions - Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

UNIT III PROGRAMMING ISSUES 9

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

UNIT IV OPENCL BASICS 9

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

UNIT V ALGORITHMS ON GPU 9

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

SUGGESTED ACTIVITIES:

1. Debugging Lab
2. Performance Lab
3. Launching Nsight
4. Running Performance Analysis
5. Understanding Metrics
6. NVIDIA Visual Profiler
7. Matrix Transpose Optimization
8. Reduction Optimization

COURSE OUTCOMES:

CO1: Describe GPU Architecture
CO2: Write programs using CUDA, identify issues and debug them
CO3: Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication
CO4: Write simple programs using OpenCL
CO5: Identify efficient parallel programming patterns to solve problems

TOTAL : 45 PERIODS

REFERENCES

1. Shane Cook, CUDA Programming: “A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, “Heterogeneous computing with OpenCL, 3rd Edition, Morgan Kauffman, 2015.
3. Nicholas Wilt, “CUDA Handbook: A Comprehensive Guide to GPU Programming, Addison - Wesley, 2013.
4. Jason Sanders, Edward Kandrot, “CUDA by Example: An Introduction to General Purpose GPU Programming, Addison - Wesley, 2010.
5. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors - A Hands-on Approach, Third Edition, Morgan Kaufmann, 2016.
6. http://www.nvidia.com/object/cuda_home_new.html
7. http://www.openCL.org

IF4004 **VISUALIZATION TECHNIQUES** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the fundamentals of data visualization.
- To know the working principles of various information visualization tools.
- To acquire knowledge about the issues in data representation.
- To visualize the complex engineering design.
- To gain skill in designing real time interactive information visualization system.

UNIT I INTRODUCTION **9**

Introduction – Visualization Stages – Computational Support – Issues – Different Types of Tasks – Data representation – Limitation: Display Space, Rendering Time, Navigation Link.

Suggested Activities:

- Blended Learning - Displaying Different types visualization images.
- Flipped classroom on task of representing information.
- External learning - Problems related to acquiring data.

Suggested Evaluation Methods:

- Tutorial - Different data visualizing images.
- Assignment on different data acquiring methods.
- Quizzes on issues and solutions in different visualization applications.

UNIT II DATA REPRESENTATION **9**

Human Factors – Foundation for a Science of Data Visualization – Environment- Optics – Optimal Display – Overview about Lightness, Brightness, Contrast, Constancy, Color –Visual Attention that Pops Out – Types of Data – Data Complexity – The Encoding of Values – Encoding of Relation – Relation and Connection – Alternative Canvass.

Suggested Activities:

- Blended learning - Human Visual and Auditory System.
- Flipped classroom on color formats.
- External learning - Survey on different human computer interaction and types of user interface.

Suggested Evaluation Methods:

- Assignment on human visual and auditory system.
- Quizzes on various color format.
- Assignment on human computer interaction user interface.

UNIT III DATA PRESENTATION **9**

Human Vision – Space Limitation – Time Limitations – Design – Exploration of Complex Information Space – Figure Caption in Visual Interface – Visual Objects and Data Objects – Space Perception and Data in Space – Images, Narrative and Gestures for Explanation.

Suggested Activities:

- Blended learning - Drawing Charts for display.
- Flipped classroom on various presentation techniques.

- External learning - Different font and font styles, symbols and Gesture representation.

Suggested Evaluation Methods:

- Assignment on chart preparation.
- Tutorial - Various presentation techniques.
- Assignment on gesture presentation.

UNIT IV INTERACTION AND DESIGN 9

Norman's Action Cycle – Interacting with Visualization – Interaction for Information Visualization – Interaction for Navigation – Interaction with Models – Interacting with Visualization – Interactive 3D Illustrations with Images and Text – Personal View – Attitude – user perspective – Convergence – Sketching – Evaluation.

Suggested Activities:

- Flipped classroom on various interacting Techniques.
- External learning - Interaction facilities and high level support for animation design.

Suggested Evaluation Methods:

- Tutorial - Interaction models.
- Assignment on animation design.

UNIT VCURRENT TRENDS 9

Design – Virtual Reality: Interactive Medical Application – Tactile Maps for visually challenged People – Animation Design for Simulation – Integrating Spatial and Nonspatial Data – Innovating the Interaction – Small Interactive Calendars – Selecting One from Many – Web Browsing Through a Key Hole – Communication Analysis – Archival Galaxies.

Suggested Activities:

- Flipped classroom on implementation of virtual reality environment.
- Mini project for designing and implementing a innovative interfaces.

Suggested Evaluation Methods:

- Demonstration of the mini project.
- Tutorial - Virtual reality application.

TOTAL: 45 PERIODS

OUTCOMES:

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

- Apply mathematics and basic science knowledge for designing information visualizing System.
- Collect data ethically and solve engineering problem in visualizing the information.
- Implement algorithms and techniques for interactive information visualization.
- Conduct experiments by applying various modern visualization tool and solve the space layout problem.
- Analyze and design system to visualize multidisciplinary multivariate Data individually or in teams.
- Develop a cost effective and a scale able information visualization system.

REFERENCES:

1. Robert Spence, “Information Visualization: An Introduction”, Third Edition, Pearson Education, 2014.
2. Colin Ware, “Information Visualization Perception for Design”, Third Edition, Morgan Kaufmann, 2012.
3. Robert Spence, “Information Visualization Design for Interaction”, Second Edition, Pearson Education, 2006.
4. Benjamin B. Bederson, Ben shneiderman, “The Craft of Information Visualization”, Morgan Kaufmann, 2003.
5. Thomas Strothotte, “Computational Visualization: Graphics, Abstraction and Interactivity”, Springer, 1998.
6. Matthew O. Ward, George Grinstein, Daniel Keim, “Interactive Data Visualization: Foundation, Techniques and Applications”, Second Edition, A.K.Peters/CRC Press, 2015.
7. Joerg Osarek, “Virtual Reality Analytics”, Gordon’s Arcade, 2016.

IF4072 **DESIGN THINKING** **L T P C**
3 0 0 3

COURSE OBJECTIVES:

- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- Research Methods used in Design
- Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I **UX LIFECYCLE TEMPLATE** **8**

Introduction. A UX process lifecycle template. Choosing a process instance for your project. The system complexity space. Meet the user interface team. Scope of UX presence within the team. More about UX lifecycles. Business Strategy. Value Innovation. Validated User Research. Killer UX Design. The Blockbuster Value Proposition. What Is a Value Proposition?.

UNIT II **CONTEXTUAL INQUIRY** **10**

The system concept statement. User work activity data gathering. Look for emotional aspects of work practice. Abridged contextual inquiry process. Data-driven vs. model-driven inquiry. Organizing concepts: work roles and flow model. Creating and managing work activity notes. Constructing your work activity affinity diagram (WAAD). Abridged contextual analysis process. History of affinity diagrams.

UNIT III **DESIGN THINKING, IDEATION, AND SKETCHING** **9**

Design-informing models: second span of the bridge . Some general “how to” suggestions. A New example domain: slideshow presentations. User models. Usage models. Work environment models. Barrier summaries. Model consolidation. Protecting your sources. Abridged methods for design-informing models extraction. Design paradigms. Design thinking. Design perspectives. User personas. Ideation. Sketching

UNIT IV **UX GOALS, METRICS, AND TARGETS** **8**

Introduction. UX goals. UX target tables. Work roles, user classes, and UX goals. UX measures. Measuring instruments. UX metrics. Baseline level. Target level. Setting levels. Observed results.

Practical tips and cautions for creating UX targets. How UX targets help manage the user experience engineering process.

UNIT V ANALYSING USER EXPERIENCE 10

Sharpening Your Thinking Tools. UX Research and Strength of Evidence. Agile Personas. How to Prioritize Usability Problems. Creating Insights, Hypotheses and Testable Design Ideas. How to Manage Design Projects with User Experience Metrics. Two Measures that Will Justify Any Design Change. Evangelizing UX Research. How to Create a User Journey Map. Generating Solutions to Usability Problems. Building UX Research Into the Design Studio Methodology. Dealing with Common objections to UX Research. The User Experience Debrief Meeting. Creating a User Experience Dashboard.

SUGGESTED ACTIVITIES:

1: Hands on Design Thinking process for a product
2: Defining the Look and Feel of any new Project
3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
4: Identify a customer problem to solve.
5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

COURSE OUTCOMES:

CO1: Build UI for user Applications
CO2: Use the UI Interaction behaviors and principles
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles

TOTAL : 45 PERIODS

REFERENCES

1. UX for Developers: How to Integrate User-Centered Design Principles Into Your Day-to-Day Development Work, Westley Knight. Apress, 2018
2. The UX Book: Process and Guidelines for Ensuring a Quality User Experience, Rex Hartson, Pardha Pyla. Morgan Kaufmann, 2012
3. UX Fundamentals for Non-UX Professionals: User Experience Principles for Managers, Writers, Designers, and Developers, Edward Stull. Apress, 2018
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016
5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017

IF4094 PATTERN RECOGNITION L T P C
3 0 0 3

COURSE OBJECTIVES:

- Understand the in-depth concept of Pattern Recognition
- Implement Bayes Decision Theory
- Understand the in-depth concept of Perception and related Concepts

- Understand the concept of ML Pattern Classification
- Understand the concept of DL Pattern Recognition

UNIT I PATTERN RECOGNITION 8

Induction Algorithms. Rule Induction. Decision Trees. BayesianMethods. Overview. NaiveBayes. The Basic Na¨ıve Bayes Classifier. Naive Bayes Induction for Numeric Attributes. Correction to the Probability Estimation. Laplace Correction. No Match. Other Bayesian Methods. Other Induction Methods. Neural Networks. Genetic Algorithms. Instance-based Learning. Support Vector Machines.

UNIT II STATISTICAL PATTERN RECOGNITION 8

About Statistical Pattern Recognition. Classification and regression. Features, Feature Vectors, and Classifiers. Pre-processing and feature extraction. The curse of dimensionality. Polynomial curve fitting. Model complexity. Multivariate non-linear functions. Bayes' theorem. Decision boundaries. Parametric methods. Sequential parameter estimation. Linear discriminant functions. Fisher's linear discriminant. Feed-forward network mappings.

UNIT III BAYES DECISION THEORY CLASSIFIERS 11

Bayes Decision Theory. Discriminant Functions and Decision Surfaces. The Gaussian Probability Density Function. The Bayesian Classifier for Normally Distributed Classes. Exact interpolation. Radial basis function networks. Network training. Regularization theory. Noisy interpolation theory. Relation to kernel regression. Radial basis function networks for classification. Comparison with the multi-layer perceptron. Basis function optimization.

UNIT IV LINEAR DISCRIMINANT FUNCTIONS 9

Linear Discriminant Functions and Decision Surfaces. The Two-Category Case. The Multicategory Case. The Perceptron Criterion Function. Batch Perceptron. Perceptron Algorithm Convergence. The Pocket Algorithm. Mean Square Error Estimation. Stochastic Approximation and the LMS Algorithm. Convergence Proof for Single-Sample Correction. Fixed increment descent. Some Direct Generalizations. Fixed increment descent. Batch variable increment Perceptron. Balanced Winnow algorithm. Relaxation Procedures. The Descent Algorithm.

UNIT V NONLINEAR CLASSIFIERS 9

The Two Layer Perception. The Three Layer Perception. Algorithms Based On Exact Classification Of The Training Set. Feedforward operation and classification. General feedforward operation. Expressive power of multilayer networks. Backpropagation algorithm. Network learning. Training protocols. Stochastic Backpropagation. Batch Backpropagation. Radial basis function networks (RBF). Special bases. Time delay neural networks (TDNN). Recurrent networks. Counter propagation. Cascade-Correlation. Cascade-correlation. Neocognitron

SUGGESTED ACTIVITIES:

1: Car Sales Pattern Classification using Support Vector Classifier
2: Avocado Sales Pattern Recognition using Linear regression
3: Tracking Movements by implementing Pattern Recognition
4: Detecting Lanes by implementing Pattern Recognition
5: Pattern Detection in SAR Images

COURSE OUTCOMES:

CO1: Discover imaging, and interpretation of temporal patterns
CO2: Identify Structural Data Patterns
CO3: Implement Pattern Classification using Machine Learning Classifiers
CO4: Implement Pattern Recognition using Deep Learning Models
CO5: Implement Image Pattern Recognition

TOTAL:45 PERIODS

REFERENCES

1. Pattern Classification, 2nd Edition, Richard O. Duda, Peter E. Hart, and David G. Stork. Wiley, 2000
2. Pattern Recognition, Jürgen Beyerer, Matthias Richter, and Matthias Nagel. 2018
3. Pattern Recognition and Machine Learning, Christopher M. Bishop. Springer, 2010
4. Pattern Recognition and Classification, Dougherty, and Geoff. Springer, 2013
5. Practical Machine Learning and Image Processing, Himanshu Singh. Apress, 2019

IF4005 BLOCKCHAIN AND CRYPTOCURRENCY L T P C
3 0 2 4

COURSE OBJECTIVES:

- How assets can be transferred in a blockchain network
- Detailed Study of Blockchain
- Deploying transactions on the Blockchain node
- Learn, develop, and advance their skills in Ethereum development
- In depth knowledge on Smart Contract Deployment

UNIT I BLOCKCHAIN CONCEPTS 7

Blockchain definitions How are blockchains different from databases? Versions of Blockchain Characteristics of blockchain Public blockchain (permissionless) Private blockchain (permissioned) Consortium blockchain Layers of Blockchain Block attributes. Structure of the block. Block header. Linking blocks Cryptography in blockchain. Classical cryptography. Cryptographic primitives. Symmetric key cryptography. Hashing in blockchain. Linking blocks in a blockchain. Nash Equilibrium. Prisoner's Dilemma. Byzantine Generals' Problem. Zero-Sum Games.

UNIT II ETHEREUM BLOCKCHAIN 11

Overview of Ethereum. Ethereum accounts Transactions Consensus Timestamp Nonce Block time Forking Genesis block Ether denominations Ethereum virtual machine Gas Peer discovery Whisper and Swarm Geth Installing geth Connecting to the mainnet network Creating a private network Creating accounts Mining Fast synchronization Ethereum Wallet Mist Sybil attack Serenity. Consensus Mechanism. Proof of Work. Proof of Stake. Delegated Proof of Stake.

UNIT III SMART CONTRACT WITH SOLIDITY 11

What Is a Smart Contract?. Life Cycle of a Smart Contract. Solidity. The Ethereum Contract ABI. Smart contract templates. Oracles. Types of blockchain oracles. Deploying smart contracts. Statements and Expressions in Solidity. Data Types of Solidity. Tokens. Mining Ether. Truffle Suite. Ganache. Deploying using Ganache. Private Ethereum Blockchain with Geth.

UNIT IV SMART CONTRACT SECURITY 8

Smart Contract Vulnerability. Preventative Techniques. PoWHC and Batch Transfer Overflow. Unexpected Ether. Parity Multisig Wallet. PRNG Contracts. Reentrancy Honey Pot. Short Address/Parameter Attack. Etherpot. Race Conditions/Front Running. Denial of Service (DoS). Wallet Cyberattacks. Blockchain network attacks. Platform attacks. Phishing Attack. Online Wallet Phishing-Malware Attacks. Double Spending or 51 Percent Attack. Credential Attacks.

UNIT V CRYPTOCURRENCY 8

About Crypto Currency Bitcoin Bitcoin public addresses Bitcoin Transaction output Bitcoin Transaction input Bitcoin Transaction verification Mining and consensus Mining a block Verification of transactions Key management Wallet balance. Altcoins. Proof of Storage. Proof of Stake (PoS). Proof of coinage. Proof of Deposit. Stellar (XLM). Binance Coin (BNB). Cardano (ADA). Dogecoin (DOGE). XRP (XRP). Litecoin (LTC)

LIST EXPERIMENTS 30

1: Voting with Ethereum Blockchain
2: Building a Betting App
3: Implement a new Crypto Currency
4: Developing a Sales Order DApp
5: Develop a Supply Chain DApp

COURSE OUTCOMES:

CO1: Record transactions between parties
CO2: Implement advanced concepts such as privacy, security and decentralized file management.
CO3: Analyse how cryptocurrencies are created, transacted, and stored
CO4: Design decentralized applications for countless applications
CO5: Instantiate an Ethereum application on the network.

TOTAL : 45+30=75 PERIODS

REFERENCES

1. Beginning Blockchain, Bikramaditya Singhal, Gautam Dhameja and Priyansu Sekhar Panda. Apress, 2018
2. Mastering Ethereum, Andreas M. Antonopoulos and Dr. Gavin Wood. O'Reilly Media, 2018
3. Introducing Ethereum and Solidity, Chris Dannen. Apress, 2017
4. The Blockchain Developer, Elad Elrom. Apress, 2019
5. Ethereum Smart Contract Development, Mayukh Mukhopadhyay. Packt Publishing, 2018
6. Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Imran Bashir Second Edition, Packt Publishing, 2018.

IF4074 **DISTRIBUTED APPLICATION DEVELOPMENT** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- Learn Depth Concept of GO Programming
- How to develop Smart Contracts
- How to Deploy Smart Contracts
- Front end Development using Angular
- Implementing Bitcoin Network

UNIT I GETTING STARTED WITH GO PROGRAMMING 8

Centralized vs Decentralized Systems Centralized Systems Decentralized Systems. Decentralized Data. Decentralized Wealth. Decentralized Identity. Decentralized Computing. Decentralized Bandwidth. Decentralized Markets for Decentralized Assets. About Go Language. The Terminal. Environment. Go. Your First Program. Variables & Data Types. Control Structures. Collection Frameworks. Functions. Structs and Interfaces. Packages. Hashes and Cryptography Packages. Servers Packages. Concurrency. Goroutines. Channels. Channel Direction. Select. Buffered Channels. The sync package. Synchronizing with mutex locks. Synchronizing access to composite values. Concurrency barriers with sync. WaitGroup. Data IO.

UNIT II BUILDING DISTRIBUTED APPLICATIONS IN GIN 8

Installing and configuring Gin. Dependency management in Golang. Writing a custom HTTP handler. Exploring API functionality. Defining the data model. HTTP endpoints. Implementing HTTP routes & Methods. Managing Data Persistence
with MongoDB. Authentication & Authorization. Developing and Deploying Web Application using Gin

UNIT III SMART CONTRACTS USING SOLIDITY & GO 10

The CAP theorem. Consensus in distributed systems. Understanding the hash function and the Merkle tree. Operations using Solidity. Control Structures. Smart contract on a private blockchain. Design of DAO. Class properties of a contract. Expression and control structures. State variables. Functions & its Modifiers. Events. Implementing funding limit with inheritance. Making a contract abstract.

UNIT IV DEVELOPING DAPPS 9

What Is a DApp?. DApp architecture. Backend (Smart Contract). Frontend (Web User Interface). Data Storage. Inter-Planetary File System (IPFS). Swarm. Developing a Cryptocurrency. Building Your Dapp. Routing. Data Storage and Retrieval. Exploring the Truffle suite. Learning Solidity's advanced features. Contract testing and debugging. Ethereum DApp with Angular.

UNIT V BITCOIN NETWORK 10

The Bitcoin Network. Network Discovery for a New Node. Bitcoin Transactions. Consensus and Block Mining. Block Propagation. Bitcoin payments. Bitcoin client. Bitcoin programming. Running a Blockchain Node. Create a Bitcoin Miner. Create a NEO Bookkeeping Node. Create an EOS Block Producer. Bitcoin Core API. Serialized Blocks. Block Header. Block Version. Bitcoin Wallet.

LIST OF EXPERIMENTS: 30

1: Developing Purchase Order DApp

2: Designing a Voting DApp
3: Designing and Deploying Vaccine Production using DApp
4: Developing Auction DApp
5: Developing Property Registration DApp

COURSE OUTCOMES:

CO1: Learn How to Compile and Deploy Solidity
CO2: Use Golang to Connect to Ethereum
CO3: Deploy Ethereum Smart Contracts Using Golang
CO4: Develop DApp using Angular
CO5: Develop Bitcoin Application

TOTAL: 45+30=75 PERIODS

REFERENCES

1. Caleb Doxsey, “Introducing Go”, O’Reilly Media, 2016
2. Vladimir Vivien, “Learning Go Programming”, Packt Publishing, 2016
3. Siraj Raval, “Decentralized Applications”, O’Reilly Media, 2016
4. Mohamed Labouardy, “Building Distributed Applications in Gin”, Packt Publishing, 2021
5. Chris Dannen, “Introducing Ethereum and Solidity”, Apress, 2017

IF4006 **FORECASTING AND OPTIMIZATION** **L T P C**
3 0 2 4

COURSE OBJECTIVES:

- Knowledge to build and apply time series forecasting models
- Learn what attributes make data a time series.
- Learn about seasonality, trends, and cyclical patterns.
- Load and Summarize Dataset
- Load and Plot Dataset

UNIT I TIME SERIES FORECASTING 8

Different types of data. Cross-sectional data. Time series data. Panel data. Internal structures of time series. General trend. Seasonality. Run sequence plot. Seasonal sub series plot. Multiple box plots. Cyclical changes. Unexpected variations. Models for time series analysis. Zero mean models. Random walk. Trend models. Seasonality models. Forecasting Time Series. Estimation of Transfer Functions. Analysis of Effects of Unusual Intervention Events to a System. Analysis of Multivariate Time Series.

UNIT II TIME SERIES DATA PREPARATION 8

Common Data Preparation Operations for Time Series. Time stamps vs. Periods. Converting to Timestamps. Providing a Format Argument. Indexing. Time/Date Components. Frequency Conversion. Time Series Exploration and Understanding.
How to Get Started with Time Series Data Analysis. Data Cleaning of Missing Values in the Time Series. Time Series Data Normalization and Standardization. Time Series Feature Engineering. Date Time Features. Lag Features and Window Features. Rolling Window Statistics. Expanding Window Statistics.

UNIT III LINEAR STATIONARY MODELS 9

Stochastic Processes and Stationarity. Wold's Decomposition and Autocorrelation. First-Order Autoregressive Processes. Second-Order Autoregressive Process. First-Order Moving Average Processes. Second-Order Moving Average Process. Estimation of the Partial Autocorrelation Function. Standard Errors of Partial Autocorrelation Estimates. General AR and MA Processes. Autoregressive-Moving Average Models. ARMA Model Building and Estimation. Duality Between Autoregressive and Moving Average Processes.

UNIT IV REGRESSION EXTENSION TECHNIQUES FOR TIME-SERIES DATA 10

Autoregressive Integrated Moving Average. Seasonal ARIMA. SARIMAX. Vector Autoregression. VARMA. Nonstationary First-Order Autoregressive Process. General Model for a Nonstationary Process Exhibiting. Homogeneity. General Form of the ARIMA Model. Three Explicit Forms for the ARIMA Model. Difference Equation Form of the Model. Random Shock Form of the Model. Inverted Form of the Model. Integrated Moving Average Processes. Integrated Moving Average Process of Order (0, 1, 1). Integrated Moving Average Process of Order (0, 2, 2). Prophet Forecasting.

UNIT V DEEP LEARNING FOR TIME SERIES FORECASTING 10

Training MLPs. Automatically Learning and Extracting Features from Raw and Imperfect Data. Deep Learning Supports Multiple Inputs and Outputs. MLPs for time series forecasting. Bi-directional recurrent neural networks. Deep recurrent neural networks. Training recurrent neural networks. Solving the long-range dependency problem. Long Short Term Memory. Gated Recurrent Units. Recurrent neural networks for time series forecasting. 2D convolutions. 1D convolution. 1D convolution for time series forecasting.

LIST OF EXPERIMENTS : 30

1: Time Series Prediction of stock prices using ARIMA Model
2: Time Series Prediction of rainfall data using SARIMA Model
3: Forecasting of agricultural commodity pricing using pro
4: Time Series Prediction of Car Sales using ARIMA and SARIMA Model
5: Predicting Air Traffic Flow using Deep Learning

COURSE OUTCOMES:

CO1: Compile and fit time series forecasting model to training data
CO2: Evaluate Forecast Model
CO3: Analysis and compare ARIMA vs SARIMA vs Deep Learning Vs Prophet
CO4: How to evaluate a Prophet model on a hold-out dataset.
CO5: Assess trained model performance

TOTAL : 45+30 =75PERIODS

REFERENCES

1. Machine Learning for Time Series Forecasting with Python, Francesca Lazzeri, PhD. Wiley 2020
2. Practical Time Series Analysis, Dr. Avishek Pal and Dr. PKS Prakash. Packt Publishing, 2017
3. Hands-on Time Series Analysis with Python, B V Vishwas and Ashish Patel. Apress,2020
4. DEEP TIME SERIES FORECASTING With PYTHON, Dr. N.D Lewis,2016
5. Practical Time Series Analysis, Aileen Nielsen. O'Reilly Media, 2019

IF4071	DEEP LEARNING	L T P C
		3 0 2 4

COURSE OBJECTIVES:

- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS 6

Fundamentals about Deep Learning. Perception Learning Algorithms. Probabilistic modelling. Early Neural Networks. How Deep Learning different from Machine Learning. Scalars. Vectors. Matrixes, Higher Dimensional Tensors. Manipulating Tensors. Vector Data. Time Series Data. Image Data. Video Data.

UNIT II NEURAL NETWORKS 9

About Neural Network. Building Blocks of Neural Network. Optimizers. Activation Functions. Loss Functions. Data Pre-processing for neural networks, Feature Engineering. Overfitting and Underfitting. Hyperparameters.

UNIT III CONVOLUTIONAL NEURAL NETWORK 10

About CNN. Linear Time Invariant. Image Processing Filtering. Building a convolutional neural network. Input Layers, Convolution Layers. Pooling Layers. Dense Layers. Backpropagation Through the Convolutional Layer. Filters and Feature Maps. Backpropagation Through the Pooling Layers. Dropout Layers and Regularization. Batch Normalization. Various Activation Functions. Various Optimizers. LeNet, AlexNet, VGG16, ResNet. Transfer Learning with Image Data. Transfer Learning using Inception Oxford VGG Model, Google Inception Model, Microsoft ResNet Model. R-CNN, Fast R-CNN, Faster R-CNN, Mask-RCNN, YOLO

UNIT VI NATURAL LANGUAGE PROCESSING USING RNN 10

About NLP & its Toolkits. Language Modeling . Vector Space Model (VSM). Continuous Bag of Words (CBOW). Skip-Gram Model for Word Embedding. Part of Speech (PoS) Global Co-occurrence Statistics–based Word Vectors. Transfer Learning. Word2Vec. Global Vectors for Word Representation GloVe. Backpropagation Through Time. Bidirectional RNNs (BRNN) . Long Short Term Memory (LSTM). Bi-directional LSTM. Sequence-to-Sequence Models (Seq2Seq). Gated recurrent unit GRU.

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING 10

About Deep Reinforcement Learning. Q-Learning. Deep Q-Network (DQN). Policy Gradient Methods. Actor-Critic Algorithm. About Autoencoding. Convolutional Auto Encoding. Variational Auto Encoding. Generative Adversarial Networks. Autoencoders for Feature Extraction. Auto Encoders for Classification. Denoising Autoencoders. Sparse Autoencoders

LIST OF EXPERIMENTS: 30

1: Feature Selection from Video and Image Data

2: Image and video recognition

3: Image Colorization
4: Aspect Oriented Topic Detection & Sentiment Analysis
5: Object Detection using Autoencoder

COURSE OUTCOMES:

CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

TOTAL: 45+30=75 PERIODS

REFERENCES

1. Deep Learning A Practitioner's Approach Josh Patterson and Adam Gibson O'Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
3. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017
5. Pro Deep Learning with TensorFlow, Santanu Pattanayak, Apress,2017

IF4073 DEVOPS AND MICROSERVICES L T P C
3 0 2 4

COURSE OBJECTIVES:

- To learn the basic concepts and terminology of DevOps
- To gain knowledge on Devops platform
- To understand building and deployment of code
- To be familiar with DevOps automation tools
- To learn basics of MLOps

UNIT I INTRODUCTION 9+6

Software Engineering - traditional and Agile process models - DevOps -Definition - Practices - DevOps life cycle process - need for DevOps –Barriers

UNIT II DEVOPS PLATFORM AND SERVICES 9+6

Cloud as a platform - IaaS, PaaS, SaaS - Virtualization - Containers –Supporting Multiple Data Centers - Operation Services - Hardware provisioning- software Provisioning - IT services - SLA - capacity planning - security - Service Transition - Service Operation Concepts.

UNIT III BUILDING , TESTING AND DEPLOYMENT 9+6

Microservices architecture - coordination model - building and testing - Deployment pipeline - Development and Pre-commit Testing -Build and Integration Testing - continuous integration - monitoring - security - Resources to Be Protected - Identity Management

UNIT IV DEVOPS AUTOMATION TOOLS 9+6

Infrastructure Automation- Configuration Management - Deployment Automation - Performance

Management - Log Management -Monitoring.

UNIT V MLOps 9+6

MLOps - Definition - Challenges -Developing Models - Deploying to production - Model Governance - Real world examples

SUGGESTED ACTIVITIES:

1: Creating a new Git repository, cloning existing repository, Checking changes into a Git repository, Pushing changes to a Git remote, Creating a Git branch
2: Installing Docker container on windows/Linux, issuing docker commands
3: Building Docker Images for Python Application
4: Setting up Docker and Maven in Jenkins and First Pipeline Run
5: Running Unit Tests and Integration Tests in Jenkins Pipelines

COURSE OUTCOMES:

CO1: Implement modern software Engineering process
CO2: work with DevOps platform
CO3: build, test and deploy code
CO4: Explore DevOps tools
CO5: Correlate MLOps concepts with real time examples

TOTAL :75 PERIODS

REFERENCES

1. Len Bass, Ingo Weber and Liming Zhu, ”DevOps: A Software Architect‘s Perspective”, Pearson Education, 2016
2. Joakim Verona - “Practical DevOps” - Packet Publishing , 2016
3. Viktor Farcic -”The DevOps 2.1 Toolkit: Docker Swarm” - Packet Publishing, 2017
4. Mark Treveil, and the Dataiku Team-”Introducing MLOps” - O’Reilly Media- 2020

MP4292 MOBILE APPLICATION DEVELOPMENT L T P C
3 0 2 4

COURSE OBJECTIVES:

- To facilitate students to understand android SDK
- To help students to gain basic understanding of Android application development
- To understand how to work with various mobile application development frameworks
- To inculcate working knowledge of Android Studio development tool
- To learn the basic and important design concepts and issues of development of mobile applications

UNIT I MOBILE PLATFORM AND APPLICATIONS 9

Mobile Device Operating Systems — Special Constraints & Requirements — Commercial Mobile Operating Systems — Software Development Kit: iOS, Android, BlackBerry, Windows Phone — MCommerce — Structure — Pros & Cons — Mobile Payment System — Security Issues

UNIT II INTRODUCTION TO ANDROID 9

Introduction to Android: The Android Platform, Android SDK, Eclipse Installation, Android

Installation, Building you First Android application, Understanding Anatomy of Android Application, Android Manifest file.

UNIT III ANDROID APPLICATION DESIGN ESSENTIALS 9

Anatomy of Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Android Manifest File and its common settings, Using Intent Filter, Permissions.

UNIT IV ANDROID USER INTERFACE DESIGN & MULTIMEDIA 9

User Interface Screen elements, Designing User Interfaces with Layouts, Drawing and Working with Animation. Playing Audio and Video, Recording Audio and Video, Using the Camera to Take and Process Pictures

UNIT V ANDROID APIs 9

Using Android Data and Storage APIs, Managing data using Sqlite, Sharing Data between Applications with Content Providers, Using Android Networking APIs, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Application to the World.

TOTAL:45 PERIODS

LIST OF EXPERIMENTS: (30)

1. Develop an application that uses GUI components, Font, Layout Managers and event listeners.
2. Develop an application that makes use of databases
3. Develop a native application that uses GPS location information
4. Implement an application that creates an alert upon receiving a message
5. Develop an application that makes use of RSS Feed.
6. Create an application using Sensor Manager
7. Create an android application that converts the user input text to voice.
8. Develop a Mobile application for simple and day to day needs (Mini Project)

COURSE OUTCOMES:

CO1: Identify various concepts of mobile programming that make it unique from programming for other platforms

CO2: Create, test and debug Android application by setting up Android development

CO3: Demonstrate methods in storing, sharing and retrieving data in Android applications

CO4: Utilize rapid prototyping techniques to design and develop sophisticated mobile interfaces

CO5: Create interactive applications in android using databases with multiple activities including audio, video and notifications and deploy them in marketplace

TOTAL: 45+30=75 PERIODS

REFERENCES

1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”, Pearson Education, 2nd ed. (2011)
2. Google Developer Training, "Android Developer Fundamentals Course – Concept Reference”, Google Developer Training Team, 2017.
3. Prasanth Kumar Pattnaik,Rajib Mall,”Fundamentals of Mobile Computing”,PHI Learning Pvt.Ltd,New Delhi-2012
4. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd, 2010
5. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd, 2009

6. Dawn Griffiths and David Griffiths, “Head First Android Development”, 1st Edition, O‟Reilly SPD Publishers, 2015. ISBN-13: 978-9352131341
7. Erik Hellman, “Android Programming – Pushing the Limits”, 1st Edition, Wiley India Pvt Ltd, 2014. ISBN-13: 978-8126547197.
8. Bill Phillips, Chris Stewart and Kristin Marsicano, “Android Programming: The Big Nerd Ranch Guide”, 4th Edition, Big Nerd Ranch Guides, 2019. ISBN-13: 978-0134706054

CP4292 MULTICORE ARCHITECTURE AND PROGRAMMING L T P C
3 0 2 4

COURSE OBJECTIVES:

- To understand the need for multi-core processors, and their architecture.
- To understand the challenges in parallel and multithreaded programming.
- To learn about the various parallel programming paradigms,
- To develop multicore programs and design parallel solutions.

UNIT I MULTI-CORE PROCESSORS 9

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

UNIT II PARALLEL PROGRAM CHALLENGES 9

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

UNIT III SHARED MEMORY PROGRAMMING WITH OPENMP 9

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

UNIT IV DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

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

UNIT V PARALLEL PROGRAM DEVELOPMENT 9

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

TOTAL:45 PERIODS

PRACTICALS:

1. Write a simple Program to demonstrate an OpenMP Fork-Join Parallelism.
2. Create a program that computes a simple matrix-vector multiplication b=Ax, either in C/C++. Use OpenMP directives to make it run in parallel.
3. Create a program that computes the sum of all the elements in an array A (C/C++) or a program that finds the largest number in an array A. Use OpenMP directives to make it run in parallel.
4. Write a simple Program demonstrating Message-Passing logic using OpenMP.

5. Implement the All-Pairs Shortest-Path Problem (Floyd's Algorithm) Using OpenMP.
6. Implement a program Parallel Random Number Generators using Monte Carlo Methods in OpenMP.
7. Write a Program to demonstrate MPI-broadcast-and-collective-communication in C.
8. Write a Program to demonstrate MPI-scatter-gather-and-all gather in C.
9. Write a Program to demonstrate MPI-send-and-receive in C.
10. Write a Program to demonstrate by performing-parallel-rank-with-MPI in C.

TOTAL:30 PERIODS

TOTAL:45+30=75 PERIODS

COURSE OUTCOMES:

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

CO1: Describe multicore architectures and identify their characteristics and challenges.

CO2: Identify the issues in programming Parallel Processors.

CO3: Write programs using OpenMP and MPI.

CO4: Design parallel programming solutions to common problems.

CO5: Compare and contrast programming for serial processors and programming for parallel processors.

REFERENCES:

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

BC4291 ETHICAL HACKING L T P C
3 0 2 4

COURSE OBJECTIVES:

- To understand and analyze security threats & countermeasures related to ethical hacking.
- To learn the different levels of vulnerabilities at a system level.
- To gain knowledge on the different hacking methods for web services and session hijacking.
- To understand the hacking mechanisms on how a wireless network is hacked.

UNIT I ETHICAL HACKING OVERVIEW & VULNERABILITIES 9

Understanding the importance of security, Concept of ethical hacking and essential Terminologies-Threat, Attack, Vulnerabilities, Target of Evaluation, Exploit. Phases involved in hacking

UNIT II FOOTPRINTING & PORT SCANNING 9

Footprinting - Introduction to foot printing, Understanding the information gathering methodology of the hackers, Tools used for the reconnaissance phase, Port Scanning - Introduction, using port scanning tools, ping sweeps, Scripting Enumeration-Introduction, Enumerating windows OS & Linux OS

UNIT III SYSTEM HACKING 9

Aspect of remote password guessing, Role of eavesdropping ,Various methods of password cracking, Keystroke Loggers, Understanding Sniffers ,Comprehending Active and Passive Sniffing, ARP Spoofing and Redirection, DNS and IP Sniffing, HTTPS Sniffing.

UNIT IV HACKING WEB SERVICES & SESSION HIJACKING 9

Web application vulnerabilities, application coding errors, SQL injection into Back-end Databases, cross-site scripting, cross-site request forging, authentication bypass, web services and related flaws, protective http headers. Understanding Session Hijacking, Phases involved in Session Hijacking,Types of Session Hijacking, Session Hijacking Tools

UNIT V HACKING WIRELESS NETWORKS 9

Introduction to 802.11, Role of WEP, Cracking WEP Keys, Sniffing Traffic, Wireless DOS attacks, WLANScanners, WLANSniffers,HackingTools,Securing Wireless Network

TOTAL:45 PERIODS

LIST OF EXPERIMENTS:

1: Study of Guessing username and passwords using Hydra
2: Experiment onRecovering password Hashes
3: Implementation to crack Linux passwords
4: Experiments on SQL injections
5: Analysis of WEP flaws
6: Experiments on Wireless DoS Attacks
7:Implementation of Buffer Overflow Prevention
8: Prevention against Cross Site Scripting Attacks
9: Experiments on Metasploit Framework
10: Implementation to identify web vulnerabilities
11. Wireshark: Experiment to monitor live network capturing packets and analyzing over the live network
12. LOIC: DoS attack using LOIC
13. FTK: Bit level forensic analysis of evidential image and reporting the same.
14. Darkcomet : Develop a malware using Remote Access Tool Darkcomet to take a remote access over network
15. HTTrack: Website mirroring using Httrack and hosting on a local network.
16. XSS: Inject a client side script to a web application
17. Emailtrackerpro: Email analysis involving header check, tracing the route. Also perform a check on a spam mail and non-spam mail

TOTAL:30 PERIODS

COURSE OUTCOMES:

CO1: Understand vulnerabilities, mechanisms to identify vulnerabilities/threats/attacks
CO2: Use tools to identify vulnerable entry points

CO3: Identify vulnerabilities using sniffers at different layers
CO4: Handle web application vulnerabilities
CO5: Identify attacks in wireless networks

TOTAL :45+30=75 PERIODS

REFERENCES

1. Kimberly Graves, "Certified Ethical Hacker", Wiley India Pvt Ltd, 2010
2. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 2010
3. RajatKhare, "Network Security and Ethical Hacking", Luniver Press, 2006
4. Ramachandran V, "BackTrack 5 Wireless Penetration Testing Beginner's Guide (3rd ed.)." Packt Publishing, 2011
5. Thomas Mathew, "Ethical Hacking", OSB publishers, 2003
6. Matthew Hickey, Jennifer Arcuri, "Hands on Hacking: Become an Expert at Next Gen Penetration Testing and Purple Teaming", 1st Edition, Wiley, 2020.
7. Jon Ericson, Hacking: The Art of Exploitation, 2nd Edition, NoStarch Press, 2008.

MU4151 ADVANCED GRAPHICS AND ANIMATION L T P C
3 0 2 4

COURSE OBJECTIVES:

- To understand the basics of geometry processing.
- To understand the fundamentals of pipelined rasterization rendering of meshed objects and curved surfaces.
- To understand and work with advanced rendering methods such as radiosity.
- To design programs for advanced animation methods.
- To become proficient in graphics programming using OpenGL

UNIT I FUNDAMENTALS 9

Basics - Scope and Applications – Graphics Standards – Display Systems – Image Formation – Graphics Systems – 2D and 3D Coordinate Systems – Vectors – Matrices and Basic Vector/Matrix Operations – Line Drawing – Object Representation – Anti-Aliasing.

Suggested Activities:

1. Practical - Basic application to be implemented for vectors and matrices.
2. Practical - Apply various implementations of the graphics algorithms and analyze.
3. Practical - Execute some shader application and fix the warnings and errors

Suggested Evaluation Methods:

1. Quiz to check the understanding of the graphics concepts (like graphics hardware, displays and standards).
2. Assessing the understanding of various basic graphics algorithms through programming assessment by using vectors and matrices

UNIT II TRANSFORMATIONS 9

2D and 3D Geometric Transformations: Translation, Rotation, Scaling, Affine – Hierarchical Modelling & viewing – The Camera Transformation – Perspective – Orthographic and Stereographic Views.

Suggested Activities:

1. Flipped classroom on rasterization.
2. Practical - Execute any shader application and set viewports, windows, draw polylines and explore the keyboard and mouse interaction routines.
3. Familiarize with transformations and hierarchical in OpenGL using a matrix stack

Suggested Evaluation Methods:

1. Quizzes on rasterization schemes.
2. Assessing the understanding of the basic elements available in the OpenGL environment through the programming structs.
3. Demonstration on transformations hierarchies using matrix stack.

UNIT III FRACTALS 9

Fractals and Self Similarity – Peano Curves – Creating Image by Iterated Functions – Mandelbrot Sets – Julia Sets – Random Fractals – Intersecting Rays with Other Primitives – Reflections and Transparency – Boolean Operations on Objects and its Applications.

Suggested Activities:

1. Flipped classroom on various algorithms used to generate the fractals.
2. Practical - Generation of fractals using Python and Numpy
3. Practical - Run any shader application and set viewports, windows, fractal rendering and explore the keyboard and mouse interaction routines.

Suggested Evaluation Methods:

1. Quiz on Fractals.
2. Demonstration the generation of fractals using Python and Numpy.
3. Assessing the understanding of generation of fractals by changing the various parameters in the OpenGL environment through the programming structs.

UNIT IV ADVANCED GRAPHICS 9

Hidden Surface Removal– Parametric Curves and Surfaces– Global Illumination – Ray Casting – Monte Carlo Algorithm – Texture Synthesis – Bump Mapping – Environmental Mapping –Advanced Lighting and Shading – Shadows –Volumetric Rendering.

Suggested Activities:

1. Flipped classroom on Texture Synthesis and photo realistic rendering
2. Run the shader application and add the texture and shadow.
3. Analyze a few more shaders - Toon/Cell, Cook-Torrance, Oren-Nayar, Gradient.

Suggested Evaluation Methods:

1. Quiz on advanced graphics techniques (like texture synthesis and photo realistic rendering).
2. Demonstration of shader application exploring texture and shadow features.
3. Discussion on bi-directional reflectance distribution function after analyzing the various shader models.

UNIT V ANIMATION 9

Overview of Animation Techniques – Keyframing, Computer Animation – Motion Capture and Editing–Forward/Inverse Kinematics– 3D Computer Animation for Applications Such as Games and

Virtual Environments – Character Animation Techniques Such as Synthesizing their Body Movements – Facial Expressions and Skin Movements – Behaviors in Crowded Scenes.

Suggested Activities:

1. Exploration of various animation techniques and tools (Self Study).
2. Carry out small projects like Design of small animation movies using any tools with good aesthetic sense.

Suggested Evaluation Methods

1. Discussion on various animation techniques and tools.
2. Projects may be evaluated based on the theme, design, creativity, tools and aesthetic sense.

30 PERIODS

PRACTICAL EXERCISES:

1. Introduction to Programming in OpenGL.
2. Write a program to draw the following points: (0.0,0.0), (20.0,0.0), (20.0,20.0), (0.0,20.0) and (10.0,25.0). For this purpose, use the GL_POINTS primitive.
3. Re-write the previous program in order to draw a house. The house consists of two figures: a square and a triangle. The first four points given above define the square, while the last three points define the triangle. For this purpose, use the GL_QUADS and GL_TRIANGLES primitives.
4. Write a program to color to primitives like cube, triangle and perform 2D rotation using OpenGL.
5. Modify the above program extending the 2D rotation to 3D with a simple 3D Orthographic Projection.
6. Write a program to roll a wheel on a horizontal line using OpenGL.
7. Draw the Koch snowflake (or some other variation of the Koch curve) using python.
8. Create a rotating cube with lighting using OpenGL.
9. Create a scene consisting of multiple spheres and cubes, apply a different texture to each object, and give a bumpy-looking appearance to each surface using normal mapping.
10. Create 10 seconds Walking animation with a rigged character using any animation tool.

TOTAL : 45+30=75 PERIODS

COURSE OUTCOMES:

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

CO1: Understand and apply 3d graphics algorithms related to transformations, illumination, texturing, etc. With the aid of software libraries.

CO2: Develop interactive applications using 3d graphics

CO3: Investigate and apply software libraries for 3d graphics and related software needs.

CO4: Understand the issues relevant to computer animation.

CO5: Describe and synthesize character animation techniques, including motion, changing their facial expressions and crowd behavior.

REFERENCES:

1. Donald D. Hearn, M. Pauline Baker, Warren Carithers, “Computer Graphics with OpenGL”, Fourth Edition, Prentice Hall, 2011.
2. JungHun Hyan, “3D Graphics for Game Programming”, Chapman and Hall/CRC, 1st Edition, 2011.
3. Foley van Dam, Feiner Hughes, “Computer Graphics Principles and Practice”, Third

Edition, Addison Wesley, 2014.
4. Alan Watt, Mark Watt, “Advanced Animation and Rendering Techniques: Theory and Practice”, Addison Wesley, 1992.
5. Rick Parent, “Computer Animation – Algorithms and Techniques”, Third Edition, Morgan Kaufman, 2012.
6. Edward Angel, Dave Shreiner, “Interactive Computer Graphics: A Top-Down Approach with OpenGL”, Sixth Edition, Addison Wesley, 2012.

AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING **L T P C**
2 0 0 0

COURSE OBJECTIVES:

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING **6**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS **6**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS **6**

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS **6**

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS **6**

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES:

1. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
4. Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

AX4092 DISASTER MANAGEMENT L T P C
2 0 0 0

COURSE OBJECTIVES:

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

UNIT I INTRODUCTION 6

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

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

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

UNIT III DISASTER PRONE AREAS IN INDIA 6

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

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT 6

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

UNIT V RISK ASSESSMENT 6

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

TOTAL : 30 PERIODS

COURSE OUTCOMES:

CO1: Ability to summarize basics of disaster

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

REFERENCES:

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

AX4093 CONSTITUTION OF INDIA L T P C
2 0 0 0

COURSE OBJECTIVES:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT V LOCAL ADMINISTRATION

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level:

Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT VI ELECTION COMMISSION

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING

1. The Constitution of India,1950(Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

AX4094 **நற்றமிழ் இலக்கியம்** **L T P C**
2 0 0 0

UNIT I **சங்க இலக்கியம்** **6**

1. தமிழின் துவக்க நூல் தொல்காப்பியம்
   – எழுத்து, சொல், பொருள்
2. அகநானூறு (82)
   - இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95,195)
   - போரை நிறுத்திய ஔவையார்

UNIT II **அறநெறித் தமிழ்** **6**

1. அறநெறி வகுத்த திருவள்ளுவர்
   - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
   – ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III **இரட்டைக் காப்பியங்கள்** **6**

1. கண்ணகியின் புரட்சி
   - சிலப்பதிகார வழக்குரை காதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
   - சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV **அருள்நெறித் தமிழ்** **6**

1. சிறுபாணாற்றுப்படை
   - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
   - சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்திணை 50 (27) - மான்

   ஆகியவை பற்றிய செய்திகள்

UNIT V **நவீன தமிழ் இலக்கியம்** **6**

1. உரைநடைத் தமிழ்,
   - தமிழின் முதல் புதினம்,
   - தமிழின் முதல் சிறுகதை,
   - கட்டுரை இலக்கியம்,
   - பயண இலக்கியம்,
   - நாடகம்,
2. நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4. பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. இணையத்தில் தமிழ்,
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

<u>தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்</u>

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University)
   - www.tamilvu.org

2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)
-https://ta.wikipedia.org
3. தர்மபுர ஆதீன வெளியீடு
4. வாழ்வியல் களஞ்சியம்
- தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம்
- தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம்
- தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்