OMKARA COLLEGE OF PROFESSIONAL EDUCATION
(A CONSTITUENT UNIT OF PATLIPUTRA UNIVERSITY, PATNA)
MCA 1st Year (Master Of Computer Applications)
Semester I

MCA-101: Computer Organization And Architecture

- Unit 1: Digital Logic Circuits
- Boolean Algebra And Logic Gates, Combinational Logic Design, Sequential Circuits, Memory Organization, Data Representation.
- Unit 2: Computer Architecture
- Computer Organization And Architecture, CPU Organization, Control Unit Design, Instruction Formats, Addressing Modes, Instruction Pipelining.
- Unit 3: Memory Systems
- Memory Hierarchy, Cache Memory, Virtual Memory, Secondary Storage Devices, Memory Management Techniques.
- Unit 4: Input/Output Systems
- I/O Interfaces, I/O Techniques (Programmed I/O, Interrupt-Driven I/O, DMA), I/O Processors, Peripheral Devices.
- Unit 5: Advanced Architectures
- Parallel Processing, Multiprocessor Architectures, RISC Vs CISC Architectures, Introduction To GPU Architecture.

MCA-102: Programming Concepts Using C++

- Unit 1: Introduction To C++
- Overview Of C++, Data Types, Variables, Operators, Control Structures, Functions, Arrays And Pointers.
- Unit 2: Object-Oriented Programming
- Classes And Objects, Encapsulation, Inheritance, Polymorphism, Abstraction, Friend Functions.
- Unit 3: Advanced C++ Features
- Function Overloading, Operator Overloading, Virtual Functions, Templates, Exception Handling.
- Unit 4: File Handling And STL
- File I/O Operations, Standard Template Library (STL), Containers, Iterators, Algorithms.
- Unit 5: Memory Management
- Dynamic Memory Allocation, Smart Pointers, Memory Leaks, Garbage

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MCA-103: Data Structures

- Unit 1: Introduction To Data Structures
- Basic Concepts, Abstract Data Types, Time And Space Complexity, Algorithm Analysis.
- Unit 2: Linear Data Structures
- Arrays, Linked Lists (Singly, Doubly, Circular), Stacks, Queues, Priority Queues.
- Unit 3: Non-Linear Data Structures
- Trees (Binary Trees, Binary Search Trees, AVL Trees), Heaps, Graphs (Representation, Traversals).
- Unit 4: Searching And Sorting
- Linear Search, Binary Search, Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort.
- Unit 5: Advanced Data Structures
- Hash Tables, B-Trees, Red-Black Trees, Trie, Segment Trees.

MCA-104: Database Management Systems

- Unit 1: Database Concepts
- Introduction To DBMS, Data Models, Database Architecture, Database Users, DBMS Languages.
- Unit 2: Relational Model
- Relational Data Model, Relational Algebra, SQL, Integrity Constraints, Normalization (1NF To BCNF).
- Unit 3: Transaction Management
- Transaction Concepts, ACID Properties, Concurrency Control Techniques, Deadlock, Recovery Mechanisms.
- Unit 4: Database Design
- ER Model, Enhanced ER Model, Logical Database Design, Physical Database Design, Database Tuning.
- Unit 5: Advanced Database Concepts
- Distributed Databases, Object-Oriented Databases, NoSQL Databases, Big Data, Data Warehousing And Mining.

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MCA-105: Computer Networks

- Unit 1: Network Fundamentals
- Network Types, Topologies, Network Models (OSI, TCP/IP), Transmission Media, Network Devices.
- Unit 2: Data Link Layer
- Framing, Error Detection And Correction, Flow Control, MAC Protocols, Ethernet, Switching.
- Unit 3: Network Layer
- IP Addressing, Subnetting, Routing Algorithms, IP Protocol, ICMP, ARP, RARP.
- Unit 4: Transport Layer
- UDP, TCP, Congestion Control, Quality Of Service, Socket Programming.
- Unit 5: Application Layer
- DNS, Email (SMTP, POP, IMAP), HTTP, FTP, Network Security Basics.

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MCA-201: Operating Systems

- Unit 1: Introduction To Operating Systems
- OS Concepts, Evolution, Types, Structure, System Calls, OS Services.
- Unit 2: Process Management
- Process Concept, Scheduling Algorithms, Inter-Process Communication, Threads, CPU Scheduling.
- Unit 3: Memory Management
- Memory Hierarchy, Partitioning, Paging, Segmentation, Virtual Memory, Page Replacement Algorithms.
- Unit 4: File Systems
- File Concepts, Access Methods, Directory Structure, File System Implementation, Disk Scheduling.
- Unit 5: Protection And Security
- Protection Mechanisms, Access Control, Authentication, Security Threats, Case Studies (UNIX, Windows).

MCA-202: Software Engineering

- Unit 1: Software Process Models
- Software Development Life Cycle, Process Models (Waterfall, Incremental, Spiral, Agile), Process Activities.
- Unit 2: Requirements Engineering
- Requirements Elicitation, Analysis, Specification, Validation, Management, Use Cases, User Stories.
- Unit 3: Software Design
- Design Principles, Architectural Design, Detailed Design, Design Patterns, UML Diagrams.
- Unit 4: Software Testing
- Testing Levels, Testing Techniques, Test Case Design, Test-Driven Development, Automated Testing.
- Unit 5: Project Management
- Project Planning, Estimation, Risk Management, Quality Management, Configuration Management, DevOps.

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MCA-203: Web Technologies

- Unit 1: Client-Side Technologies
- HTML5, CSS3, JavaScript, DOM Manipulation, Responsive Web Design, Bootstrap.
- Unit 2: JavaScript Frameworks
- Introduction To Modern JS Frameworks (React, Angular, Vue), Components, State Management, Routing.
- Unit 3: Server-Side Technologies
- Node.Js, Express.Js, PHP, Server-Side Rendering, RESTful APIs, GraphQL.
- Unit 4: Database Integration
- SQL Databases With Web Applications, NoSQL Databases, ORM, Database Connectivity.
- Unit 5: Web Security And Deployment
- Authentication, Authorization, HTTPS, CORS, XSS, CSRF, SQL Injection, Web Hosting, Containerization.

MCA-204: Java Programming

- Unit 1: Java Fundamentals
- Java Features, JVM, Data Types, Control Structures, Arrays, Classes, Objects, Methods, Packages.
- Unit 2: Object-Oriented Programming In Java
- Inheritance, Polymorphism, Abstraction, Interfaces, Inner Classes, Anonymous Classes.
- Unit 3: Exception Handling And Multithreading
- Exception Hierarchy, Try-Catch Blocks, Custom Exceptions, Thread Lifecycle, Synchronization, Concurrent API.
- Unit 4: Java Collections And I/O
- Collection Framework, Lists, Sets, Maps, Generics, File I/O, Serialization, NIO.
- Unit 5: Java Enterprise Technologies
- JDBC, Servlets, JSP, Introduction To Spring Framework, Hibernate ORM.

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MCA-205: Design And Analysis Of Algorithms

- Unit 1: Algorithm Analysis
- Time And Space Complexity, Asymptotic Notation (Big-O, Omega, Theta), Recurrence Relations, Master Theorem.
- Unit 2: Algorithm Design Techniques
- Divide And Conquer, Greedy Algorithms, Dynamic Programming, Backtracking, Branch And Bound.
- Unit 3: Graph Algorithms
- BFS, DFS, Shortest Path Algorithms (Dijkstra's, Bellman-Ford), Minimum Spanning Trees (Prim's, Kruskal's).
- Unit 4: String Algorithms
- String Matching (Naive, KMP, Rabin-Karp), Tries, Suffix Trees, Regular Expressions.
- Unit 5: NP-Completeness
- P And NP Classes, NP-Completeness, Reduction, Approximation Algorithms, Heuristic Approaches.

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Semester III

MCA-301: Mobile Application Development

- Unit 1: Introduction To Mobile Platforms
- Mobile Ecosystem, Android Architecture, IOS Architecture, Cross-Platform Development.
- Unit 2: Android Development
- Android SDK, Activities, Fragments, Intents, UI Design, Layouts, Material Design.
- Unit 3: Data Storage And APIs
- SQLite, Shared Preferences, Room Database, RESTful API Integration, JSON Parsing.
- Unit 4: Advanced Mobile Features
- Location Services, Maps, Camera, Sensors, Push Notifications, Background Processing.
- Unit 5: Cross-Platform Development
- React Native, Flutter, Xamarin, Hybrid App Development, Performance Considerations.

MCA-302: Cloud Computing

- Unit 1: Cloud Computing Fundamentals
- Cloud Computing Concepts, Service Models (IaaS, PaaS, SaaS), Deployment Models, Virtualization.
- Unit 2: Cloud Platforms
- AWS, Azure, Google Cloud Platform, Core Services, Management Consoles.
- Unit 3: Cloud Storage And Databases
- Object Storage, Block Storage, Cloud Databases (SQL And NoSQL), Data Migration.
- Unit 4: Cloud Security
- Security Challenges, Identity And Access Management, Encryption, Compliance, Best Practices.
- Unit 5: Cloud Application Development
- Microservices, Serverless Computing, Containers, Docker, Kubernetes, CI/CD Pipelines.

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Semester III

MCA-303: Artificial Intelligence And Machine Learning

- Unit 1: Introduction To AI
- AI Concepts, History, Intelligent Agents, Problem-Solving, Search Algorithms (BFS, DFS, A*).
- Unit 2: Knowledge Representation
- Logic, Rule-Based Systems, Semantic Networks, Frames, Ontologies, Expert Systems.
- Unit 3: Machine Learning Basics
- Supervised Learning, Unsupervised Learning, Reinforcement Learning, Feature Engineering, Model Evaluation.
- Unit 4: Machine Learning Algorithms
- Linear Regression, Logistic Regression, Decision Trees, Random Forests, SVM, K-Means Clustering, Neural Networks.
- Unit 5: Deep Learning
- Neural Network Architectures, Convolutional Neural Networks, Recurrent Neural Networks, Transfer Learning, TensorFlow/PyTorch.

MCA-304: Information Security

- Unit 1: Security Fundamentals
- Security Concepts, CIA Triad, Security Threats, Vulnerabilities, Risk Management, Security Policies.
- Unit 2: Cryptography
- Symmetric Encryption, Asymmetric Encryption, Hash Functions, Digital Signatures, PKI, SSL/TLS.
- Unit 3: Network Security
- Firewalls, IDS/IPS, VPN, Wireless Security, Network Attacks, Defense Mechanisms.
- Unit 4: Application Security
- Web Application Security, OWASP Top 10, Secure Coding Practices, Code Review, Penetration Testing.
- Unit 5: Security Management
- Security Governance, Compliance, Incident Response, Disaster Recovery, Business Continuity, Security Auditing.

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Semester III

MCA-305: Elective I (Big Data Analytics)

- Unit 1: Introduction To Big Data
- Big Data Concepts, 5Vs Of Big Data, Big Data Ecosystem, Use Cases, Challenges.
- Unit 2: Hadoop Ecosystem
- HDFS, MapReduce, YARN, Hadoop Architecture, Hadoop Components (Pig, Hive, HBase).
- Unit 3: Data Processing
- Batch Processing, Stream Processing, Apache Spark, Spark SQL, Spark Streaming.
- Unit 4: NoSQL Databases
- NoSQL Concepts, Types (Document, Key-Value, Column-Family, Graph), MongoDB, Cassandra.
- Unit 5: Data Visualization And Analytics
- Data Visualization Techniques, Tools (Tableau, Power BI), Predictive Analytics, Text Analytics, Social Media Analytics.

MCA-401: Elective II (Internet Of Things)

- Unit 1: IoT Fundamentals
- IoT Concepts, Architecture, Protocols, Standards, Applications, Challenges.
- Unit 2: IoT Hardware
- Sensors, Actuators, Microcontrollers (Arduino, Raspberry Pi), Communication Modules.
- Unit 3: IoT Communication
- Wireless Technologies (WiFi, Bluetooth, ZigBee, LoRa), MQTT, CoAP, HTTP/REST.
- Unit 4: IoT Data Management
- Data Collection, Processing, Storage, Analytics, Cloud Integration, Edge Computing.
- Unit 5: IoT Security And Applications
- Security Challenges, Authentication, Encryption, Privacy, Smart Homes, Smart Cities, Industrial IoT.

MCA-402: Elective III (Blockchain Technology)

- Unit 1: Blockchain Fundamentals
- Blockchain Concepts, Distributed Ledger, Consensus Mechanisms, Cryptographic Primitives.
- Unit 2: Bitcoin And Cryptocurrencies
- Bitcoin Architecture, Transactions, Mining, Wallets, Altcoins, Tokenomics.
- Unit 3: Ethereum And Smart Contracts
- Ethereum Platform, Solidity Programming, Smart Contracts, DApps, Web3.
- Unit 4: Enterprise Blockchain
- Permissioned Blockchains, Hyperledger Frameworks, Consortium Blockchains, Use Cases.
- Unit 5: Blockchain Applications
- Supply Chain, Healthcare, Finance, Governance, NFTs, DeFi, Challenges And Limitations.

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Semester IV

MCA-403: Project Work

- The Project Work Is A Comprehensive Application Of The Knowledge Gained Throughout The MCA Program. Students Are Required To Develop A Software Application Or Conduct Research In An Emerging Area Of Computer Science Under The Guidance Of A Faculty Member. The Project Includes:
    - Problem Identification And Requirement Analysis
    - System Design And Architecture
    - Implementation Using Appropriate Technologies
    - Testing And Validation
    - Documentation And Presentation
    - Final Project Report And Viva-Voce Examination