SEMESTER-II

COURSE TITLE: Design and Analysis of Algorithm

Course Code: MMCACDA225						Examination Scheme	T	P
Total number of Lecture Hours: 60						External	72	-
						Internal	28	-
Lecture (L):	4	Practical (P):	-	Tutorial (T):	-	Total Credits		4

COURSE LEARNING OUTCOMES (CLO):

CLO1: Students will be able to analyze the time and space complexity of algorithms using asymptotic notations and recurrence-solving techniques such as the substitution method, recursion trees, and the Master Method.
CLO2: Students will apply algorithmic paradigms like divide-and-conquer, greedy method, and randomization to solve computational problems such as sorting, shortest paths, and primality testing.
CLO3: Students will implement and evaluate optimization techniques using dynamic programming, backtracking, and branch-and-bound strategies for problems like TSP, 8-Queen, and knapsack.
CLO4: Students will classify computational problems based on complexity classes (P, NP, NP-Complete, NP-Hard) and apply approximation algorithms to solve intractable problems such as vertex cover and subset sum.

Course Content	TEACHING HOURS
UNIT I: Fundamentals of Algorithm Analysis	**15 Hrs**
Introduction to Algorithms, Analysis of Algorithms, Growth of Functions, Asymptotic notations. Recurrences, Substitution method, Iteration method, Recursion trees, The Master Method, Time and Space Complexity study of some basic algorithms.	
UNIT II: Advanced Algorithmic Techniques	**15 Hrs**
Randomized Algorithms: Identifying the repeated element, Primality testing, Advantages and Disadvantages. Divide and Conquer Strategy: Binary search, Quick sort, Merge sort, Greedy Method, General method, Knapsack problem, Single source shortest paths.	
UNIT III: Optimization and Search Strategies	**15 Hrs**
Dynamic programming Strategy: All pair shortest paths, Traveling salesman problems. Backtracking Strategy: 8-Queen problem, Sum of subsets, Knapsack problem. Branch and Bound Strategy: Least Cost Branch and Bound, 8-Queen Problem	
UNIT IV: Computational Complexity and Approximation Algorithms	**15 Hrs**
Lower boundary theory, Lower bound theory through reductions, P and NP problems. NP hard and NP complete problems, Cook's Theorem, Approximate Algorithms and their need, The vertex Cover Problem, The traveling salesman problem, The subset sum problem	

CLO-PLO Matrix for the Course											
	PLO										
Unit-Wise CLOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg (CLO)**
MMCACDA225.1	3	2	2	0	3	0	1	1	1	3	**1.6**
MMCACDA225.2	3	3	3	0	3	0	1	2	2	3	**2.0**
MMCACDA225.3	2	3	3	0	3	0	1	2	2	3	**1.9**
MMCACDA225.4	3	2	2	1	3	1	1	1	2	3	**1.9**
Avg (PLO)	**2.8**	**2.5**	**2.5**	**0.25**	**3.0**	**0.25**	**1.0**	**1.5**	**1.75**	**3.0**	**1.85**

Textbooks:

1. Horowitz, Sahni, Rajasekaran "Fundamentals of Computer Algorithms",Galgotia Publications

Reference Books:

1. Coremen, Leiserson, Rivest,Stein, "Introduction to Algorithms", 2nd edition, PHI.
2. Michael T. Goodrich, Roberto Tamassia "Algorithm Design and Applications" , Wiley
3. Aho, Hopcroft and Ullman, "The Design and Analysis of Computer Algorithms", Pearson

COURSE TITLE: Mobile Application Development

Course Code: MMCACMA225						**Examination Scheme**	
Total number of Lecture Hours: 60						**External**	**72**
						Internal	**28**
Lecture (L):	**4**	**Practical (P):**	**2**	**Tutorial (T):**	**0**	**Total Credits**	**4**

COURSE LEARNING OUTCOMES (CO):

CLO1: Understand mobile app development fundamentals, Java basics, and development lifecycle.

CLO2: Set up Android development environment and build basic Android applications.

CLO3: Explain core Android components, data handling, intents, and permissions.

CLO4: Design Android user interfaces and implement database connectivity with SQLite.

COURSE CONTENT	TEACHING HOURS
UNIT 1: Mobile Application Development	**15 Hrs.**
Mobile Applications and Device Platforms, Alternatives for Building Mobile Apps, Comparing Native vs. Hybrid Applications, The Mobile Application Development Lifecycle, The Mobile Application Front-End and Back-End, Key Mobile Application Services, Introduction to Java, Java Setup and Program structure, Inheritance and Exception, Handling Events, Debugging, Introduction to Classes.	
UNIT 2: Introduction to Android	**15 Hrs.**
The Android Platform, Android SDK, Eclipse Installation, Android Installation, Building you First Android application, Understanding Anatomy of Android Application, Need of Android, Advanced Android Features, Tools and Software required for developing an Android application.	
UNIT 3: Android terminologies	**15 Hrs.**
Android terminologies, Application Context, Activities, Services, Intents, Android Storing and Retrieving data, Receiving and Broadcasting Intents, Content Provider, Android Manifest File and its common settings, Using Intent Filter, Permissions, Android Networking and Web.	
UNIT 4: Android User Interface Design Essentials	**15 Hrs.**
Android User Interface Design Essentials: Fundamental UI design, User Interface Screen elements, Designing User Interfaces with Layouts, Text View, List View, Grid View, Image View, Scroll View, Drawing and Working with Animation, SQLite Database, Creating and Connection of the database.	

CLO-PLO Matrix for the Course

	PLO										
UNIT-WISE CLOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg (CLO)**
MMCACMA225.1	3	2	2	0	0	0	0	0	0	0	**2.33**
MMCACMA225.2	0	0	3	3	3	0	0	0	0	0	**3.0**
MMCACMA225.3	0	0	0	0	3	3	2	0	0	0	**2.67**
MMCACMA225.4	0	0	0	0	0	0	0	3	2	0	**2.5**
Avg (PLO)	**1.5**	**1.0**	**1.67**	**1.5**	**2.0**	**1.5**	**1.0**	**1.5**	**1.0**	**0**	**2.63**

Textbooks
1. Lauren Darcey and Shane Conder, "Android Wireless Application Development", Pearson Education, 2nd ed. (2011)
2. Jerome DiMarzio, "Beginning Android Programming with Android Studio", 4th Edition.
Reference Books
1. Reto Meier, "Professional Android 2 Application Development", Wiley India Pvt Ltd
2. Mark L Murphy, "Beginning Android", Wiley India Pvt Ltd
3. Hortan, John, "Android Programming for Beginners", Packet Publication, 2015, ISBN: 978-1-78588-326-2.

DCE-III

COURSE TITLE: Advanced Operating Systems

Course Code: MMCADA0225						Examination Scheme	T	P
Total number of Lecture Hours: 60						External	72	-
						Internal	28	-
Lecture (L):	4	Practical(P):	0	Tutorial (T):	0	Total Credits	4	

COURSE LEARNING OUTCOMES (CLO):

CLO1: Identify OS types; apply scheduling and fault-tolerance in basic, distributed, and Real Time Operating System.

CLO2: Implement IPC and synchronization in centralized, distributed, and Real Time Operating System.

CLO3: Analyze memory management in traditional, distributed, and Real Time Operating System.

CLO4: Apply deadlock handling in centralized, distributed, and Real Time Operating System.

Course Content	TEACHING HOURS
UNIT 1: Introduction and Scheduling	**15 Hrs.**
Operating System Overview, Types of Operating Systems; Basic Operating System: Processes, Scheduling criteria, Scheduling Algorithms. Introduction to Distributed Operating System, Processor allocation and scheduling in distributed systems - System Models, Load balancing and sharing approach, fault tolerance.	
UNIT 2: Inter-Process Communication and Synchronization	**15 Hrs.**
Interprocess Communication and Synchronization, Classical problems, Critical section, Semaphores, Monitors. Synchronization in Distributed Systems; Clock Synchronization and related algorithms, Logical Clocks. Mutual Exclusion: Centralized & Distributed (Contention & Token) Algorithms. Election Algorithms: Bully Algorithm, Invitation Algorithm. Client Server model; Remote procedure call and implementation issues.	
UNIT 3: Memory Management	**15 Hrs.**
Memory Management: Address Spaces, Virtual Memory. Page Replacement Algorithms, Design and Implementation Issues for Paging Systems, Segmentation. General architecture of Distributed Shared Memory systems; Design and Implementation issues of DSM; granularity - Structure of shared memory space, consistency models, replacement strategy, thrashing.	
UNIT 4: Deadlocks	**15 Hrs.**
Deadlocks characterization, Methods for handling deadlocks; Deadlock Prevention, Avoidance, Detection, Recovery. Deadlocks in distributed OS; Deadlock Modeling, Handling Deadlocks in Distributed Systems, Deadlock Avoidance, Deadlock Prevention, Deadlock Detection; Centralized Approach for Deadlock Detection, Fully Distributed Approaches for Deadlock Detection, WFG-Based Distributed Algorithm for Deadlock Detection, Recovery from Deadlock, Issues in Recovery from Deadlock.	

CLO-PLO Matrix for the Course											
	PLO										
UNIT-WISE CLOs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Avg (CLO)**
MMCADAO225.1	3	2	2	0	0	0	0	0	0	0	**2.33**
MMCADAO225.2	0	0	3	3	2	0	0	0	0	0	**2.67**
MMCADAO225.3	0	0	0	0	3	2	0	0	0	0	**2.50**
MMCADAO225.4	0	0	0	0	0	2	3	3	0	0	**2.67**
Avg (PLO)	**1.5**	**1.0**	**1.67**	**1.5**	**2.5**	**2.0**	**1.5**	**1.5**	**0**	**0**	**2.54**

Textbooks:

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, "Operating System Principles", John Wiley.
2. Pradeep K. Sinha , "Distributed Operating Systems : Concepts and Design", PHI
3. Rajib Mall, Real-Time Systems: Theory and Practice (Second Edition), Pearson Education.

Reference Books:

1. Andrew.S. Tanenbaum, "Modern Operating Systems", PHI. Andrew. S. Tanenbaum,"Distributed Operating System", PHI.
2. Andrew S. Tanenbaum, Modern Operating Systems (Third Edition), Pearson Education.
3. David E. Simon, An Embedded Software Primer, Pearson Education.
4. Laplante, P., Real-Time Systems Design and Analysis (Third Edition), IEEE/Wiley Interscience.
5. Jane W.S. Liu, Real-Time Systems (Sixth Edition), Pearson Education.
6. Raj Kamal, Embedded Systems: Architecture, Programming and Design (Third Edition), Tata McGraw-Hill Education

COURSE TITLE: Digital Image Processing

Course Code: MMCADDI225						Examination Scheme	T	P
Total number of Lecture Hours: 60						External	72	-
Total number of Practical Hours: -						Internal	28	-
Lecture (L):	4	Practical(P):	0	Tutorial (T):	0	Total Credits	4	

COURSE LEARNING OUTCOMES (CLO):

CLO1: Understanding the fundamental concepts of digital image processing, including image formation, digitization, and pixel relationships.

CLO2: Apply spatial and frequency domain techniques for image enhancement using filtering and transformation methods.

CLO3: Analyze image degradation models and perform restoration and morphological operations for noise removal and structure preservation.

CLO4: Implement edge detection and image segmentation techniques for identifying and extracting regions of interest in digital images.

Course Content	TEACHING HOURS
UNIT 1: Introduction.	**15 Hrs.**
Introduction Digital Image processing, Origins of DIP, Examples, Fundamental steps in DIP,Components of DIP. Fundamentals Elements of visual perception: brightness, contrast, hue, saturation, Mach-band effect; Light and the electromagnetic spectrum. Image formation and digitization concepts; Image Sensing and acquisition; Image samplingand quantization. Basic relationships between pixels: Neighbours of pixel adjacency connectivity, regions andboundaries, Distance measures.	
UNIT 2: Image Enhancement	**15 Hrs.**
Image enhancement in the spatial domain: Background; Point and arithmetic/ logic operations; Some basic grey level transformations; Histogram processing: Equalization,Matching. Mechanics of spatial filtering: Correlation, Convolution; Smoothing spatial filters: Averaging and Weighted-Averaging Filters, Gaussian Filter; Sharpening spatial filters: First and Second Derivatives, Laplacian, Unsharp Masking and High Boost Filtering. Image enhancement in the frequency domain: Background, Introduction to the Fourier transform and the frequency domain, Smoothing Frequency-Domain filters, Sharpening Frequency Domain filters.	
UNIT 3: Image Restoration and Morphological Processing.	**15 Hrs.**
Model of image degradation/restoration process: Noise models; Restoration by spatial filtering: Mean Filters, Order-Statistics Filters; Restoration by frequency domain filtering:Bandreject Filters, Bandpass Filters. Morphological Processing: Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform,Boundary Detection, Hole filling, connected components, thinning, thickening, skeletons,pruning. Color Image Processing: Color Fundamentals, Color Models: RGB, CMY	

and CMYK, HIS,Conversion from RGB to HSI and vice versa	
UNIT 4: Edge Detection and Segmentation.	**15 Hrs.**
Edge detection: Basic Formulation: Detecting Points and Lines, Edge Models; Gradient andits Properties; Gradient Operators: Roberts, Prewitt, Sobel; Canny Edge Detector; Thresholding: Basic Global Thresholding, Basic Adaptive Thresholding. [6 Lectures] Region based segmentation: Basic Formulation, Region growing, Region splitting and Merging; Segmentation by morphological watersheds: Basic concepts, Dam construction,Watershed Algorithm.	

CLO-PLO Matrix for the Course

CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Average (CLO)
MMCADDI225.1	3	1	2	0	2	0	1	1	0	2	1.2
MMCADDI225.2	2	3	2	1	3	0	1	2	1	3	1.8
MMCADDI225.3	3	3	3	1	3	1	2	2	1	3	2.2
MMCADDI225.4	2	3	3	1	3	1	2	3	2	3	2.3
Average(PLO)	2.5	2.5	2.5	0.75	2.75	0.5	1.5	2	1	2.75	1.8

Textbooks:

1. Rafael C. Gonzalez, Richard E. Woods. Digital Image Processing, Pearson, SecondEdition, 2004.
2. Anil K. Jain. Fundamentals of Digital Image Processing, Pearson 2002.

Reference Books:

1. Principles of Digital Image Processing by Wilhelm Burger.

COURSE TITLE: Decision Support Systems

Course Code: MMCADDS225						Examination Scheme	T	P
Total number of Lecture Hours: 60						External	72	-
						Internal	28	-
Lecture (L):	4	Practical(P):	0	Tutorial (T):	0	Total Credits	4	

COURSE LEARNING OUTCOMES (CLO):

CLO1: Understand decision support systems (DSS), their development methodologies, and technology platforms to aid in effective decision-making.
CLO2: Apply modeling techniques in DSS to address scenarios involving certainty, uncertainty, and risk.
CLO3: Design and implement DSS solutions using appropriate tools, platforms, and methodologies.
CLO4: Analyze enterprise-level DSS and knowledge management systems for enhanced organizational decision-making and collaboration.

Course Content	TEACHING HOURS
UNIT 1: Decision Making	**15 Hrs.**
DSS Development Introduction – Traditional and alternative development methodologies - Change Management – DSS Technology Levels and Tools – Development Platforms – Tool Selection..	
UNIT 2: Modeling and Analysis	**15 Hrs.**
Definition – Characteristics and capabilities of DSS – DSS components - Modeling and issues – Static and dynamic models – Certainty, Uncertainty and Risk – Influence Diagrams – Structure of Mathematical models.	
UNIT 3: DSS Development	**15 Hrs.**
Introduction – Traditional and alternative development methodologies - Change Management – DSS Technology Levels and Tools – Development Platforms – Tool Selection.	
UNIT 4: Enterprise DSS and Knowledge Management	**15 Hrs.**
Communication support – Collaboration support - Group support systems and technologies – GSS meeting process – Creativity and idea generation – Enterprise information systems – Evolution – Characteristics and capabilities of executive support systems – Organizational DSS - Organizational learning and transformation – Knowledge management initiatives – approaches – implementation.	

CLO-PLO Matrix for the Course

	PLOs										
Unit-Wise CLOs	1	2	3	4	5	6	7	8	9	10	Average (CLO)
MMCADDS225.1	3	2	2	2	2	1	2	2	2	2	**2.0**
MMCADDS225.2	3	3	2	2	3	1	2	2	2	3	**2.3**
MMCADDS225.3	3	3	3	2	3	1	2	2	2	3	**2.4**
MMCADDS225.4	3	2	3	3	3	2	3	2	2	2	**2.5**
Average (PLO)	**3.0**	**2.5**	**2.5**	**2.25**	**2.75**	**1.25**	**2.25**	**2**	**2**	**2.5**	**2.3**

Textbooks

1. Efraim Turban, Jay E Aronson, Ting Peng Liang, Decision Support and Intelligent Systems, Prentice Hall of India, 7th Edition 2005.
2. Efraim Turban, Ramesh Sharda, Dursun Delen, Decision support and Business Intelligence systems, Pearson Education, 9th Edition, 2011.

Reference Books: -

1. Decision Support systems for business Intelligence 2nd edition by Vicki L Sauter Willey.
2. Elain Rich and Kevin Knight, Artificial intelligence, TMH, 2006

COURSE TITLE: Cryptography and Network Security

Course Code: MMCADCN225						Examination Scheme	T	P
Total number of Lecture Hours: 60						External	72	-
						Internal	28	-
Lecture (L):	4	Practical(P):	0	Tutorial (T):	0	Total Credits	4	

COURSE LEARNING OUTCOMES (CO):

CLO1: Students will be able to explain fundamental concepts of information and network security, including security goals, classical encryption methods, and number theory used in cryptography.

CLO2: Students will apply symmetric and asymmetric cryptographic algorithms such as AES, RSA, and ECC to ensure secure communication.

CLO3: Students will analyze and implement data integrity techniques using hash functions, MACs, and digital signature schemes.

CLO4: Students will describe and evaluate network security practices including TLS, SSH, firewalls, and intrusion detection systems.

Course Content	TEACHING HOURS
UNIT I: Basics of Security and Classical Encryption	**15 Hrs.**
Introduction to Information and Network Security, Security Goals: Confidentiality, Integrity, Availability, Types of Attacks and Threats, Basics of Number Theory for Cryptography, Classical Encryption Techniques: Substitution, Transposition, One-Time Pad	
UNIT II: Modern Cryptography	**15 Hrs.**
Symmetric Encryption: DES, AES, and Modes of Operation, Stream Ciphers and Pseudorandom Number Generators, Asymmetric Encryption: RSA, Diffie-Hellman, ElGamal, and ECC	
UNIT III: Data Integrity and Digital Signatures	**15 Hrs.**
Cryptographic Hash Functions (SHA-1, SHA-3), Message Authentication Codes (HMAC, CMAC), Digital Signatures: RSA, ElGamal, ECDSA, Key Management Basics	
UNIT IV: Network Security Practices	**15 Hrs.**
Secure Communication: HTTPS, TLS, SSH, Email and IP Security, Firewalls and Intrusion Detection Systems.	

CLO-PLO Matrix for the Course

Unit-Wise CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	Avg (CLO)
MMCADCN225.1	3	2	1	1	2	2	1	1	1	2	**1.6**
MMCADCN225.2	3	3	2	1	3	2	1	2	2	3	**2.2**
MMCADCN225.3	3	3	2	1	3	3	2	2	2	3	**2.4**
MMCADCN225.4	2	3	2	2	2	2	1	1	1	2	**1.8**
Average (PLO)	**2.75**	**2.75**	**1.75**	**1.25**	**2.5**	**2.25**	**1.25**	**1.5**	**1.5**	**2.5**	**2**

Textbooks

1. William, Stalling, Cryptography and Network Security, 8/E." Prentice Hall. (2023).
2. Forouzan, Behrouz A., and Debdeep Mukhopadhyay. Cryptography and network security (Sie). McGraw-Hill Education, 2011.

Reference Books

1. Paar, Christof, and Jan Pelzl. Understanding cryptography: a textbook for students and practitioners. Springer Science & Business Media, 2009.
2. Introduction to Modern Cryptography (Chapman & Hall/CRC Cryptography and Network Security Series) Jonathan Katz , Yehuda Lindell

DCE-IV

COURSE TITLE: Advanced Computer Networks								
Course Code: MMCADAC225						**Examination Scheme**	**T**	**P**
Total number of Lecture Hours:60						**External**	**72**	**-**
						Internal	**28**	**-**
Lecture (L):	**4**	**Practical's (P):**	**-**	**Tutorial (T):**	**-**	**Total Credits**	**4**	

COURSE LEARNING OUTCOMES (CLO): Upon successful completion of this course, learners will be able to:

CLO1: List the functionalities of different layers in both the OSI and TCP/IP reference models.
CLO2: Identify data link layer design issues and apply error detection and correction techniques.
CLO3: Describe the principles of switching and routing algorithms used in computer networks.
CLO4: Distinguish between TCP and UDP formats and procedures, understanding their respective uses and characteristics.

Course Content	TEACHING HOURS
UNIT I:	**-15 Hrs**
Introduction: Components of Network, Topologies, Categories of Networking: LAN, WAN, MAN. Uses of Networks. Reference Models: TCP/IP Model, The OSI Model, and Comparison of the OSI and TCP/IP reference model. Architecture of Internet. **Transmission Media:** Guided transmission media, Wireless transmission media, Radio Transmission, Microware Transmission, Infrared Transmission and Light Transmission, Digital Modulation and Multiplexing, Switching.	
UNIT II:	**-15 Hrs**
Data Link Layer: Design issues, Error Detection & Correction, Elementary Data Link Layer Protocols, Sliding window protocols and SONET **Medium Access Control Sub layer:** The Channel Allocation problem and Multiple Access Protocols, Ethernet. Multiple Access Protocols - ALOHA, CSMA,CSMA/CD, CSMA/CA, Collision free protocols, Ethernet- Physical Layer, Ethernet Mac Sub layer, Data link layer switching: Use of bridges, learning bridges, spanning tree bridges, repeaters, hubs, bridges, switches, routers and gateways.	
UNIT III:	**-15 Hrs**
Network Layer: Network Layer Design issues, store and forward packet switching connection less and connection oriented networks-routing algorithms-optimality principle, shortest path, flooding, Distance Vector Routing, Link State Routing, Path Vector Routing, Hierarchical Routing; Congestion control algorithms, IP addresses, CIDR, Subnetting, SuperNetting, IPv4, Packet Fragmentation, IPv6 Protocol, Transition from IPv4 to IPv6, ARP, RARP, OSPF , BGP and Traffic Prioritization.	
UNIT IV:	**-15 Hrs**
Transport Layer: Services provided to the upper layer's elements of transport protocol addressing connection establishment, Connection release, Error Control & Flow Control, Crash Recovery. The Internet Transport Protocols: UDP, Introduction to TCP, The TCP Service Model, The TCP Segment Header, The Connection Establishment, The TCP Connection Release, The TCP Sliding Window, The TCP Congestion Control Algorithm, Socket Programming. **Application Layer**: Introduction, providing services, Applications layer paradigms: Client server model, HTTP, E-mail, WWW, TELNET, DNS.	

CLO-PLO Matrix for the Course											
Unit-Wise CLOs	**PLO 1**	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**Avg (CLO)**
MMCADAC225.1	3	1	1	1	1	1	1	1	1	1	**1.2**
MMCADAC225.2	2	3	3	1	2	2	2	1	1	3	**2**
MMCADAC225.3	3	3	3	3	2	1	2	2	2	3	**2.4**
MMCADAC225.4	3	2	2	2	2	1	1	1	1	2	**1.7**
Average (PLO)	**2.75**	**2.25**	**2.25**	**1.75**	**1.75**	**1.25**	**1.5**	**1.25**	**1.25**	**2.25**	**1.38**

Textbooks

1. Kurose, James F., and Keith W. Ross. *Computer Networking: A Top-Down Approach.* 8th ed., Pearson, 2021.
2. Stallings, William. *Data and Computer Communications.* 11th ed., Pearson, 2022.
3. Tanenbaum, Andrew S., and David J. Wetherall. *Computer Networks.* 5th ed., Pearson, 2013.

Reference Books

1. Forouzan, Behrouz A. *TCP/IP Protocol Suite.* 5th ed., McGraw-Hill Education, 2023.
2. Comer, Douglas E. *Internetworking with TCP/IP: Principles, Protocols, and Architecture.* Vol. 1, 6th ed., Pearson, 2021.
3. Stallings, William. *Wireless Communications and Networks.* 2nd ed., Pearson, 2005.

COURSE TITLE: Cloud Computing

Course Code: MMCADCC225						Examination Scheme	T	P
Total number of Lecture Hours: 60						External	72	-
						Internal	28	-
Lecture (L):	4	Practical(P):	0	Tutorial (T):	0	Total Credits	4	

COURSE LEARNING OUTCOMES (CLO):

CLO1: Understanding of the fundamental concepts of cloud computing, including cloud models (IaaS, PaaS, SaaS), deployment types, and their impact on business agility, performance, and security.

CLO2: Analyse the role of virtualization in cloud computing and evaluate the deployment and functionality of cloud-based web services.

CLO3: Assess the reliability, scalability, and economic aspects of cloud service management using contemporary tools and platforms.

CLO4: Design, develop, and deploy applications using modern cloud platforms such as AWS, Azure, and Google App Engine.

Course Content	TEACHING HOURS
UNIT 1: CLOUD COMPUTING FUNDAMENTALS	**15 Hrs.**
Basic Concepts and Terminology, Goals and benefits, Risks and Challenges, Roles and boundaries, Cloud characteristics. Cloud Delivery Models: IaaS, PaaS, Saas. Cloud Deployment Models: Public, private and Hybrid Cloud.	
UNIT 2: CLOUD-ENABLING TECHNOLOGIES & SECURITY FOUNDATIONS	**15 Hrs.**
Virtualization fundamentals: Hypervisors, VM provisioning, isolation Web technologies and multitenancy Service-oriented architecture (SOA) in cloud Network, storage, and broadband infrastructure Cloud security basics, Threat Agents ,Cloud Security Threats	
UNIT 3: CLOUD COMPUTING MECHANISMS	**15 Hrs.**
Cloud Infrastructure Mechanism: Virtual Server, Cloud Storage Device, Cloud Usage Monitor, Resource Replication. Specialized Cloud Mechanisms: Load balancing, failover, replication, caching, SLA monitoring, billing, auto-scaling Cloud Management Mechanisms: SLA Management System and Billing Management System	
UNIT 4: CLOUD COMPUTING ARCHITECTURE	**15 Hrs.**
Fundamental Architectures: Workload Distribution Architecture, Resource Pooling Architecture, Dynamic Scalability Architecture, Service Load Balancing Architecture, Cloud Bursting Architecture. Advanced Architectures: Hypervisor Clustering ,Load Balanced Virtual Server Instances Architecture, Non-Disruptive Service Relocation Architecture, Zero Downtime Architecture.	

CLO-PLO Matrix for the Course

	PLOs										
CLOs	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	Average (CLO)
MMCADCC225.1	3	1	2	0	2	1	1	1	0	2	1.3
MMCADCC225.2	2	3	2	1	2	0	1	1	1	3	1.6
MMCADCC225.3	2	2	3	1	3	2	2	2	1	3	2.1
MMCADCC225.4	2	3	3	1	3	1	2	3	2	3	2.3
Average(PLO)	**2.25**	**2.25**	**2.5**	**0.75**	**2.5**	**1**	**1.5**	**1.75**	**1**	**2.75**	**1.8**

Textbooks

1. Gautam Shroff, "Enterprise Cloud Computing: Technology, Architecture, Applications", Cambridge University Press; 2nd Edition [ISBN: 9780521137355], 2023.
2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach" McGraw-Hill Education; 2nd Edition [ISBN: 9780071826400], 2018.
3. Dimitris N. Chorafas, "Cloud Computing Strategies" CRC Press; 2nd Edition [ISBN: 9780367338611], 2021.

Reference Books

1. Thomas Erl, "Cloud Computing: Concepts, Technology & Architecture" Prentice Hall; 3rd Edition [ISBN: 9780133994164], 2024.
2. Rajkumar Buyya, Christian Vecchiola, and Selvi, S. Thamarai, "Mastering Cloud Computing: Foundations and Applications Programming" Morgan Kaufmann; 3rd Edition [ISBN: 9780128180747], 2022.

COURSE TITLE: Linux Programming

Course Code: MMCADLP225						Examination Scheme	T	P
Total number of Lecture Hours: 60						External	72	-
						Internal	28	-
Lecture (L):	4	Practical(P):	0	Tutorial (T):	0	Total Credits	4	

COURSE LEARNING OUTCOMES (CLO):

CLO1: Understand the structure, utilities, and administrative functionalities of the Linux operating system, including user and process management.

CLO2: Apply shell scripting constructs to automate tasks and develop basic command-line applications using loops, conditionals, and functions.

CLO3: Demonstrate understanding of Linux kernel architecture and perform kernel extension through system calls and modules.

CLO4: Design and implement basic graphical user interface (GUI) applications using the toolkit and signal-slot mechanisms.

Course Content	TEACHING HOURS
UNIT 1: Introduction to Linux	**15 Hrs.**
Introduction – History, acquisition and installation, Linux features and directory structure. Linux utilities – directory and file manipulation, text processing, process management, system information, creating and managing users, setting ownerships/permissions, managing services.	
UNIT 2: Shell scripting	**15 Hrs.**
Shell – definition & types. Variables – local, shell & environment. Operators – test, expr, bc, built-in. Floating-point arithmetic. Expressions – arithmetic, relational and logical. Looping & decision-making statements. Substitution – filename, variable and command. Functions and positional parameters. Writing shell scripts for developing basic applications.	
UNIT 3: Kernel development	**15 Hrs.**
Linux kernel architecture. Building the kernel. Extending the kernel -- Syscalls and kernel modules. Compiling Modules. Loading/unloading modules. Module licensing. Exporting symbols. Writing kernel modules for extending Linux kernel.	
UNIT 4: GUI programming	**15 Hrs.**
X Window System - Introduction, history, features and working. X-Server, X-Protocol, X-Client, & X-lib. Qt toolkit – Introduction, cross-platform GUI development. Qt creator. Basic structure of a Qt program. Compilation. Signal-Slot mechanism. Qt widgets. Container widgets. Custom layouts and slots. Writing Qt programs for developing basic GUI applications.	

CLO-PLO Matrix for the Course

Unit-Wise CLOs	PLOs										
	1	2	3	4	5	6	7	8	9	10	Average (CLO)
MMCADLP225.1	3	3	3	1	3	2	2	2	1	3	**2.3**
MMCADLP225.2	3	3	3	1	3	2	2	3	1	3	**2.4**
MMCADLP225.3	3	3	3	1	3	2	2	3	2	3	**2.5**
MMCADLP225.4	2	3	3	2	3	1	2	3	1	3	**2.3**
Average (PLO)	**2.75**	**3.0**	**3.0**	**1.25**	**3.0**	**1.75**	**2.0**	**2.75**	**1.25**	**3.0**	**2.38**

Textbooks:

1. R. Petersen, LINUX: The Complete Reference, 6th Edition, Tata McGraw Hill, 2008.

Reference Books:

1. S. Veeraraghavan. Shell Programming in 24 hours. SAMS/Techmedia, 2007.
2. R. Love. Linux Kernel Development. Addison-Wesley, 2010.
3. J. Blanchette, M. Summerfield. C++ GUI Programming with Qt3. Prentice Hall, 2004.

COURSE TITLE: Theory of Computation

Course Code: MMCADTC225						**Examination Scheme**	
Total number of Lecture Hours: 60						**External**	**72**
						Internal	**28**
Lecture (L):	**4**	**Practical (P):**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

COURSE LEARNING OUTCOMES (CO):

Upon successful completion of this course, learners will be able to:

CLO1: Explain the fundamentals of computation, including regular languages, finite automata, and regular expressions.

CLO2: Describe context-free languages, pushdown automata, parsing techniques, and grammar normal forms.

CLO3: Analyze context-sensitive languages, Turing machines, and their computational models.

CLO4: Understand undecidability, computational complexity, and key decision problems in computation theory.

COURSE CONTENT	TEACHING HOURS
UNIT 1: Introduction to Computation	**15 Hrs.**
Introduction to computation, Regular Languages: Introduction to formal languages, regular operations, Closure property. Finite Automata, Deterministic Finite Automata, Kleene's theorem, Non-deterministic Finite Automata (NFA), ε-NFA, Conversion of ε-NFA to NFA, NFA to DFA, Minimization, Finite Automata with output: Mealy and Moore machines. Regular Expression; Equivalence of DFA, NFA, and RE. Non-Regular Languages and Pumping Lemma.	
UNIT 2: Context-Free Languages	**15 Hrs.**
Introduction to Context-Free Languages (CFL), Pushdown Automata (PDA), Grammars, Context Free Grammars, Parsing and Ambiguity, Parsing and Membership, Inherent Ambiguity of Context-Free Languages, Chomsky Normal Form, Membership Algorithm for CFG. Deterministic vs non-deterministic PDAs. Closure property and Pumping Lemma for CFLs.	
UNIT 3: Context-Sensitive Languages and Turing Machine	**15 Hrs.**
Recursive and Recursively Enumerable Languages, Unrestricted Grammars, Context-Sensitive Languages (CSL), Context Sensitive Grammars, Linear Bounded Automata (LBA). Introduction to Turing Machines, Turing Machines as Language Acceptors and Transducers, Turing's Thesis, Equivalence of Deterministic, Non-deterministic, and multi-tape TMs. Universal TMs.	
UNIT 4: Undecidability and Computational Complexity	**15 Hrs.**
Decidability and Undecidability, Reductions and its applications, Rice's theorems for RE sets, Post Correspondence Problem. Halting Problem, Halting vs Looping. Hilbert's algorithm. Complexity Classes (P and NP), Satisfiability (SAT) Problem, Hamiltonian Path Problem, Clique Problem. Polynomial Time Reduction.	

CLO-PLO Matrix for the Course

UNIT-WISE CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO5	PLO 6	PLO 7	PLO 8	PLO 9	PLO10	Avg (CLO)
MMCADTC225.1	3	2	0	0	0	0	0	0	0	0	**2.5**
MMCADTC225.2	0	0	3	2	0	0	0	0	0	0	**2.5**
MMCADTC225.3	0	0	0	0	3	2	0	0	0	0	**2.5**
MMCADTC225.4	0	0	0	0	0	0	3	3	0	0	**3.0**
Avg (PLO)	**1.5**	**1.0**	**1.5**	**1.0**	**1.5**	**1.0**	**1.5**	**1.5**	**0**	**0**	**2.88**

Textbooks

1. New York: Wiley. Linz, Peter. An introduction to formal languages and automata. Jones & Bartlett Learning. Seventh Edition.
2. "Introduction to the Theory of Computation" by Michael Sipser, Third Edition.

Reference Books

1. Cohen, Daniel IA, Introduction to computer theory, 2nd Edition.
2. Parkes, Alan P. Introduction to languages, machines and logic: computable languages, abstract machines and formal logic. Springer Science & Business Media, 2012., 2nd Edition

COURSE TITLE: Research and publication Ethics

Course Code: MMCACRP225						**Examination Scheme**	
Total number of Lecture Hours: 60						**External**	**72**
						Internal	**28**
Lecture (L):	**4**	**Practicals(P) :**	**0**	**Tutorial (T):**	**0**	**Total Credits**	**4**

COURSE LEARNING OUTCOMES (CLO):

CLO1: Explain the fundamental principles, theories, and guidelines of research ethics and responsible conduct of research (RCR).
CLO2: Identify and analyze ethical issues in academic publishing, including authorship, peer review, plagiarism, and publication misconduct.
CLO3: Utilize ethical research tools and follow best practices for ensuring data integrity, transparency, and compliance with IRB protocols.
CLO4: Evaluate the societal and global impact of ethical research and interpret emerging ethical challenges in science and technology.

Course Content	TEACHING HOURS
UNIT 1: Introduction to Research Ethics	**15 Hrs**
Introduction to research ethics, Research integrity and academic integrity, Scientific misconduct: falsification, fabrication, plagiarism, Moral philosophy: virtue ethics, deontology, consequentialism.	
UNIT 2: Scientific Conduct	**15 Hrs**
Ethical practices in research, Authorship and contributorship, Conflicts of interest, Responsibilities of a researcher, Research misconduct and handling allegations.	
UNIT 3: Publication Ethics Publication process and ethics, Redundant publication, salami slicing, Plagiarism and detection tools (Turnitin, iThenticate), Predatory journals and how to identify them, Ethics in peer review and editorial responsibility	**15 Hrs**
UNIT 4: Open Access Publishing and Copyright	**15 Hrs**
Types of open access: gold, green, hybrid, Creative Commons licenses, Copyright laws in research, Institutional repositories, Preprints and postprints, Impact factor, h-index, i10-index, Citation databases: Scopus, Web of Science, Google Scholar, Using reference management tools (Zotero, Mendeley, EndNote)	

CLO-PLO Matrix for the Course

Unit wise CLOs	PLOs										
	1	2	3	4	5	6	7	8	9	10	Average (CLO)
MMCACRP225.1	2	2	1	2	1	3	2	3	1	2	**1.9**
MMCACRP225.2	2	2	2	2	1	3	2	3	2	3	**2.2**
MMCACRP225.3	2	2	3	3	3	2	2	2	2	3	**2.4**
MMCACRP225.4	1	2	2	2	2	3	3	3	2	3	**2.3**
Average (PLO)	**1.75**	**2.0**	**2.0**	**2.25**	**1.75**	**2.75**	**2.25**	**2.75**	**1.75**	**2.75**	**2.2**

Text Books

1. Research Ethics: A Practical Guide, Gary Comstock, Routledge, 2020.
2. Scientific Integrity: Text and Cases in Responsible Conduct of Research, Francis L. Macrina, ASM Press, 2014.

Reference Books

1. Publication Ethics: Rights and Wrongs in Academic Publishing, Norman K. Denzin and Michael D. Giardina, SAGE Publications, 2018.
2. The Ethics of Scientific Research: A Guidebook for Course Development, Judy E. Stern and Deni Elliott, University Press of New England, 1997.
3. Responsible Conduct of Research, Adil E. Shamoo and David B. Resnik, Oxford University Press, 2015.

COURSE TITLE: Mobile Application Development Lab

Course Code: MMCALMA225						Examination Scheme	T	P
Total number of Practical Hours: 60						External	0	36
						Internal	0	14
Lecture (L):	0	Practical (P):	2	Tutorial (T):	0	Total Credits		2

COURSE LEARNING OUTCOMES (CO):

CLO1: Demonstrate basic Java programming and object-oriented concepts.

CLO2: Apply advanced OOP principles for secure and reusable code design.

CLO3: Set up Android environment and develop basic Android applications.

CLO4: Design responsive Android UIs and implement app communication and data storage.

Practical's

Week 1

- Set up Java development environment.
- Write and execute basic Java programs.
- Understand program structure and syntax.
- Learn to use the main method and print output to the console.

Week 2

- Learn to store data using arrays.
- Process data with loops (e.g., temperature tracking).
- Calculate averages and identify data points above a threshold.

Week 3

- Define user classes and create constructors.
- Initialize objects with values.
- Practice object creation and method invocation.

Week 4

- Use inheritance to model relationships (e.g., shapes).
- Override methods for specific behaviors in subclasses.
- Implement code reuse and flexible behavior.

Week 5

- Model a banking system with polymorphism and interfaces.
- Handle multiple account types through a common interface.
- Demonstrate code flexibility and extensibility.

Week 6

- Implement encapsulation in a student database.
- Use access modifiers (private, public) for data protection.
- Ensure data integrity and security through controlled access.

Week 7

- Create abstract classes and implement method overriding.
- Design game characters (e.g., Warrior, Wizard) with specific actions.
- Understand abstract classes for structuring game behaviors.

Week 8

- Install Android Studio or Eclipse with SDK.
- Set up the development environment for Android.
- Build and run a simple "Hello World" Android app.

Week 9

- Learn the key components of an Android app (Activity, Manifest, Layout).
- Modify project structure to understand component interaction.
- Understand how Android components work together in an app.

Week 10

- Navigate between Activities using Intents.
- Use Intent Filters to handle implicit Intents.
- Learn to send and receive data between components.

Week 11

- Declare app permissions in the Android Manifest.
- Request runtime permissions for sensitive features (e.g., camera, network).
- Understand Android's security model and user privacy.

Week 12

- Create Broadcast Receivers to listen for system or app events.
- Send broadcasts to notify other components of events.
- Implement communication between different app components.

Week 13

- Design responsive UIs using LinearLayout, RelativeLayout, ConstraintLayout.
- Use UI components like TextView, Buttons, and ListViews.
- Ensure UIs are visually appealing and adaptable to screen sizes.

Week 14

- Implement advanced UI elements (animations, ScrollViews).
- Integrate SQLite for CRUD operations in an Android app.
- Create dynamic apps that store and retrieve data from local databases.

CLO-PLO Matrix for the Course

UNIT-WISE CLOs	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	**Avg (CLO)**
MMCALMA225.1	2	3	0	0	0	0	0	0	0	0	**2.5**
MMCALMA225.2	0	0	3	2	0	0	0	0	0	0	**2.5**
MMCALMA225.3	0	0	0	0	3	3	0	0	0	0	**3.0**
MMCALMA225.4	0	0	0	0	0	0	3	3	0	0	**3.0**
Avg (PLO)	**1.0**	**1.5**	**1.5**	**1.0**	**1.5**	**1.5**	**1.5**	**1.5**	**0**	**0**	**2.75**

Textbooks

1. **Android Programming: The Big Nerd Ranch Guide** (5th Ed, 2022) – Bill Phillips et al.
2. **Head First Android Development** (3rd Ed, 2021) – Dawn & David Griffiths
3. **Professional Android** (4th Ed, 2018) – Reto Meier, Ian Lake

Reference Books

1. Kotlin Programming: The Big Nerd Ranch Guide (2019) – Josh Skeen
2. Mobile App Development with Flutter (2020) – Eric Windmill
3. Android Internals: A Confectioner's Cookbook – Jonathan Levin
4. Official Android Developer Guide – developer.android.com