

ANNA UNIVERSITY, CHENNAI
NON - AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. MOBILE AND PERVASIVE COMPUTING
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

- I. Have a successful professional career in industry, government, academia, military and start-ups as innovative engineers.
- II. Effectively solve engineering problems associated with Cyber Physical Systems, Real Time mobility Applications, Smart systems, and Networking Applications.
- III. Have the ability to think analytically and logically to understand technical problems in ubiquitous systems and provide solutions through research and lifelong learning.
- IV. Adopt ethical practices to collaborate with team members and team leaders to build cutting-edge technical solutions in a connected world.
- V. Strongly focus on transformative ideas and critical analysis, to innovate and be active members ready to serve the society, locally and internationally.

2. PROGRAM SPECIFIC OUTCOMES (PSOs):

1. Adapt new technologies such as 5G and beyond for developing solutions to real world problems.
2. Exhibit proficiency in pervasive computing areas for providing solutions to real world problems in industry and research establishments in the application areas of IoT, autonomous vehicles, and smart homes/Cities.
3. Excel in hybrid mobile application development with a focus on security to address business needs.

PROGRESS THROUGH KNOWLEDGE

ANNA UNIVERSITY, CHENNAI
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M.E. MOBILE AND PERVASIVE COMPUTING
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CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND 1st SEMESTER SYLLABI
SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA4105	Applied Mathematics for Pervasive Computing	FC	4	0	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.	MP4151	Embedded Systems and IIoT	PCC	3	0	2	5	4
5.	CP4153	Network Technologies	PCC	3	0	0	3	3
6.	MP4152	Wireless Communications	PCC	3	0	0	3	3
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
TOTAL				20	0	6	26	21

*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.	MP4253	Cloud Computing Technologies	PCC	3	0	0	3	3
2.	MP4252	Mobile Application Development	PCC	3	0	2	5	4
3.	MP4251	Cyber Physical Systems	PCC	3	0	2	5	4
4.	NE4251	Network Security	PCC	3	0	0	3	3
5.		Professional Elective I	PEC	3	0	0	3	3
6.		Professional Elective II	PEC	3	0	0	3	3
7.		Audit Course – II*	ACC	2	0	0	2	0
PRACTICALS								
8.	MP4211	Term Paper and seminar	EEC	0	0	2	2	1
9.	NE4261	Network Security Laboratory	PCC	0	0	2	2	1
TOTAL				20	0	8	28	22

*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.	MP4351	Smart Convergent Technologies	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.	MP4311	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.	MP4411	Project Work II	EEC	0	0	24	24	12
TOTAL				0	0	24	24	12

TOTAL NO. OF CREDITS: 74

 PROGRESS THROUGH KNOWLEDGE

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.	MP4075	Web Services and API Design	PEC	3	0	0	3	3
2.	BD4251	Big Data Mining and Analytics	PEC	3	0	0	3	3
3.	MP4073	Human Computer Interaction	PEC	3	0	0	3	3
4.	MP4001	Energy Aware Computing	PEC	3	0	0	3	3
5.	IF4079	Social Network Analysis	PEC	3	0	0	3	3
6.	MP4071	Cognitive Computing	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.	MP4002	RFID and Sensor Technology	PEC	3	0	0	3	3
2.	MP4003	Body Area Networks	PEC	3	0	0	3	3
3.	CP4071	Autonomous Systems	PEC	3	0	0	3	3
4.	MP4074	Soft Computing Techniques	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.	MP4004	Mobile Game Development	PEC	3	0	0	3	3
2.	MP4005	Full - Stack Mobile Development	PEC	3	0	0	3	3
3.	MP4072	Healthcare Analytics	PEC	3	0	0	3	3
4.	NE4071	Haptic Technology	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.	CP4252	Machine Learning	PEC	3	0	2	5	4
2.	BC4151	Biometric Systems	PEC	3	0	2	5	4
3.	IF4073	Deep Learning	PEC	3	0	2	5	4
4.	CP4072	Bioinformatics	PEC	3	0	2	5	4
5.	CP4073	Blockchain Technologies	PEC	3	0	2	5	4
6.	MU4253	Mixed Reality	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



COURSE OBJECTIVES:

This course will help the student to

- study the methods of solving a system of linear equations using matrix theory.
- learn the mathematical aspects of graph, colouring, various graph theoretic algorithms which are applicable to computer languages.
- study the linear programming models and Transportation models and various techniques to solve them.
- determination of probability and moments, distributions of discrete and continuous random variables and random processes.
- study the characteristics of queueing models and discrete Markov chains, applications of them.

UNIT I MATRIX METHODS**12**

Introduction to vector spaces - Basic vector analysis methods - Matrix norms – Jordan canonical form – Generalized eigenvectors – Singular value decomposition – Pseudo inverse – Least square approximations – QR decomposition method.

UNIT II GRAPH THEORY**12**

Introduction to paths, trees, vector spaces - Matrix coloring and directed graphs - Some basic algorithms – Shortest path algorithms – Depth - First search on a graph – Isomorphism – Other Graph - Theoretic algorithms – Performance of graph theoretic algorithms – Graph theoretic computer languages.

UNIT III OPTIMIZATION TECHNIQUES**12**

Linear programming - Basic concepts – Graphical and simplex methods – Big M method - Two phase simplex method - Revised simplex method - Transportation problems – Assignment problems.

UNIT IV PROBABILITY AND RANDOM VARIABLES**12**

Probability – Axioms of probability – Conditional probability – Bayes theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Exponential, Normal distributions – Two dimensional random variables - Poisson process.

UNIT V QUEUEING THEORY**12**

Single and multiple servers - Markovian queueing models - Finite and infinite capacity queues – Finite source model – Queueing applications.

TOTAL: 60 PERIODS**COURSE OUTCOMES :**

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

- apply various methods in matrix theory to solve system of linear equations.
- mathematical concepts on graph theory and various graph related algorithms.
- could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
- computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.

- exposing the basic characteristic features of a queuing system and acquire skills in analyzing queuing models, using discrete time Markov chains to model computer systems.

REFERENCES :

1. Bronson, R. "Matrix Operations", Schaum's outline series, 2nd Edition, McGraw Hill, 2011.
2. Lewis, D.W. "Matrix Theory", Allied Publishers, Chennai, 1995.
3. Narasingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall India, 1997.
4. Rao, S. S. "Engineering Optimization, Theory and Practice", 4th Edition, John Wiley and Sons, 2009.
5. Taha H .A. "Operations Research: An Introduction", 10th Edition, Pearson Education Asia, New Delhi, 2017.
6. Walpole R.E., Myer R.H., Myer S.L., and Ye, K., "Probability and Statistics for Engineers and Scientists ", 9th Edition, Pearson Education, Delhi, 2012.

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 & Biodiversity, 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-filing, 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.

MP4151

EMBEDDED SYSTEMS AND IIOT

L T P C
3 0 2 4

COURSE OBJECTIVES:

- To learn the internal architecture of an embedded processor including timers and interrupts.
- To learn and use embedded C programming.
- To provide exposure on architecture and components of IIOT.
- To introduce the communication protocols of IIOT.
- To study about visualization and data processing of IIOT.

UNIT I EMBEDDED PROCESSOR

9

Embedded processors –8051 Microcontroller – Architecture, Instruction set and programming. Programming parallel ports, Timers and serial port – Memory and I/O devices interfacing – Interrupt handling.

UNIT II EMBEDDED C PROGRAMMING

9

Programming Embedded Systems in C - Memory And I/O Devices Interfacing - Implementing Timers, Interrupts and Serial communication in embedded C- Need For RTOS - Multiple Tasks

and Processes – Context Switching - Priority Based Scheduling Policies.

UNIT III INTRODUCTION & ARCHITECTURE OF IIOT 9

Introduction to IOT, IIOT, IOT Vs. IIOT, Architecture of IIoT, IOT node- Components of IIOT - Fundamentals of Control System, introductions, components, closed loop & open loop system, IIOT System components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, Introduction to sensors, Types of sensors, working principle of basic Sensors - Ultrasonic Sensor, IR sensor, MQ2, Temperature and Humidity Sensors (DHT-11). Digital switch, Electro Mechanical switches, Roles of sensors and actuators in IIOT, Special requirements for IIOT sensors.

UNIT IV COMMUNICATION TECHNOLOGIES OF IIOT 9

Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet, Current, M2M etc. Need of protocols; Communication Protocols: Wi-Fi, Wi-Fi direct, IEEE 802.15.4, Zigbee, Z wave, BLE, SPI, RFID, Industry standards communication technology (COAP, LoRAWAN, OPC UA, MQTT AMQP IIOT), connecting into existing Modbus and Profibus technology, wireless network communication.

UNIT V VISUALIZATION OF IIOT 9

Cloud platforms: Overview of cots cloud platforms, predix, thingworx, azure etc. Front-end EDGE devices, Enterprise data for IIoT, Emerging descriptive data standards for IIoT, Cloud database, Cloud computing, Fog or Edge computing. Connecting an Arduino/Raspberry pi to the Web: Introduction, setting up the Arduino/Raspberry pi development environment, Options for Internet connectivity with Arduino, Configuring your Arduino/Raspberry pi board for the IoT.

TOTAL: 45 PERIODS

SUGGESTED ACTIVITIES:

1. A Study on the various embedded processors like virtual watches, PDAS, digital cameras, mp3 players
2. Develop an application using embedded C programming in arduino
3. Build a project using IIOT components
4. Study of communication protocols and technology in IIOT
5. Presentation on most prominent IIOT visualization tools

PRACTICAL EXERCISES:

1. Experiments on Arduino, ESP8266, raspberry Pi
2. Measurement of temperature & pressure values of the process using raspberry pi/node mcu.
3. Modules and Sensors Interfacing (IR sensor, Ultrasonic sensors, Soil moisture sensor) using Raspberry pi/node mcu.
4. Modules and Actuators Interfacing (Relay, Motor, Buzzer) using Raspberry pi/node mcu.
5. Demonstration of MQTT communication
6. Demonstration of LoRa communication.

TOTAL: 30 PERIODS

HARDWARE/SOFTWARE REQUIREMENTS

1. Arduino
2. ESP8266
3. Raspberry Pi

COURSE OUTCOMES:

- CO1:** Describe the internal architecture of an embedded processor including timers and interrupts.
- CO2:** Write the embedded C programming.
- CO3:** Use the components of IIOT for building applications.
- CO4:** Demonstrate and perform the communication by using the protocols.
- CO5:** Explain about visualization and data processing of IIOT.

TOTAL: 75 PERIODS**REFERENCES:**

1. Michael J. Pont, "Embedded C", Pearson Education, 2007.
2. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014.
3. Mahmood, Zaigham (Ed), "The Internet of Things in the Industrial Sector", Springer Publication, 2019.
4. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, "Industrial Internet of Things: Cyber manufacturing System (wireless Technology)", Springer Publication, 2017.
5. Hakima Chaouchi, "The Internet of Things Connecting Objects to the Web" ISBN: 978-1-84821-140-7, Willy Publications, 2010.
6. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
7. Ismail Butun, "Industrial IoT Challenges, Design Principles, Applications, and Security", Springer Publications, 2020.
8. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
9. David Etter, "IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT", 2016.
10. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, ISBN: 978-1-119-99435-0, 2 nd Edition, Willy Publications.
11. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications.

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

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

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 Combining – 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.

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/>

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
5. 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. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company, 2007.
3. Sahni, Pradeep Et. Al. , " Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, 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 of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution 1917 And 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 Panchayat. 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., LexisNexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, LexisNexis, 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 ஓளவையார்

UNIT II**அறநெறித் தமிழ்****6**

1. அறநெறி வகுத்த திருவள்ளுவர்
 - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புறவு அறிதல், 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 ஓளவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
 2. நற்றிணை
 - அன்னைக்குரிய புன்னை சிறப்பு
 3. திருமந்திரம் (617, 618)
 - இயமம் நியமம் விதிகள்
 4. தரமச்சாலையை 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

தமிழ் இலக்கிய வெளியீடுகள் / புத்தகங்கள்

1. தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University)
- www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)
- <https://ta.wikipedia.org>
3. தர்மபுர ஆதின வெளியீடு
4. வாழ்வியல் களஞ்சியம்
- தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5. தமிழ்கலைக் களஞ்சியம்
- தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6. அறிவியல் களஞ்சியம்
- தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்

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