Chaudhary Ranbir Singh University

(Established by the Haryana State Legislature Act 28 of 2014)
(Recognised u/s 2(f) and 12(B) of UGC Act, 1956)

Syllabus
for

Post Graduate Programme

Master of Computer Applications

as per NEP-2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2024-25 (in phased manner)

DEPARTMENT OF COMPUTER SCIENCE AND APPLICATIONS
FACULTY OF SCIENCES

CHAUDHARY RANBIR SINGH UNIVERSITY, JIND – 126102

With effect from the Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	4th		
Name of the Course	Data Communication and Computer Networks		
Course Code	M24-CAP-401		
Course Type	DEC-3		
Level of the course (As per Annexure-I	400-499		
Pre-requisite for the course (if any)	-		
Course Objectives	The course aims to provide a comprehensive understanding of network characterization, design issues, and service models, focusing on the OSI and TCP/IP reference models and their practical applications. It covers data communication concepts, including performance parameters, transmission media, modulation techniques, and switching methods, emphasizing the role of wired and wireless networks. The course delves into the data link layer, exploring protocols, error detection, media access, and IEEE standards, alongside advancements in wireless technologies like Wi-Fi, Wi- Max, and Bluetooth. It further examines the transport and network layers, addressing routing algorithms, congestion control, and QoS mechanisms, with a detailed focus on IPv4, IPv6, and protocols like TCP and UDP.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1:** characterize various types of computer networks and standards along with an insight into the principles of networking by using protocol layering of the Internet and the TCP/IP protocol suite. **CLO-2:** comprehend the notion of data communication and its related functional components and aspects. **CLO-3:** understand design issues related to Local area Networks and get acquainted with the prevailing wired and wireless LAN technology standards. **CLO-4:** get versed with the routing, addressing, congestion control, and security issues in Networks and the Internet architecture .		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Network Characterization**: Goals and Applications; Categorization according to Size, Purpose, Design issues & Transmission Technologies; Network Architecture and Service Models; Design issues for the Layers; Reference Models: OSI and TCP/IP; Functions of layers and protocols of TCP/IP; Comparison of OSI & TCP/IP ; Data Transmission using TCP/IP; **Networking Models & Applications:** Centralized, Decentralized, and Distributed; Client-Server and Peer-to-Peer; File sharing & Web- based; Content Distribution Networks; **Introduction to Example Networks:** The Internet and its Conceptual View ; Internet Services; Accessing The Internet; Connection-Oriented Networks: X.25, Frame Relay and ATM;	15
II	**Data Communication Concepts & Components**: Digital and Analog Data and Signals,	15

	Asynchronous and Synchronous transmission; bit rate & baud, bandwidth & Channel Capacity; Nyquist Bit Rate, Shannon Capacity; Network Performance Parameters; Transmission Impairment; **Connecting Devices & Transmission Media:** Network Interface Cards, Connectors, Hubs, Transceivers & Media Connectors; Link-Layer Switches, Bridge, Routers, Gateways, Virtual LANs; Guided Transmission Media; Wireless transmission; Satellite communication; **Data Encoding & Modulation Techniques:** NRZ, NRZ-I, Manchester and Differential Manchester encoding; 4B/5B ; Pulse Code Modulation & Delta Modulation; Digital to Analog encoding; **Switching and Bandwidth Utilization:** Methods of Switching; Virtual Circuit & Datagram Networks; Multiplexing; Spread Spectrum; **Wired Networks and the Local Loop**: Telephone Networks; Modems; Broadband and ADSL; ADSL Versus Cable; Hybrid Fiber-Coaxial Network ; Fiber-to-the-Home Broadband;	
III	**Data Link Layer**: Communication at the Data Link Layer; Nodes and Links; Link Layer Addressing; Examples of Data Link layer protocols; **Design Issues**: Framing techniques; Error Detection and Correction; Sliding Window Flow Control Protocols; **Media Access Control:** Random Access: Aloha, CSMA , CSMA/CD; Collision free protocols with Controlled Access; Wavelength Division Multiple access for Fiber-Optic Data Communication; **IEEE LAN standards:** Ethernet (Physical specifications, Encoding, Frame Format & MAC protocol); Binary Exponential Backoff algorithm; **Introduction to Wireless Networks:** IEEE 802.11 Wireless LAN; Wi-Max; Wireless LAN Protocol: MACA; Bluetooth and other wireless PAN technologies; Cellular Networks: Generations; GSM, CDMA, LTE.	15
IV	**Transport layer** : Addressing, Services and Protocols; TCP and UDP services & header formats; **Network Layer** : Services, Routing Algorithms: Shortest Path Routing, Flooding , Distance Vector Routing, Link State Routing, Hierarchical Routing, Multi Cast Routing, Routing for Mobile hosts; **Network Layer in TCP/IP:** Basic characteristics of IP protocol; addressing and header format of IPv4 ; IPv6; **Congestion Control & Quality of Service:** General Principals; Congestion control in Virtual – Circuit Subnets; Congestion Control in Datagram Subnets: Choke packets, Load Shedding; Random Early Detection, Jitter Control; Over provisioning, Buffering, Traffic Shaping, Leaky Bucket, Token Bucket, Resource Reservation, Admission Control, Packet Scheduling;	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Reference Books:

1) Andrew S. Tanenbaum, Computer Networks, 4th Edition - PHI.
2) Behrouz A Forouzan, Data Communications and Networking, 5th Edition- Mc-Graw Hill Education.
3) Michael A. Gallo, William M. Hancock, Computer Communications and Networking Technologies – CENGAGE learning.
4) William Stallings, Data and Computer Communications, 5th Edition – PHI.

With effect from the Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	4th		
Name of the Course	Data Science		
Course Code	M24-CAP-402		
Course Type	DEC-3		
Level of the course (As per Annexure-I	500-599		
Pre-requisite for the course (if any)	-		
Course Objectives	The objective of this course is to introduce students to the foundational concepts and practical techniques used in data science. It aims to equip learners with the skills to collect, clean, analyze, and visualize data to generate meaningful insights. The course covers the end-to-end data science lifecycle, starting from data acquisition and preprocessing to exploratory data analysis, statistical modeling, and machine learning. Students will explore real-world data applications, understand the use of Python-based tools, and learn how to effectively communicate findings through visualization and storytelling. The course also emphasizes ethical considerations and best practices in handling data responsibly in decision-making contexts.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO 1**: Students will be able to explain the data science lifecycle and identify the roles and tools involved in solving real-world data problems. **CLO 2**: Students will demonstrate the ability to preprocess, clean, and explore datasets using Python-based libraries for meaningful data interpretation. **CLO 3**: Students will apply basic statistical and machine learning techniques to build and evaluate predictive models on structured data. **CLO 4**: Students will create effective data visualizations, interpret model outputs, and understand ethical responsibilities in data-driven decision-making.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Introduction to Data Science: Definition and components of data science, data science vs. data analytics vs. machine learning, applications of data science in various domains. Data science lifecycle: data collection, data wrangling, analysis, interpretation, and communication. Overview of tools: Python, Jupyter, NumPy, pandas, and Matplotlib. Introduction to types of data and sources.	15
II	Data Preprocessing and Exploration: Handling missing values, data cleaning and transformation, outlier detection and treatment, encoding categorical variables, data normalization and standardization. Exploratory data analysis (EDA): using pandas and visualization libraries for summarizing and exploring datasets, correlation analysis, feature engineering.	15
III	Statistical Foundations and Machine Learning: Descriptive and inferential statistics, probability distributions, hypothesis testing, regression analysis. Introduction to supervised learning: linear regression, logistic regression, decision trees. Basics of unsupervised learning: clustering and dimensionality reduction. Model evaluation metrics: accuracy, precision, recall, F1-score, confusion matrix, cross- validation.	15

IV	Data Visualization and Communication: Principles of effective data visualization, tools for visualization in Python: Matplotlib, Seaborn, and Plotly. Dashboards and storytelling with data. Introduction to real-world case studies and capstone mini-projects. Ethical concerns in data science: data privacy, algorithmic bias, and responsible AI.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory**	**70**
➢ Class Participation:	5	Written Examination	
➢ Seminar/presentation/assignment/quiz/class test etc.:	10		
➢ Mid-Term Exam:	15		

Part C-Learning Resources

Reference Books

1) Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly Media.
2) Cathy O'Neil and Rachel Schutt, Doing Data Science, O'Reilly Media.
3) Aurélien Géron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, O'Reilly Media.
4) Wes McKinney, Python for Data Analysis, O'Reilly Media.
5) Hadley Wickham and Garrett Grolemund, R for Data Science, O'Reilly Media (for supplementary reading and comparative learning).

With effect from the Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	4th		
Name of the Course	Design and Analysis of Algorithms		
Course Code	M24-CAP-403		
Course Type	DEC-3		
Level of the course (As per Annexure-I	500-599		
Pre-requisite for the course (if any)	-		
Course Objectives	This course aims to provide students with a deep understanding of algorithm design, analysis, and complexity, equipping them with the skills to develop efficient solutions to computational problems. It introduces foundational concepts such as asymptotic notation and algorithmic paradigms like divide-and-conquer, greedy methods, and dynamic programming. Students will explore advanced data structures, graph and string algorithms, and will also gain exposure to probabilistic analysis and randomized algorithms. The course further delves into computational geometry and the theoretical aspects of computational complexity, including NP-completeness and intractable problems, preparing students for both practical algorithm development and theoretical analysis.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1:** Students will be able to analyze and compare algorithm performance using asymptotic notations and apply divide-and-conquer strategies with recurrence-solving techniques. **CLO-2:** Students will develop efficient algorithmic solutions using dynamic programming and greedy methods for problems like matrix chain multiplication, Huffman coding, and optimal binary search trees. **CLO-3:** Students will understand and implement key graph and string algorithms, including shortest path algorithms, maximum flow techniques, and pattern matching methods. **CLO-4:** Students will comprehend geometric algorithmic techniques and critically evaluate problem complexity using concepts from computational complexity theory, including NP-completeness and reducibility.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Introduction: Algorithms, Role of algorithms in computing, Analyzing algorithms, Designing algorithms, Asymptotic notations. Divide and Conquer: Solving recurrence equations: Back substitution method, Recursion tree method, Masters theorem. Probabilistic Analysis and Randomized Algorithms: The hiring problem, Indicator random variables, Randomized algorithms, Probabilistic analysis and further uses of indicator random variables	15
II	Trees: Red-black trees and Splay trees.	15

	Dynamic Programming (DP): Elements of DP, Matrix chain multiplication, Longest common subsequence, optimal binary search trees. Greedy Techniques (GT): Elements of GT, Activity selection problem, Huffman codes, Knapsack Problem.	
III	Graph Algorithms: Topological sort, Strongly connected components, Single source shortest path: Analysis of Dijkstra's Algorithm, Limitations of Dijkstra's Algorithm, Negative weight cycle, Bellman-Ford algorithm. All Pairs Shortest Path: Relation of Shortest path and matrix multiplication, Analysis of Floyd Warshall algorithm. Maximum Flow: Flow network, Ford-Fulkerson method. Strings: Storage of strings, Naive string-matching algorithm, Rabin-Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm	15
IV	Computational Geometry: Line-segment properties, Convex hull, Closest pair of points. Computational complexity: Notion of Polynomial time algorithms, Complexity classes: P, NP, NP-Hard and NP-Complete, Polynomial time verification, Reducibility, NP- Completeness, Examples of NP-Complete and NP-Hard problems: Traveling Salesman Problem, Knapsack, Bin Packing, Satisfiability, Vertex Cover, Clique, Independent Set.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Reference Books:

1) 1. Cormen, Leiserson, Rivest, Introduction to Algorithms, PHI India.
2) Neapolitan R., Foundations of Algorithms, Jones and Bartlett Learning.
3) Cooper A., Computability Theory, Chapman and Hall/ CRC Press.
4) A.V.Aho, J.E.Hopcroft, and J.D.Ullman, The Design and Analysis of Computer Algorithms, Pearson Education India
5) AnanyLevitin, Introduction to the Design and Analysis of Algorithms, Pearson Education.
6) R.C.T Lee, S.S.Tseng, R.C.Chang, Y.T.Tsai, Introduction to Design and Analysis of Algorithms: A Strategic Approach, Tata McGraw Hill
7) Steven Skiena, The Algorithm Design Manual, Springer India.

With effect from the Session: 2024-25			
Part A - Introduction			
Name of Programme	MCA		
Semester	4th		
Name of the Course	Cyber Security		
Course Code	M24-CAP-405		
Course Type	DEC-4		
Level of the course	400-499		
Pre-requisite for the course (if an)			
Course Objectives	The objective of this course is to introduce students to the fundamental concepts, principles, and practices of cyber security. It aims to develop a foundational understanding of cyber threats, vulnerabilities, attack types, and security mechanisms. The course covers a broad spectrum of topics including system and network security, cryptographic techniques, risk management, cyber laws, and ethical practices. Students will learn about current trends in cyber attacks and the defensive techniques used to secure data, applications, and infrastructure in both individual and organizational contexts. The course emphasizes a practical understanding of security tools and techniques, fostering the skills necessary to protect information systems and ensure confidentiality, integrity, and availability of digital assets.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO 1**: Students will be able to explain the key concepts of cyber security, identify common types of cyber threats, and understand the foundational principles of securing digital systems. **CLO 2**: Students will demonstrate knowledge of cryptographic techniques and security mechanisms used to ensure data confidentiality, integrity, and secure communication. **CLO 3**: Students will analyze system and network security vulnerabilities and apply basic security measures to protect digital infrastructure. **CLO 4**: Students will understand the legal and ethical aspects of cyber security and recognize current trends and professional opportunities in the field.		
Credits	Theory	Tutorial	Total
	2		2
Teaching Hours per week	2		2
Internal Assessment Marks	15		15
End Term Exam Marks	35		35
Max. Marks	50		50
Examination Time	3		3

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Introduction to Cyber Security: Importance of cyber security in the digital era, objectives and scope, fundamental concepts such as assets, threats, vulnerabilities, risk, attack vectors, and security controls. Types of cyber attacks: malware, phishing, social engineering, denial of service, ransomware, man-in-the-middle attacks. Principles of cyber defense and the CIA triad (confidentiality, integrity, availability).	8
II	Security Mechanisms and Cryptography: Authentication methods, password policies, access control models, firewalls, intrusion detection and prevention systems (IDPS), virtual private networks (VPNs), antivirus tools. Basics of cryptography: symmetric and asymmetric encryption, digital signatures, hashing algorithms, key management, public key infrastructure (PKI), and applications of cryptography in securing data.	7
III	Network and System Security: Security issues in operating systems and applications, endpoint security,	8

	patch management, secure configuration, wireless network security, securing web applications, browser security, and email security. Network security architecture, IP security, and secure communication protocols such as SSL/TLS and HTTPS.	
IV	Cyber Laws, Ethics, and Emerging Trends: Overview of cyber laws in India and global regulations (IT Act, GDPR), ethical hacking, digital forensics, data privacy and governance. Introduction to security frameworks and standards (ISO 27001, NIST, OWASP). Emerging cyber threats in IoT, cloud computing, AI, and social media.	7
Total Contact Hour		**30**

Suggested Evaluation Methods

Internal Assessment: 15		**End Term Examination: 35**	
➢ **Theory**	**15**	➢ **Theory:**	**35**
➢ Class Participation:	4	Written Examination	
➢ Seminar/presentation/assignment/quiz/class test etc.:	4		
➢ Mid-Term Exam:	7		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1) William Stallings, Network Security Essentials: Applications and Standards, Pearson Education.
2) Nina Godbole and Sunit Belpure, Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India.
3) Chuck Easttom, Computer Security Fundamentals, Pearson Education.
4) Behrouz A. Forouzan, Cryptography and Network Security, McGraw-Hill Education.
5) Rao B. Ramesh and Govindarajulu, Cyber Security Fundamentals, Wiley.

With effect from the Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	4th		
Name of the Course	Soft Computing		
Course Code	M24-CAP-407		
Course Type	DEC-4		
Level of the course (As per Annexure-I	500-599		
Pre-requisite for the course (if any)	-		
Course Objectives	This course provides a comprehensive introduction to soft computing techniques, including fuzzy logic, neural networks, and evolutionary algorithms. It covers metaheuristic optimization methods such as PSO, ACO, and other bio-inspired algorithms. Students will learn fuzzy set theory, inference systems, and design of fuzzy controllers. The course also explores various neural network models and genetic algorithms for solving real-world optimization and classification problems. Emphasis is placed on applications, limitations, and emerging trends in soft computing.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1:** Soft Computing and Optimization: Students will understand soft computing techniques and apply metaheuristic optimization methods to solve complex problems. **CLO-2:** Fuzzy Systems: Students will analyze fuzzy logic principles and implement fuzzy inference systems for decision-making. **CLO-3:** Neural Networks: Students will develop and apply neural network models for pattern recognition and machine learning. **CLO-4:** Genetic Algorithms: Students will design genetic algorithms and utilize evolutionary principles for optimization.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Soft Computing:** Conventional AI to Computational Intelligence; Soft Computing Constituents and Applications. **Introduction to Non-traditional Metaheuristic Optimization Techniques:** Random Optimization, Simulated Annealing, Tabu Search, Ant Colony Optimization, Particle Swarm Optimization, Harmony Search, Memetic Algorithms, Other Evolutionary Algorithms such as Firefly Algorithm, Bee Algorithm, Shuffled Frog Leap algorithm, Bat algorithm etc.	15
II	**Fuzzy Set theory:** Fuzzy Sets & Classical Sets; Operations on Fuzzy Sets, Fuzzy Relations, Linguistic Variables. **Membership Functions**: Introduction, Features & Fuzzification, Methods of Membership Value Assignment; Defuzzification. **Fuzzy Systems:** Crisp Logic, Predicate Logic, Fuzzy Logic; Fuzzy Rule Base and Approximate Reasoning, Fuzzy Quantifiers; Fuzzy Inference Systems, Fuzzy Decision Making, Fuzzy Logic Control System; Fuzzy Expert Systems.	15
III	**Neural Networks**: Fundamental Concepts, Basic Models and Architecture; Machine Learning Using Neural Networks; Associative Memory Networks and their Applications. **Supervised Learning Neural Networks**: Perceptron Networks, Radial Basis Function Networks: Back Propagation Neural Network: Architecture, Learning, Applications, & Research Directions; The Boltzman Machine. **Unsupervised Learning Networks:** Competitive Learning networks; Kohonen Self-Organizing Net-	15

	works; Hebbian learning; The Hopfield Network; Counter propagation Networks; Adaptive Resonance Theory: Introduction, Architecture, & Applications; Feed forward Networks; Reinforcement Learning.	
IV	**Genetic Algorithms:** Introduction to Genetic Algorithms and their Terminology; Traditional Optimization and Search Techniques vs Genetic Algorithm; Operators in Genetic Algorithms: selection, crossover, mutation; Problem Solving using Genetic Algorithm; Classification of Genetic Algorithms; Holland's Schemata theorem; Advantages and Limitations of Genetic Algorithm; Applications of Genetic Algorithm.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory**	**70**
➢ Class Participation:	5	Written Examination	
➢ Seminar/presentation/assignment/quiz/class test etc.:	10		
➢ Mid-Term Exam:	15		

Part C-Learning Resources

1) S. N. Sivanandam& S. N. Deepa, Principles of Soft Computing, Wiley - India.
2) Jyh Shing Roger Jang, Chuen Tsai Sun, EijiMizutani, Neuro Fuzzy and Soft Computing, Prentice Hall
3) S.Rajasekaran and G.A.VijayalakshmiPai, Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications, Prentice-Hall of India Pvt. Ltd.
4) George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic: Theory and Applications, Prentice Hall.
5) George J. Klir, Ute St. Clair, Bo Yuan, Fuzzy Set Theory: Foundations and Applications Prentice Hall.
6) Simon O. Haykin, Neural networks: a comprehensive foundation, Pearson Education.
7) Mitchell Melanie, An Introduction to Genetic Algorithm, Prentice Hall
8) Goldberg D. E., Genetic Algorithms in Search, Optimization, and Machine Learning, Pearson Education.
9) Ahmad Lotfi, Jonathan Garibaldi, Applications and Science in Soft Computing, Springer.
10) Rajkumar Roy, Mario Koppen, Soft Computing and Industry: Recent Applications, Springer.
11) James A. Freeman, David M. Skapura, Neural Networks Algorithms, Applications, and Programming Techniques, Pearson Education India.
12) Du, Ke-Lin, Swamy, M. N. S., Search and Optimization by Metaheuristics: Techniques and Algorithms, Springer
13) OmidBozorg-Haddad, Mohammad Solgi, Hugo A. Loaiciga, Meta-heuristic and Evolutionary Algorithms for Engineering Optimization, Wiley

With effect from the Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	4th		
Name of the Course	Mobile Computing		
Course Code	M24- CAP -409		
Course Type	DEC-5		
Level of the course (As per Annexure-I	500-599		
Pre-requisite for the course (if any)	-		
Course Objectives	The objective of this course is to provide students with a solid foundation in the concepts, architecture, and technologies that drive mobile computing systems. The course explores the evolution of mobile communication, wireless networks, and mobile devices, highlighting the design and implementation of mobile applications in a distributed and heterogeneous environment. Students will gain insights into mobile operating systems, wireless transmission principles, cellular technologies, and security challenges associated with mobile environments. The course also addresses current trends in mobile platforms and development frameworks, enabling students to analyze, design, and build efficient and secure mobile computing solutions suited to modern business and societal needs.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO 1:** Demonstrate an understanding of the fundamental concepts, architectures, and communication models of mobile computing, including various mobile and wireless communication technologies such as GSM, GPRS, 3G/4G, LTE, and mobile IP. **CLO 2**: Describe the Android platform architecture, development tools (SDK, AVD, DDMS), and the Android application lifecycle, and set up a basic Android development environment using Android Studio. **CLO 3**: Design and implement user interfaces for Android applications using various layout managers and UI components, and utilize intents for inter-component communication and interaction within applications. **CLO 4**: Develop Android applications that utilize services, fragments, location-based features, persistent storage mechanisms (internal, external, SQLite), and integrate third-party services such as Google Maps.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Introduction to Mobile Computing: Concepts and scope, Features and applications of mobile computing, Mobile and wireless devices: smartphones, tablets, PDAs, Limitations and challenges of mobile environments, Wireless communication basics: signal propagation, multiplexing, modulation, Overview of mobile communication systems: GSM, GPRS, 3G/4G, LTE, Mobile computing architecture: Internet-based and satellite-based models, Wireless LAN architecture and mobile IP.	15
II	Introduction: Mobile Applications, Characteristics and Benefits, Application Models, Basics of Android, Importance and scope, Android Versions, Features of Android, Android Architecture, Android Stack, Android Applications Structure, Android Emulator, Android SDK, Overview of Android Studio, Android and File Structure, Android Virtual Device Manager, DDMS, LogCat, Understanding Activities (Activity Life Cycle).	15
III	Android User Interface: Measurements –Device and pixel density independent measuring units. Layouts –Linear, Relative, Grid and Table Layouts. User Interface (UI) Components –Editable and non-editable Text Views, Buttons, Radio and Toggle	15

	Buttons, Checkboxes, Spinners, Dialog and pickers, List View, Spinner View. Intents and Broadcasts: Intent –Using intents to launch Activities, Types of Intent, Passing data to Intents, using Intent to dial a number or to send SMS.	
IV	Services- Callbacks and Override in application, Application Signing, API keys for Google Maps, Publishing application to the Android Market. Fragments –Creating fragments, Lifecycle of fragments, adding, removing and replacing fragments with fragment transactions Location and Mapping: location based services, Google Maps activity Persisting Data to files: Saving to Internal Storage, Saving to External Storage Introduction to SQLite database: creating and opening a database, creating tables, content provider	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory**	**70**
➢ Class Participation:	5	Written Examination	
➢ Seminar/presentation/assignment/quiz/class test etc.:	10		
➢ Mid-Term Exam:	15		

Part C-Learning Resources

Reference Books

1) Raj Kamal, Mobile Computing, Oxford University Press.
2) Asoke K. Talukder, Hasan Ahmed, and Roopa R. Yavagal, Mobile Computing: Technology, Applications and Service Creation, McGraw-Hill Education.
3) Jochen Schiller, Mobile Communications, Pearson Education.
4) Reto Meier and Ian Lake, Professional Android, Wrox.
5) Wei-Meng Lee, Beginning Android Programming with Android Studio, Wiley.

With effect from the Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	4th		
Name of the Course	Cloud Computing and IoT		
Course Code	M24- CAP -410		
Course Type	DEC-5		
Level of the course (As per Annexure-I	500-599		
Pre-requisite for the course (if any)	-		
Course Objectives	This course introduces the fundamentals of cloud computing and IoT, covering architectures, service models, virtualization, and enabling technologies. Students will explore cloud services, security, and compliance, as well as IoT components, communication protocols, and ecosystem design. Hands-on experience with platforms like Arduino and Raspberry Pi prepares students to build and manage cloud-integrated IoT systems for real-world applications.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1** Understand core issues of cloud computing and enabling technologies. **CLO-2** Learn services provided on cloud computing platforms & security challenges. **CLO-3** Understand concepts, architecture, applications & networking technologies of IoT. **CLO-4** Learn IoT-oriented communication protocols and security concerns.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Cloud Computing:** Definition and Characteristics of Cloud Computing, Evolution and Enabling Technologies, Benefits & Challenges, NIST Reference Architecture of Cloud Computing; Deployment Models, Service Models, Service Oriented Architecture (SOA). **Virtualization:** Virtualization and Its Role in Cloud Computing; Benefits & Drawbacks of Virtualization, Types of Virtualization, Server Virtualization, Hypervisor-Based Approaches, Virtualization Of - Operating System, Platform, CPU, Network, Application, Memory and I/O Devices.	15
II	**Cloud Computing Services & Applications:** Cloud Computing Platforms; Compute Services, Storage Services, Database Services, Applications Services, Queuing Services, E-Mail Services, Notification Services, Media Services, Content Delivery Services, Analytics Services, Deployment& Management Services, Identity & Access Management Services and their Case Studies. **Cloud Security and Compliance:** Security Challenges in The Cloud, Data Protection and Privacy, Compliance and Regulatory Issues.	15
III	**Internet of Thing (IoT):** Definition and Characteristics of IoT, Key Components of IoT (Sensors, Actuators, Devices). IoT Ecosystems and Architecture, Conceptual Framework, Common Applications of IoT. Modified OSI Model for IoT/M2M Systems, M2M Vs IoT. **Iot Networking Technologies:** NFC, RFID, Bluetooth BR/EDR and Bluetooth Low Energy, Zigbee, WiFi.	15
IV	**Iot Communication Technologies & Security Issues:** Constrained Nodes, Constrained Networks, Types of Constrained Devices, Low Power and Lossy Networks. Security Issues and Challenges in IoT. **IoT Protocols** – 6LoWPAN, QUIC Protocol; Data Protocols - MQTT, MQTT-SN, CoAP, AMQP. Introduction to Arduino and Raspberry Pi Boards.	15
	Total Contact Hours	60

Suggested Evaluation Methods	
Internal Assessment: 30	**End Term Examination: 70**

➢ **Theory**	**30**	➢ **Theory**	**70**
➢ Class Participation:	5	Written Examination	
➢ Seminar/presentation/assignment/quiz/class test etc.:	10		
➢ Mid-Term Exam:	15		

Part C-Learning Resources

Textbook

1) Rajkumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing – Principles and Paradigms, Wiley India Pvt. Ltd.
2) Sudip Misra, Anandarup Mukherjee, Arijit Roy, Introduction to IOT, Cambridge
3) Arshdeep Bahga, Vijay Madisetti, Cloud Computing – A Hands-on Approach, University Press.
4) Raj Kamal, Internet of Things - Architecture and Design Principles, McGraw Hills

Reference Books

1) Mayur Ramgir, Internet of Things – Architecture, Implementation and Security, Pearson
2) Kai Hwang, Geoffrey C.Fox, and Jack J. Dongarra, Distributed and Cloud Computing, Elsevier India Private Limited
3) Anthony T. Velte, Toby J. Velte and Robert Elsenpeter, Cloud computing: A practical Approach, McGraw Hill
4) Vijay Madisetti and Arshdeep Bahga, Internet of Things (A Hands-on Approach), VPT

With effect from the Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	4th		
Name of the Course	Principles of Programming Languages		
Course Code	M24-CAP-411		
Course Type	DEC-5		
Level of the course (As per Annexure-I	500-599		
Pre-requisite for the course (if any)	-		
Course Objectives	This course offers a foundational understanding of programming languages, covering their evolution, paradigms, and core components. Topics include formal language theory, parsing, language semantics, type systems, and program verification. Students will explore object-oriented concepts, control structures, memory management, and advanced features like parallel programming and scripting languages, gaining both theoretical and practical insights.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO I:** Students will be able to analyze the structure and translation of programming languages using formal methods such as BNF grammars and recursive descent parsing, and understand the role of translators and binding times in language implementation. **CLO II:** Students will understand the theoretical foundations of programming languages through the Chomsky hierarchy, and be able to design and interpret finite state automata and context-free grammars while applying semantic models like attribute grammars and denotational semantics. **CLO III:** Students will be able to implement and compare object-oriented concepts such as abstract data types, inheritance, and polymorphism, and evaluate various sequence control mechanisms used in modern programming languages. **CLO IV:** Students will understand and apply different parameter passing techniques, memory management strategies, and scoping rules, and explore advanced programming topics such as parallelism, exception handling, scripting languages, and distributed processing.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Preliminaries: History, Impact of Programming Paradigms, Role of Programming Languages, Good Language, Effects of Programming Environment, Translators and virtual architectures, Binding and Binding time, Language Syntax, Analysis of Program, Synthesis of Object program, Formal translation models: BNF Grammars, General parsing, Language translation, Recursive descent parsing.	15
II	Formal languages and automata: The Chomsky hierarchy of formal languages, regular grammars, Regular expressions, Finite State Automata, Context-free grammars, Pushdown automata, Ambiguous grammars. Language Semantics: Attribute grammars, Denotational semantics, Program verification and validation, Data objects, variables, constants, data types, declaration, type checking, type casting, type promotion, Enumerators, Composite data types.	15
III	Object Orientated concepts: Structured data types, Abstract data types, Information hiding, Subprogram concepts, Good program design, Type definitions, Type equivalence, Inheritance, Derived classes, Abstract classes, Polymorphism, Inheritance and software reuse. Sequence control: Implicit and explicit sequence control, Sequence control within arithmetic expressions, sequence control between statements, sequencing with non-arithmetic expressions, Subprogram Sequence	15

	control.	
IV	Miscellaneous topics: Parameter passing techniques, Static & Dynamic Scoping, Storage of variables, Static storage, Heap Storage management, Distributed Processing, Exceptions and Exception handlers, Co-routines, Scheduled subprograms, Parallel programming, Processor design, Hardware and Software architectures, Network Programming, Evolution of scripting languages, Applets, XML.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory**	**70**
➢ Class Participation:	5	Written Examination	
➢ Seminar/presentation/assignment/quiz/class test etc.:	10		
➢ Mid-Term Exam:	15		

Part C-Learning Resources

1) Pratt T.W., Zelkowitz M.V., Gopal T.V., Programming Languages Design and Implementation, Pearson Education.
2) Sebesta W. Robert, Concepts of Programming Languages, Pearson Education.
3) Appleby Doris &VandeKopple J. Julius, Programming Languages-Paradigm and practice, Tata McGraw Hill.
4) Sethi Ravi, Programming Languages: Concepts & Constructs, Pearson Education
5) Scott M., Programming Language Pragmatics, Elsevier India.

With effect from the Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	4th		
Name of the Course	Research and Publication Ethics		
Course Code	M24-CAP-413		
Course Type	EEC		
Level of the course (As per Annexure-I	500-599		
Pre-requisite for the course (if any)	-		
Course Objectives	This course aims to introduce students to the fundamental concepts of philosophy and ethics in the context of research and publication. It focuses on developing an understanding of research integrity, ethical decision-making, and responsible conduct in scientific work. The course also familiarizes learners with ethical guidelines and standards set by organizations such as COPE and WAME. Additionally, it enables students to identify and prevent unethical practices in research and publication.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO1:** Students will understand the basic concepts of philosophy and ethics, including their nature, scope, and role in research and moral decision-making. **CLO2:** Explain and analyze issues of research integrity, including intellectual honesty and scientific misconduct such as fabrication, falsification, and plagiarism. **CLO3:** Evaluate ethical concerns in publication practices, including redundant publications, selective reporting, and misrepresentation of data. **CLO4:** Apply ethical guidelines and standards (such as COPE and WAME) to identify and prevent publication misconduct, including predatory publishing and authorship issues.		
Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: Examiner will be required to set FIVE questions in all. Question Number 1 will consist of total 4 parts (objective type/short-answer type questions) covering the entire syllabus and will carry 8 marks. In addition to the compulsory question there will be two units. Examiner will set two questions from each Unit of the syllabus and each question will carry 8 marks.

Student will be required to attempt THREE questions in all. Question Number 1 will be compulsory. In addition to compulsory question, student will have to attempt TWO more questions selecting One question from each Unit.

Unit	Topics	Contact Hours
I	Introduction to philosophy: definition, nature and scope, concept, branches Ethics: definition, moral philosophy, nature of moral judgments and reactions. Ethics with respect to science and research, Intellectual honest and research integrity, Scientific misconducts: falsification, fabrication, and plagiarism. Redundant publications: duplicate and overlapping publications, salami slicing Selective reporting and misrepresentation of data.	15
II	Publication ethics: definition, introduction and importance Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, Violation of publication ethics, authorship and contributorship Identification of publication misconduct, complaints and appeals, Predatory publishers and journals	15

Total Contact Hours	30

Suggested Evaluation Methods			
Internal Assessment: 15		**End Term Examination: 35**	
➢ **Theory**	**15**	➢ **Theory**	**35**
➢ Class Participation:	3	Written Examination	
➢ Seminar/presentation/assignment/quiz/class test etc.:	5		
➢ Mid-Term Exam:	7		

Part C-Learning Resources

1. Muralidhar K et al., Ethics in Science Education, Research and Governance, Indian National Science Academy, 2019
2. Huma Praveen and Nayeem Showkat, Research Ethics, e-PG Pathshala, 2017
3. Bird A, Philosophy of Science, Routledge, 2006
4. MacIntye, Alasdair, A Short History of Ethics, London, 1967
5. P. Chaddah, Ethics in Competitive Research: Do not get scooped; do not get plagiarized, ISBN: 978-9387480865 (Self-Published)