Kurukshetra University, Kurukshetra

(Established by the State Legislature Act-XII of 1956)
("A++" Grade, NAAC Accredited)

Syllabus
for

Post Graduate Programme

Master of Computer Applications

(First and Second Semester)
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

DEPARTMENT OF COMPUTER SCIENCE AND APPLICATIONS
FACULTY OF SCIENCES

KURUKSHETRA UNIVERSITY, KURUKSHETRA -136119

With effect from the Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	2nd		
Name of the Course	Server Side Web Technology		
Course Code	M24-CAP-201		
Course Type	CC-5		
Level of the course (As per Annexure-I	400-499		
Pre-requisite for the course (if any)	-		
Course Objectives	This course provides an in-depth understanding of web servers, client-server architecture, and Node.js, focusing on non-blocking I/O, event-driven programming, and package management. Students will learn to handle files, build HTTP servers, and manage asynchronous tasks while mastering error handling and debugging. With Express.js, they will design RESTful APIs, implement routing and middleware, and integrate user authentication. The course also introduces MongoDB for NoSQL database operations, including CRUD and indexing, equipping students to build scalable, secure web applications.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1:** Students will be able to set up a Node.js environment, understand its non-blocking I/O and event-driven architecture, and manage packages and modules effectively. **CLO-2:** Students will gain the ability to handle files and directories, create robust HTTP servers, and implement event-driven programming while managing asynchronous tasks and debugging errors. **CLO-3:** Students will be able to develop Express.js applications with structured routing, middleware, and RESTful APIs, including secure user authentication using JWT and sessions. **CLO-4:** Students will learn to set up and manage MongoDB databases, perform CRUD operations, and utilize indexes to optimize query performance for NoSQL applications.		
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 web servers, Client-Server Architecture, Request-Response Cycle, Server-Side vs. Client-Side. Introduction to Node.js: Overview of Node.js, Non-blocking I/O, Event-driven architecture, Benefits of using Node.js in the MERN stack. Installing Node.js, Using Node Package Manager (npm), Creating and managing packages. Modules: Working with core modules, Creating and importing custom modules, require and exports.	15
II	File handling: Reading from and writing to files, Handling directories, Managing asynchronous tasks efficiently.	15

	Building Web Servers: Creating a basic HTTP server, Handling HTTP requests and responses, Understanding request methods (GET, POST, PUT, DELETE). Event-Driven Programming Using EventEmitter, Creating custom events, Handling real-time data. Error Handling and Debugging: Try-catch blocks, Handling asynchronous errors, Using debugging tools (e.g., node --inspect, Chrome DevTools).	
III	Express.js Basics: Introduction to Express.js, Setting up Express projects, Understanding routing and middleware. Using template engines (e.g., EJS) for server-side rendering, Designing RESTful APIs, CRUD operations, Structuring API routes. Built-in middleware (e.g., body-parser), Creating custom middleware, Error handling middleware. User authentication using JWT (JSON Web Tokens) and sessions.	15
IV	Introduction to MongoDB: NoSQL vs. SQL databases, Setting up MongoDB locally and on cloud (e.g., MongoDB Atlas), Document-based NoSQL database, JSON-like documents. Setting Up MongoDB: Installation, creating databases, collections, and documents CRUD Operations in MongoDB: Inserting, querying, updating, deleting documents Indexes in MongoDB: Creating and using indexes	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) "Node.js Design Patterns" by Mario Casciaro and Luciano Mammino
2) "Learning Node.js Development" by Andrew Mead
3) "Express in Action" by Evan M. Hahn
4) "REST API Development with Node.js" by Fernando Doglio
5) "MongoDB: The Definitive Guide" by Shannon Bradshaw, Eoin Brazil, and Kristina Chodorow
6) "Learning MongoDB" by Amit Phaltankar, Juned Ahsan, and Michael Harrison

With effect from the Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	2nd		
Name of the Course	Computer Network		
Course Code	M24-CAP-202		
Course Type	CC-6		
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;	15

	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;	
II	**Data Communication Concepts & Components**: Digital and Analog Data and Signals, 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;	15
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	2nd		
Name of the Course	Database Management Systems		
Course Code	M24-CAP-203		
Course Type	CC-7		
Level of the course (As per Annexure-I	400-499		
Pre-requisite for the course (if any)	-		
Course Objectives	This course provides a comprehensive understanding of database concepts, including the three-schema architecture, relational models, and the ER model. It covers SQL and PL/SQL for database management, exploring queries, constraints, and advanced functions. Students will learn relational algebra, normalization techniques, and query optimization to enhance database design and performance. The course also addresses transaction processing, concurrency control, and database recovery, emphasizing reliability, consistency, and security in database systems.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1**: Understand and apply the three-schema architecture, data independence, and entity-relationship modeling to design effective database schemas. **CLO-2**: Develop and execute SQL and PL/SQL queries, including advanced operations like joins, constraints, triggers, and aggregate functions, for robust database management. **CLO-3**: Analyze relational algebra operations and apply normalization techniques to optimize database structure and ensure data integrity. **CLO-4**: Demonstrate knowledge of transaction processing, concurrency control methods, and database recovery techniques to maintain database reliability and security.		
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	Database System Concepts and Architecture: Three - Schema Architecture and Data Independence, Entity Relationship Model: Entity Types, Entity Sets, Attributes & keys, Relationships Types & instances ER Diagrams, Naming conventions and Design Issues. Relational Model Constraints, Concept of Keys.	15
II	SQL: Data Definition and Data Types, DDL, DML, and DCL, Join Operations, Views & Queries in SQL, Specifying Constraints & Indexes in SQL, aggregate functions - min, max, count, average, sum. Group by, Order by and Having clauses, PL/SQL: Architecture of PL/SQL, Basic Elements of PL/SQL, PL/SQL Transactions, Cursors and Triggers.	15

III	Relational Algebra: Unary and Binary Relational Operations, Functional Dependencies, Normal Forms Based on Primary Keys- (1NF, 2NF, 3NF, BCNF), Multi-valued Dependencies, 4 NF, Join dependencies, 5 NF, Domain Key Normal Form. Query Processing and Optimization	15
IV	Transaction Processing Concepts: Introduction to Transaction Processing, Transaction & System Concepts, Properties of Transaction, Schedules and Recoverability, Serializability of Schedules. Concurrency Control Techniques: Locking Techniques, Time stamp ordering, Multi-version Techniques, Database backup, recovery and security.	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) Date C.J., An Introduction to Database Systems, Pearson Education.
2) Hector G.M., Ullman J.D., Widom J., Database Systems: The Complete Book, Pearson Education.
3) Silberschatz A., Korth H., Sudarshan S., Database System Concepts, McGraw Hill.

With effect from the Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	2nd		
Name of the Course	Artificial Intelligence		
Course Code	M24-CAP-204		
Course Type	CC-8		
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 introduction to the concepts, theories, and applications of Artificial Intelligence (AI), enabling students to understand various knowledge representation techniques using propositional logic, predicate logic, and fuzzy logic. It also introduces search techniques for problem-solving, covering uninformed, informed, and game-playing strategies. Additionally, the course explores the functioning of production systems, expert systems, genetic algorithms, and machine learning techniques, offering students practical insights into their applications in AI.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO-1 Demonstrate an understanding of the foundational concepts of AI, its historical development, and the distinction between Strong AI and Weak AI. CLO-2 Apply propositional logic, predicate logic, and fuzzy logic for knowledge representation and reasoning in AI systems. CLO-3 Implement various search algorithms such as BFS, DFS, A*, and Minimax to solve complex AI problems, including two-player games. CLO-4 Explain and apply machine learning algorithms including supervised (e.g., neural networks, decision trees) and unsupervised (e.g., k-means, PCA) techniques for data analysis and AI applications.		
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	Definition, history, and evolution of AI, Strong AI vs. Weak AI, Applications of AI; Knowledge Representation using logic: Propositional logic: syntax, semantics, truth tables, logical connectives, inference rules, Predicate logic: first-order logic, quantifiers, predicates, clausal form and unification; Fuzzy logic: fuzzy sets, membership functions, fuzzy reasoning.	15
II	Search Techniques: Problem formulation: state space representation, Uninformed Search Strategies: Breadth-First Search, Depth-First Search (DFS), Iterative Deepening DFS;	15

	Informed Search Strategies: Hill climbing, Best-first search, A* algorithm, admissibility, monotonicity, and informedness, Search in Two-Player Games: Minimax algorithm, Alpha-Beta pruning.	
III	Production Systems: rules, working memory, and control strategies, forward chaining and backward chaining, commutative and non-commutative production systems, Expert Systems: Definition and characteristics, Architecture, Applications; Genetic Algorithms: Components of GAs: chromosomes, crossover, mutation, selection, replacement, Fitness functions and evolution processes, GA vs. traditional problem-solving techniques	15
IV	Machine Learning (ML): Definition and importance, Types: supervised, unsupervised, reinforcement learning; Supervised Learning: Linear regression, Decision Trees, k-Nearest Neighbors (k-NN), Neural networks: introduction, perceptron, multilayer networks, back-propagation, Unsupervised Learning: Algorithms: k-Means clustering, Hierarchical clustering, Principal Component Analysis.	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) Luger, G. F. (2009). *Artificial Intelligence: Structures and Strategies for Complex Problem Solving* (6th ed.). Pearson Education.
2) Russell, S., & Norvig, P. (2010). *Artificial Intelligence: A Modern Approach* (3rd ed.). Prentice Hall.
3) Rich, E., Knight, K., & Nair, S. B. (2017). *Artificial Intelligence* (3rd ed.). McGraw-Hill Education.
4) Coppin, B. (2004). *Artificial Intelligence Illuminated*. Narosa Publishing House.

With effect from Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	2nd		
Name of the Course	Practical-4		
Course Code	M24-CAP-205		
Course Type	PC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)			
Course objectives	This course aims to provide hands-on experience in building web applications and understanding networking concepts. Part A focuses on mastering server-side development with Node.js and Express.js, enabling students to design efficient applications integrated with databases like MongoDB. Part B emphasizes networking principles, offering insights into data transmission, error detection, routing, and network protocols through programming and simulation, preparing students for real-world applications in web development and network administration.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1:** and implement server-side applications using Node.js and Express.js, including handling HTTP methods, managing file operations, and building RESTful APIs integrated with MongoDB for CRUD operations and authentication. **CLO-2:** Demonstrate the ability to use Node.js core modules, custom modules, middleware, and debugging tools to build dynamic, efficient, and error-resilient web applications. **CLO-3:** Analyze and implement networking concepts and protocols, including OSI and TCP/IP models, socket programming, and data transmission methods, using Python or C++. **CLO-4:** Apply algorithms and techniques in networking, such as error detection (CRC), routing (Dijkstra's algorithm), and flow control protocols (Go-Back-N, Selective Repeat), through programming and simulation tools.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B- Contents of the Course	
Practicals	**Contact Hours**
Practical course will consist of two components Part-A and Part-B. The examiner will set 5 questions at the time of practical examination asking 3 questions from the Part-A and 2 questions from the Part-B by taking course learning outcomes (CLO) into consideration. The examinee will be required to solve one problem from the Part-A and one from the Part-B.	120
Part-A 1) Set up a simple HTTP server in Node.js that responds with "Hello, World!" when accessed via a browser. 2) Illustrate the client-server architecture by creating a basic web application that sends a request to the server and displays the response in the browser. 3) Implement a program to demonstrate the request-response cycle by logging HTTP request headers and returning a JSON response.	60

4) Compare server-side and client-side operations by creating a simple application where the server processes data and the client displays it. 5) Install Node.js and initialize a new project using npm. Create and manage packages using `package.json`. 6) Write a program using Node.js core modules like `fs` and `os` to read system information and save it to a file. 7) Create a custom module for string manipulation (e.g., reversing, converting to uppercase) and use it in a Node.js script. 8) Write a Node.js program to read and write data to a text file asynchronously, logging success or error messages to the console. 9) Create a script to list all files and directories in a specified folder and display them hierarchically. 10) Implement a program that manages a directory: creating it if it doesn't exist, adding files, and deleting files. 11) Build a basic HTTP server in Node.js that supports different HTTP methods (GET, POST, PUT, DELETE) and logs each request. 12) Create a server that serves static files (e.g., HTML, CSS, JS) from a public directory. 13) Use the `EventEmitter` class to create and emit custom events, such as notifying users when a file operation is completed. 14) Implement a real-time data handler using events, simulating a live stock ticker system. 15) Create a script that performs file operations and uses `try-catch` blocks to handle file-not-found errors gracefully. 16) Debug a Node.js script using `node --inspect` and Chrome DevTools, identifying and fixing a logical error. 17) Create a basic Express.js application to handle routing for `/home`, `/about`, and `/contact` with respective responses. 18) Develop a RESTful API using Express.js to manage a list of books (CRUD operations). 19) Set up a server-side rendering engine (EJS) to dynamically generate HTML pages with user data. 20) Implement custom middleware in an Express.js application to log request details and handle errors. 21) Implement a JWT-based authentication system for a RESTful API, allowing users to register and log in. 22) Create an Express.js application to demonstrate session management for user login and logout. 23) Install MongoDB locally and create a database called `school`. Add a `students` collection and insert sample documents. 24) Use MongoDB Atlas to create a cloud-hosted database and connect to it using Node.js. 25) Write a script to query MongoDB for documents with specific conditions, such as retrieving students with grades above 80. 26) Develop a Node.js script to perform CRUD operations on a `products` collection in MongoDB. 27) Create an Express.js application that connects to MongoDB and exposes APIs for CRUD operations on a `tasks` collection. 28) Add indexes to a MongoDB collection and demonstrate their impact on query performance by measuring execution time before and after indexing. 29) Write a script that creates a compound index on multiple fields in a collection and tests its effectiveness with specific queries.	
Part-B 1) Compare the OSI and TCP/IP reference models by creating a document that maps the functionality of each layer. 2) Develop a Python script to simulate data transmission using TCP/IP sockets between a client and server. 3) Write a program to calculate Nyquist Bit Rate and Shannon Capacity for a given set of inputs (bandwidth, signal levels, noise).	60 (Lab hours include instructions for writing programs and demonstration by a teacher and for running the

4) Implement 4B/5B encoding for a given binary sequence using Python or C++. 5) Implement time-division multiplexing for multiple signals using Python. 6) Compare ADSL and cable broadband connections by analyzing speed, latency, and reliability. 7) Simulate and test the operation of sliding window flow control protocols (Go-Back-N and Selective Repeat). 8) Write a program to implement error detection using CRC (Cyclic Redundancy Check). 9) Implement the Binary Exponential Backoff algorithm and simulate its role in collision resolution. 10) Implement a shortest path routing algorithm (e.g., Dijkstra's algorithm) to find the optimal path in a simulated network.	programs on computer by students.)

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the programs	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Examination:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1) "Node.js Design Patterns" by Mario Casciaro and Luciano Mammino
2) "Learning Node.js Development" by Andrew Mead
3) "Express in Action" by Evan M. Hahn
4) "REST API Development with Node.js" by Fernando Doglio
5) "MongoDB: The Definitive Guide" by Shannon Bradshaw, Eoin Brazil, and Kristina Chodorow
6) "Learning MongoDB" by Amit Phaltankar, Juned Ahsan, and Michael Harrison
7) Andrew S. Tanenbaum, Computer Networks, 4th Edition - PHI.
8) Behrouz A Forouzan, Data Communications and Networking, 5th Edition- Mc-Graw Hill Education.

With effect from Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	2nd		
Name of the Course	Practical-5		
Course Code	M24-CAP-206		
Course Type	PC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)			
Course objectives	The primary objective of this course is to equip students with the theoretical knowledge and practical skills necessary to solve complex computational problems. Through Part A, students will gain expertise in database design, implementation, and optimization, leveraging advanced SQL and PL/SQL techniques. Part B focuses on problem-solving using search algorithms, state-space representations, and optimization methods such as Genetic Algorithms, enabling students to tackle challenges in AI and operations research efficiently.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1:** Analyze, design, and implement database schemas for real-world applications such as library management, hospital management, and e-commerce systems, while applying concepts of ER diagrams, relational schema, normalization, and functional dependencies. **CLO-2:** Demonstrate the ability to write and optimize SQL queries, implement advanced database features such as views, indexes, triggers, cursors, and perform database operations using relational algebra and PL/SQL programming. **CLO-3:** Formulate and implement state-space representations, search algorithms (BFS, DFS, Iterative Deepening DFS), and production systems to solve complex problems like puzzles, mazes, and water-jug problems. **CLO-4:** Design and develop solutions using Genetic Algorithms by encoding chromosomes, defining fitness functions, and applying these techniques to solve optimization problems like the Travelling Salesman Problem (TSP) and mathematical function maximization.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	
Part B- Contents of the Course			
Practicals			**Contact Hours**
Practical course will consist of two components Part-A and Part-B. The examiner will set 5 questions at the time of practical examination asking 3 questions from the Part-A and 2 questions from the Part-B by taking course learning outcomes (CLO) into consideration. The examinee will be required to write and execute 2 questions from the Part-A and one from the Part-B.			120
Part-A 1) Create an ER diagram for a library management system that includes entity types, attributes, keys, relationships, and instances. 2) Convert the ER diagram into relational schemas and define the primary and foreign keys. 3) Implement a database schema in a DBMS for an e-commerce application. Define the constraints, such as NOT NULL, UNIQUE, CHECK, and FOREIGN KEY. 4) Create a database for a hospital management system. Define tables for doctors, patients, appointments, and prescriptions. 5) Perform basic operations such as inserting, updating, and deleting records. 6) Write queries to retrieve data from multiple tables using INNER JOIN, LEFT JOIN, RIGHT JOIN, and FULL OUTER JOIN.			60

7) Create a query to find patients who have visited a specific doctor using JOIN. 8) Create a view to display the total number of patients attended by each doctor. 9) Add an index to optimize the search for patients by their last names. 10) Write a PL/SQL program to implement a banking transaction system that transfers money between two accounts. Use COMMIT and ROLLBACK statements. 11) Create a cursor to fetch and display all overdue book records from a library database. 12) Develop a trigger to automatically update the stock count when a new product is added to an inventory database. 13) Write and execute queries in relational algebra for the following operations: selection, projection, union, intersection, difference, Cartesian product, and join for a student database. 14) Identify functional dependencies in a given database (e.g., a university database). 15) Normalize the database to 1NF, 2NF, 3NF, and BCNF, showing each step of decomposition. 16) Write an inefficient query for fetching data from a large database. Use EXPLAIN PLAN to analyze it and optimize the query using indexes and appropriate joins.	
Part-B 1) Formulate a state-space representation for the "8-puzzle problem." Represent states, actions, and transitions clearly and define the goal state. 2) Implement Breadth-First Search (BFS) to solve a maze where the start and goal positions are specified. 3) Use Depth-First Search (DFS) to navigate through a graph of cities and find a path from a given source to a destination. 4) Apply Iterative Deepening DFS to solve a water-jug problem (e.g., measure exactly 4 liters using a 3-liter and a 5-liter jug). 5) Develop a production system to solve the "Tower of Hanoi" problem. 6) Write a program to implement a Genetic Algorithm to maximize a mathematical function (e.g., f(x)=x2,0≤x≤31). Demonstrate the use of binary encoding for chromosomes. 7) Define a fitness function for solving the "Travelling Salesman Problem (TSP)" using a Genetic Algorithm.	60 (Lab hours include instructions for writing programs and demonstration by a teacher and for running the programs on computer by students.)

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the programs	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Examination:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1) Silberschatz A., Korth H., Sudarshan S., Database System Concepts, McGraw Hill.
2) Luger, G. F. (2009). *Artificial Intelligence: Structures and Strategies for Complex Problem Solving* (6th ed.). Pearson Education.

With effect from Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	2nd		
Name of the Course	Mathematical Foundations for Computer Science		
Course Code	M24-CAP-207		
Course Type	BC-3		
Level of the course (As per Annexure-I	400-499		
Pre-requisite for the course (if any)	-		
Course Objectives	The objective of this paper is to make the students familiar with the commonly used mathematics and statistics in the field of computer science.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1:** Students will be able to apply set theory, relations, and functions to solve problems in discrete mathematics, including the use of pigeonhole principles and recursive functions. **CLO-2:** Students will demonstrate proficiency in performing matrix operations, solving systems of linear equations, and applying numerical methods for interpolation, integration, and differentiation. **CLO-3:** Students will develop the ability to organize, analyze, and interpret data using measures of central tendency, dispersion, and statistical visualization techniques. **CLO-4:** Students will gain the ability to model relationships between variables using regression and correlation analysis, and apply probability principles, including Bayes' theorem, to real-world scenarios.		
Credits	Theory	Practical	Total
	0	0	0
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	Sets: Set theory: Basic concept, set types, set operations, cardinality, and notation. Relations: Relations and its representations, Properties of binary relation –Reflexive, symmetric, Asymmetric, transitive, Equivalence, Inverse & Composition of a relation, closure of relations, its types, Partial ordering relation, Hasse diagram, minimal elements, upper bound, lower bound, Lattices Functions: definition, floor functions, ceiling functions, surjective, injunctive and bijective functions, Inverse Function, Composition of functions, recursive Functions, Pigeon hole principles and its application.	15
II	Addition and multiplication of matrices, Laws of matrix algebra, Singular and non-singular matrices, Inverse of a matrix, Systems of linear equations, Eigen values and Eigen vectors, Diagonalization of a square matrix. Interpolation, Numerical Integration and Differentiation.	15
III	Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample. Data: Quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives. Measures of Central Tendency: Mean, Median, Mode. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, skewness and kurtosis. Statistical Methods: Definition and scope of Statistics,	15

	concepts of statistical population and sample. Data: Quantitative and qualitative, attributes, variables, scales of measurement nominal, ordinal, interval and ratio. Presentation: tabular and graphical, including histogram and ogives. Measures of Central Tendency: Mean, Median, Mode. Measures of Dispersion: range, quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, skewness and kurtosis.	
IV	Bivariate data: Definition, scatter diagram, simple, partial and multiple correlation (3 variables only), rank correlation. Simple linear regression, principle of least squares and fitting of polynomials and exponential curves. Probability: Introduction, random experiments, sample space, events and algebra of events. Definitions of Probability – classical, statistical, and axiomatic. Conditional Probability, laws of addition and multiplication, independent events, theorem of total probability, Bayes' theorem and its applications.	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) Gupta, S. C. and Kapoor, V.K. : Fundamentals Of Mathematical Statistics, Sultan Chand &Sons
2) Seymour Lipschutz, Marc Lars Lipson, Discrete mathematics, McGraw-Hill international editions, Schaum's series.
3) V. Rajaraman, Computer-Oriented Numerical Methods., PHI Reference Books:
4) Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
5) Hogg, R.V., Tanis, E.A. and Rao J.M. : Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
6) Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, The World Press, Kolkata.
7) Babu Ram: Discrete Mathematics
8) Shanti Narayana : Differential & Integral calculus

With effect from Session: 2024-25			
Part A - Introduction			
Name of the Programme	MCA		
Semester	2nd		
Name of the Course	Practical-6		
Course Code	M24-CAP-208		
Course Type	BC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)			
Course objectives	The course aims to equip students with the ability to implement fundamental concepts of sets, relations, and functions using programming techniques. It focuses on developing skills for performing matrix operations, solving linear equations, and applying numerical methods through programming. Additionally, it enables students to analyze statistical data, apply probability concepts, and perform regression analysis using computational tools.		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	**CLO-1:** Students will be able to implement fundamental concepts of set theory, relations, and functions, including operations, properties, and representations, to solve real-world problems using programming techniques. **CLO-2:** Students will be able to perform matrix operations, solve systems of linear equations, and apply numerical techniques such as interpolation, integration, and differentiation through programming exercises. **CLO-3:** Students will be able to analyze and represent data using statistical measures, including measures of central tendency, dispersion, and graphical tools, and interpret the results effectively. **CLO-4:** Students will be able to apply probability theories, Bayes' theorem, and regression analysis to model and solve problems involving uncertainty and bivariate data using programming tools.		
Credits	Theory	Practical	Total
	0	0	0
Teaching Hours per week	0	2	2
Internal Assessment Marks	0	15	15
End Term Exam Marks	0	35	35
Max. Marks	0	50	50
Examination Time	0	4 hours	

Part B- Contents of the Course	
Practicals	**Contact Hours**
The examiner will set 3 questions at the time of practical examination by taking course learning outcomes (CLO) into consideration. The examinee will be required to write and execute 2 questions.	60
1) Set Operations: Write a program to perform union, intersection, difference, and symmetric difference on two sets. 2) Cardinality: Implement a program to calculate the cardinality of a given set. 3) Binary Relation Properties: Write a program to check whether a given binary relation is reflexive, symmetric, asymmetric, or transitive. 4) Hasse Diagram: Create a program to generate a Hasse diagram for a partial ordering relation. 5) Lattices: Write a program to verify whether a given set with a partial order forms a lattice. 6) Functions: Implement a program to check whether a function is injective, surjective, or bijective. 7) Recursive Functions: Write a program to compute the factorial of a number using recursion and apply it to solve problems using pigeonhole principles. 8) Pigeonhole Principle: Write a program to prove the pigeonhole principle for a given input set.	60 (Lab hours include instructions for writing programs and demonstration by a teacher and for running the programs on computer by students.)

9) Matrix Operations: Write a program to add, subtract, and multiply two matrices. 10) Inverse of a Matrix: Implement a program to find the inverse of a square matrix using Gauss-Jordan elimination. 11) Eigenvalues and Eigenvectors: Write a program to compute the eigenvalues and eigenvectors of a square matrix. 12) System of Linear Equations: Create a program to solve a system of linear equations using Gaussian elimination. 13) Diagonalization: Write a program to diagonalize a square matrix if possible. 14) Interpolation: Implement a program to perform Lagrange or Newton interpolation for a given set of points. 15) Numerical Integration: Write a program to compute the definite integral of a function using the trapezoidal or Simpson's rule. 16) Numerical Differentiation: Create a program to find the derivative of a function using finite difference methods. 17) Data Presentation: Write a program to create a histogram and ogive for a given data set. 18) Measures of Central Tendency: Implement a program to calculate mean, median, and mode for a given data set. 19) Measures of Dispersion: Write a program to compute range, quartile deviation, mean deviation, standard deviation, and coefficient of variation for a data set. 20) Moments, Skewness, and Kurtosis: Create a program to calculate the moments of a distribution and determine its skewness and kurtosis. 21) Tabular Representation: Write a program to present data in tabular form based on user input (quantitative or qualitative). 22) Scatter Diagram: Write a program to generate a scatter plot for bivariate data and compute the correlation coefficient. 23) Regression: Implement a program to compute the equation of a simple linear regression line and predict values based on the model. 24) Polynomial Fitting: Write a program to fit a polynomial curve using the principle of least squares. 25) Exponential Curve Fitting: Create a program to fit an exponential curve to a given data set. 26) Probability Calculations: Write a program to compute probabilities using classical, statistical, and axiomatic definitions. 27) Conditional Probability: Implement a program to calculate conditional probability and verify the laws of addition and multiplication. 28) Bayes' Theorem: Write a program to solve problems using Bayes' theorem. 29) Random Events Simulation: Create a program to simulate random experiments, generate a sample space, and calculate probabilities.	

Suggested Evaluation Methods

Internal Assessment: 15		**End Term Examination: 35**	
➢ **Practicum**	**15**	➢ **Practicum**	**35**
• Class Participation:	4	Lab record, Viva-Voce, write-up and execution of the programs	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	4		
• Mid-Term Examination:	7		

Part C-Learning Resources

Reference Books:

1) Gupta, S. C. and Kapoor, V.K. : Fundamentals Of Mathematical Statistics, Sultan Chand &Sons
2) Seymour Lipschutz, Marc Lars Lipson, Discrete mathematics, McGraw-Hill international editions, Schaum's series.
3) V. Rajaraman, Computer-Oriented Numerical Methods., PHI Reference Books:
4) Kenneth H. Rosen, Discrete Mathematics and its Applications, Tata McGraw – Hill
5) Hogg, R.V., Tanis, E.A. and Rao J.M. : Probability and Statistical Inference, Seventh Ed, Pearson Education, New Delhi.
6) Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of Statistics, Vol. I & II, The World Press, Kolkata.
7) Babu Ram: Discrete Mathematics
8) Shanti Narayana : Differential & Integral calculus

Session: 2024-25			
Part A - Introduction			
Name of Programme	MCA		
Semester	2nd		
Name of the Course	Constitutional, Human and Moral Values, and IPR		
Course Code	M24-CHM-201		
Course Type	CHM		
Level of the course	400-499		
Pre-requisite for the course (if an)			
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Learn the different Constitutional Values, Fundamental rights and duties enshrined in the Indian Constitution. CLO 2: Understand humanism, human virtues and values, and ide of International peace. CLO 3: Grasp the basic concepts of Moral Values and Professional Conduct which are required to become a part of the civil society and for developing professionalism. CLO 4: Understand concepts of Intellectual Property Rights, Copyright, Patent, Trademark etc., and about threats of Plagiarism.		
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	**Constitutional Values:** Historical Perspective of Indian Constitution; Basic Values enshrined in the Preamble of the Indian Constitution; Concept of Constitutional Morality; Patriotic Values and Ingredients of Nation Building; Fundamental Rights and Duties ; Directive Principles of the State Policy.	8
II	**Humanistic Values:** Humanism, Human Virtues and Civic Sense; Social Responsibilities of Human Beings; Ethical ways to deal with human aspirations; Harmony with society and nature; Idea of International Peace and Brotherhood (Vasudhaiv Kutumbkam).	7
III	**Moral Values and Professional Conduct:** Understanding Morality and Moral Values; Moral Education and Character Building; Ethics of Relations: Personal, Social and Professional; Introduction to Gender Sensitization; Affirmative approach towards Weaker Sections (SCs, STs, OBCs, EWS & DAs); Ethical Conduct in Higher Education Institutions; Professional Ethics.	8
IV	**Intellectual Property Rights:** Meaning, Origins and Nature of Intellectual Property Rights (IPRs);Different Kinds of IPRs – Copyright, Patent, Trademark, Trade Secret/Dress, Design, Traditional Knowledge; Infringement and Offences of IPRs – Remedies and Penalties; Basics of Plagiarism policy of UGC.	7
	Note: Scope of the syllabus shall be restricted to generic and introductory level of mentioned topics.	

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) Ahuja, V K. (2017). Law relating to Intellectual Property Rights, India, IN: Lexis Nexis. Bajpai, B. L., Indian Ethos and Modern Management, New Royal Book Co., Lucknow, 2004.
2) Basu, D.D., Introduction to the Constitution of India (Students Edition) Prentice Hall of India Pvt. Ltd., New Delhi, 20th ed., 2008.
3) Dhar, P.L. & R.R. Gaur, Science and Humanism, Commonwealth Publishers, New Delhi, 1990. George, Sussan, How the Other Half Dies, Penguin Press, 1976.
4) Govindarajan, M., S. Natarajan, V.S. Sendilkumar (eds.), Engineering Ethics (Including Human Values), Prentice Hall of India Private Ltd, New Delhi, 2004.
5) Harries, Charles E., Michael S. Pritchard & Michael J. Robins, Engineering Ethics, Thompson Asia, New Delhi, 2003.
6) Illich, Ivan, Energy & Equity, Trinity Press, Worcester, 1974.
7) Meadows, Donella H., Dennis L. Meadows, Jorgen Randers & William W. Behrens, Limits to Growth: Club of Rome's Report, Universe Books, 1972.
8) Myneni, S.R, Law of Intellectual Property, Asian Law House. Narayanan, P, IPRs.
9) Neeraj, P., &Khusdeep, D. (2014). Intellectual Property Rights, India, IN: PHI learning Private Limited. Nithyananda, K V. (2019). Intellectual Property Rights: Protectionand Management. India, IN: Cengage Learning India PrivateLimited.
10) Palekar, Subhas, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati, 2000.
11) Phaneesh, K.R., Constitution of India and Professional Ethics, New Delhi.
12) Pylee, M.V., An Introduction to Constitution of India, Vikas Publishing, New Delhi, 2002. Raman, B.S., Constitution of India, New Delhi, 2002.
13) Reddy, B., Intellectual Property Rights and the Law, Gogia Law Agency.
14) Reddy, N.H., SantoshAjmera, Ethics, Integrity and Aptitude, McGraw Hill, New Delhi. Sharma, Brij Kishore, Introduction to the Constitution of India, New Delhi,