MANIPAL UNIVERSITY
JAIPUR

PROGRAMME PROJECT REPORT (PPR)

For

Master of Computer Applications (MCA)

ONLINE DEGREE PROGRAMME

DIRECTORATE OF ONLINE EDUCATION (DOE)
MANIPAL UNIVERSITY, JAIPUR-303 007
RAJASTHAN

MANIPAL UNIVERSITY
CIQA
JAIPUR

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PROGRAMME PROJECT REPORT

Introduction

The Programme leading to the award of Master of Computer Applications (MCA) is developed to prepare students to take up a career in the field of IT and Computer Applications. This is a Post Graduate Programme where students are exposed to various areas of Computer Applications including the latest developments in the Industry.

1. Programme's Mission and Objectives

To afford a Quality Postgraduate Degree in Information Technology (MCA) through Online Learning mode to impart high quality training to students using the latest tools in computer technology. To upkeep the high standard of education, the academic syllabus is designed keeping in view the latest trends and technologies in the field of Computer Science. The coursework is designed to be flexible and wide-ranging, incorporating cutting edge technology and ensuring that the students have a firm grasp on the core fundamentals of IT, and its applications.

The objectives of the programme are to enable students:

- To work productively as IT professionals both at supportive and leadership roles
- To advance successfully in their chosen career path utilizing technical abilities, leadership qualities, communication, and interpersonal skills with high regard to legal and ethical responsibilities, in IT domain.
- To build their profession adaptable to the changes in technology, with lifelong learning

2. Relevance of Programme with Manipal University, Jaipur Mission and Goals

In order to align with the mission and goals of Manipal University Jaipur, the Online MCA Programme is planned to enable students and working professionals gain knowledge in various domains of IT, specialize in a domain of their choice, gain knowledge of not only IT, but also managerial skills including analysis, data based decision making and entrepreneurship, in newer and emerging markets, products and technologies.

Vision

Global Leadership in Higher Education and Human Development

Mission

- Be the most preferred University for innovative and interdisciplinary learning
- Foster Academic research and professional excellence in all domains
- Transform young minds into competent professionals with good human values.

3. Nature of Prospective Target Group of Learners

It is by now well accepted that an MCA degree is an important tool for professionals to contribute to business in all areas of IT, expand their career options and move up their career ladder, acquire Leadership skills or embark on an entrepreneurial journey.

This Online programme has been designed for conventional learners, as well as working professionals and other individuals aspiring to acquire knowledge and associated academic credentials. Considering that all candidates interested in pursuing a degree may not be able to afford the same through a campus mode for reasons of paucity of time or financial constraints, online delivery is a feasible option to enable them to acquire knowledge and skills. Delivery through this mode also contributes towards Gross Enrolment Ratio (GER) of 50% by 2035, as envisaged by the Government of India.

The programme is so designed that the prospective students who may not be able to afford full time, residential MCA are provided with high value learning, anytime, anyplace, at one's own pace.

4. Appropriateness of programme to be conducted in Online mode to acquire specific skills and competence

The courses in the programme are delivered through Self-Learning e-Module which is a modular unit of e-learning material which is inter-alia self-explanatory, self-contained, self-directed at the learner, and amenable to self-evaluation, and enables the learner to acquire

the prescribed level of learning in a course of study and includes contents in the form of a combination of the following e-Learning content, and made available through four-quadrant approach namely,

(a) e-Tutorial - faculty led Audio - Video Lectures, (b) e-Content (combination of PDF/ epub) Text Materials, (c) Discussion forum for raising of doubts and clarifying the same on real time basis by the Course Coordinators/Course Mentors assigned to students (d) Self-Assessment Quiz, Test and Assignments to reinforce learning. Reference books are also mentioned in the syllabus. Latest Edition of Reference books may be referred to.

A robust Learning Management System that keeps track of delivery of e-Learning Programmes, learner's engagement, assessment, results and reporting in one centralized location, is in place. All of the above can be done/delivered by online and other platforms without much loss of fidelity. Hence the MCA programme is suited for Online mode of learning.

5. Instructional Design

5.1. Curriculum design

Curriculum has been designed by experts in the area of Management and care has been taken to include contemporary topics, as well as topics that also inculcate environmental awareness in students. The curriculum and syllabus are approved by the Board of Studies, Centre for Internal Quality Assurance (CIQA) and University Academic Council which consists of experts from Academia and Industry.

5.2. Programme structure and detailed syllabus

5.2.1. Programme Structure

Master of Computer Applications

Course Key	Course	Credits
	I year First Semester	
DCA6101	Fundamentals of Computer and IT	Bridge Course
DCA6102	Programming in C	4
DCA6103	Foundation of Mathematics	4
DCA6104	Advanced Database Management System (DBMS)	4
DCA6105	Computer Architecture	4
DCA6130	Programming in C – Practical	2

DCA6131	Advanced DBMS – Practical	2
Second Semester		
DCA6201	Operating System	4
DCA6202	Advanced Data Structure	4
DCA6203	Web Technologies	4
DCA6204	Advanced Computer Networks	4
DCA6205	Communication Skills	2
DCA6230	Advanced Data Structures using C++ - Practical	2
DCA6231	Web Technologies – Practical	2
II Year Third Semester		
DCA7101	Probability and Statistics	4
DCA7102	Programming in Java	4
DCA7103	Advanced Software Engineering	4
DCA7104	Analysis and Design of Algorithm	4
	Elective – I	**4**
DCA8141	Wireless and Mobile Communication	
DCA8142	Open Source DB Systems	
DCA8143	Cryptography and Network Security	
DCA7130	Java Programming – Practical	2
DCA7131	Seminar	1
Fourth Semester		
DCA7230	Project work	24
	Elective – II	**4**
DCA8241	Advanced Web Programming	
DCA8242	Cloud DB System	
DCA8243	Storage Management	
	Total Credits	**93**

5.2.2 Detailed Syllabus

First Year
First Semester

Course code: DCA6101	**Course Title: Fundamentals of Computer and IT (Bridge Course)**
Unit 1	**Introduction to Computers:** Computer – Definitions, The Evolution of Computers, Characteristics of Computers, Organisation of a Computer, Generation of Computer, Classification of Computers, Distributed Computer System, Parallel Computers.
Unit 2	**Computer & Mathematics**: Decimal, Binary, Octal, Hexadecimal Number Systems, Converting Techniques in Number Systems, One's Complements, Two's Complements, Rules and

	Laws of Boolean Algebra, Basic Gates (NOT, AND & OR).
Unit 3	**Logic Gates**: Introduction, Definition of Combinational Circuits & Sequential Circuits, Flip Flops, Shift Registers and their types, Counters, Types of FLIP FLOPS. Central Processing Units: Introduction, CPU Essentials, Architectural Performance, Processors, CPU Overclocking.
Unit 4	**Computer Memory**: Introduction, Memory Systems and Cells, Memory Arrays, RAM, ROM, External Memory (Secondary Memory), Floppy Disk Drives, Compact Disk Read Only Memory, Magnetic Storage Drives, Physical Devices Used to Construct Memories. Components: Connecting the Computer Components, Types of BUS, Industry Standard Architecture (ISA), Peripheral Component Interconnect (PCI), Accelerated Graphics Port (AGP), Front Side Bus (FSB), Dual Independent Bus (DIB), Troubleshooting.
Unit 5	**Data Storage:** Introduction, Hard Drive, CD-ROM Drive, DVD Drive, Blue-Ray Disc Drive, Flash Memory Drive.
Unit 6	**Input & Output Devices:** Introduction, Input Devices, Output Devices.
Unit 7	**Computer Software:** Introduction, System Software and Application Software, Open Source Technology, Software Development, Software analysis and design, Software testing, programming methods, software applications.
Unit 8	**Operating System:** Introduction, Operating System Concepts, Functions, Development, Components, Services.
Unit 9	**Computer Communication:** Concept of computer communication, Basic Elements, Data communication, Network Type, OSI Model, Transmission Control Protocol/Internet Protocol Model, Internet.
Unit 10	**Computer Networks:** Introduction, TCP/IP Protocol Suite, History of Internet, Concepts of Internet, How Internet Works, Requirements of Internet, Uses of Internet, Internet Explorer, Internet Applications

Reference Books

1. Sinha, Pradeep K., and Priti Sinha. *Computer fundamentals*. BPB publications
2. Kaye, Barbara K., and Norman J. Medoff. *World Wide Web: a mass communication perspective*. McGraw-Hill Higher Education.
3. Bartee, Thomas C. *Digital computer fundamentals*. No. 04; QA76. 5, B37.

Course code: DCA6102	**Course Title: Programming in C**
Unit 1	**Introduction to C Programming:** Introduction**,** Features of C and its Basic Structure, Simple C Programs, Constants, Concept of an Integer and Variable, Rules for Naming Variables and Assigning Values to Variables.
Unit 2	**Operators and Expressions:** Introduction, Arithmetic Operators, Unary, Relational and Logical Operators, Conditional Operator, Bitwise Operators, Increment and Decrement Operators, Size and Precedence of Operator, Precedence of Operators, Library Functions.
Unit 3	**Data Types and Input/Output Operators:** Introduction, Floating-point

	Numbers, Type Cast Operator, Type Char, Keywords, Character Input and Output, Formatted Input and Output, gets() and puts() functions, Interactive Programming.
Unit 4	**Control Statements and Decision Making:** Introduction, Goto Statement, If Statement, Conditional Expression, Switch Statement, Types of Loop, Do While, For.
Unit 5	**Functions:** Basic, Prototype, Recursion.
Unit 6	**Storage Classes:** Introduction, Storage Classes and Visibility, Automatic or Local Variables, Global Variables, Static Variables, External Variables.
Unit 7	**Arrays and Strings:** Introduction, One dimension and Multi dimension array, Strings.
Unit 8	**Pointers:** Basic, Pointers and One-dimensional Arrays, Null Pointers, Pointers and Strings, Pointers and Two-dimensional Arrays.
Unit 9	**Structures and Unions:** Introduction, Basics of Structures, Structures and Functions, Arrays of Structures, Pointers to Structures, Self-Referential Structures, Unions.
Unit 10	**Preprocessor:** Introduction, File Inclusion, Macro Definition and Substitution, Conditional Compilation**.**
Unit 11	**Dynamic Memory Allocation and Linked List:** Introduction, Dynamic Memory Allocation, Concept of Linked List.
Unit 12	**File management:** Introduction, Defining and Opening a file, Closing Files, Input/Output Operations on Files, Error Handling During I/O Operations, Random Access to Files, Command Line Arguments.

Reference Books

1. Balagurusamy, E. *Programming in ANSI C*, 8/e. McGraw-Hill Education.

Course code: DCA6103	**Course Title: Foundation of Mathematics**
Unit 1	**Sets:** Introduction, Sets and their Representations, Empty Set, Finite and Infinite Sets, Equal and Equivalent Sets, Subsets, Power Set, Universal Set, Venn Diagrams, Complement of a Set, Operations on Sets, Cartesian Product of Sets.
Unit 2	**Statements:** Introduction, Basic Logical Connectives, Conjunction, Disjunction, Negation of Compound Statements, Truth Value and Tables, Tautologies, Logical Equivalence, Applications and Negation.
Unit 3	**Number System:** Introduction, Concept of Limit, Concept of Continuity.
Unit 4	**Differentiation**: Differentiation of Powers of x, Differentiation of ex and log x, Differentiation of Trigonometric Functions, Rules for Finding Derivatives, Differentiation by Substitution, Differentiation from First Principles, Successive Differentiation, Leibnitz's Theorem, Cauchy's Theorem, Asymptotes.
Unit 5	**Integration:** Integration of Standard Functions, Rules of Integration.
Unit 6	**Reduction Formula:** Trigonometric Functions, Definition of improper Integrals, Beta-Gamma Functions.
Unit 7	**Partial Derivative:** Introduction, Chain Rule, Differentiation of Implicit Functions, Exact Differential, Extreme Values, Methods of Lagrange Multiplier, Jacobians, Double and Triple Integrals.
Unit 8	**Scalar & Vector:** Definition, Representation of Vector, Addition and Subtraction of Vector, Components, Multiplication of Vector, Scalar Triple Product, Vector Triple Product, Differentiation of Vector Function, Integration of Vector Function, Scalar and Vector Field, Gradient of Scalar Field, Arc Length, Divergence and Curl of Vector Field, Line Integral, Surface Integral, Volume Integral, Green's

	Theorem, Divergence Theorem, Stroke's Theorem.
Unit 9	**Matrix:** Introduction, Definition, Operations, Square Matrix and Its Inverse, Determinants, Properties of Determinants, Inverse of a Matrix, Elementary Row and Column Transformation, Consistency of System of linear Equations, Techniques of Solution to Equations.
Unit 10	**Complex Numbers:** Introduction, Conjugate of a Complex Number, Modulus of a Complex Number, Geometrical Representation of Complex Number, Exponential Form of a Complex Number, n^{th} Roots of a Complex Number, Limits, Continuity, Differentiability, Cauchy Riemann Equation.

Reference Books

1. Narayan, Shanti. *A textbook of matrices*. S. Chand.
2. Shanti, Narayan, and P. K. Mittal. *Integral Calculus*. S. Chand Publishing.
3. Ross, Shepley L. *Introduction to ordinary differential equations*. John Wiley & Sons.
4. Spiegel, Murray R., et al. *Complex variables: With an introduction to conformal mapping and its applications*. McGraw-Hill.

Course code: DCA6104	**Course Title: Advanced Database Management System**
Unit 1	**Comparison between Different Databases:** Introduction, Significance of Databases, Applications of Database System, Personal databases, Two-Tier client/server databases, Multi-tier client/server databases, Enterprise application, Different Types of DBMS, Based on data model, Based on number of users, Based on number of sites, Based on cost, Based on purpose, Comparison between Centralised and Distributed Database.
Unit 2	**RDBMS and SQL:** Introduction, Relational Query Languages, SQL, Integrity Constraints, Entity integrity, Domain integrity, Referential integrity, Data Definition Statements, Creating relations in SQL, Adding and deleting tuples, Destroying and altering relations, Data Manipulation Language, SELECT statement, Subquery, Querying multiple relations, Functions, GROUP BY, Updating the database, Views, Embedding SQL Statements, Transaction Processing, Dynamic SQL, Normalisation and Database Design, Denormalisation.
Unit 3	**Query Optimisation**: Introduction, Query Execution Algorithm, External sorting, Implementing the SELECT operation, Methods to implement JOIN operation, Project and Set operations implementation, Aggregate operations implementation, Heuristics in Query Optimisation, Notation for query trees and query graphs, General transformation rules for relational algebraic operations, Conversion of query trees into the query execution plans, Semantic Query Optimisation, Multi-Query Optimisation and Application, Execution Strategies for SQL Sub Queries, Query Processing for SQL Updates.
Unit 4	**Query Execution:** Introduction, Introduction to Physical-Query-Plan Operators, Scanning tables, Sorting while scanning tables, One-Pass Algorithms for Database Operations, Nested-Loop Joins, Tuple-based nested-loop join, Iterator for a tuple-based nested-loop join, Two-Pass Algorithms based on Sorting, Two-Pass Algorithms Based on Hashing, Index-Based Algorithms, Buffer Management, Parallel Algorithms for Relational Operations, Using Heuristics in Query Optimisation, Basic Algorithm for Executing Query Operations.

Unit 5	**Adaptive Query Processing and Query Evaluation**: Introduction, Query Processing Mechanism: Eddy, Eddy Architecture and how Eddy allows Extreme flexibility, Properties of Query Processing Algorithms, Need and Uses of Adaptive Query Processing, Complexities, Robust Query Optimisation through Progressive Optimisation, Query Evaluation Techniques for Large Databases, Query Evaluation Plans.
Unit 6	**Transaction Processing:** Introduction, Transaction Processing: An Introduction, Advantages and Disadvantages of Transaction Processing System, Advantages of transaction processing system, Disadvantages of transaction processing system, Online Transaction Processing System, Serialisability and Recoverability, Cascading rollback, Recoverable schedules, Managing rollbacks using locking, View Serialisability, Resolving Deadlocks, Deadlock detection by timeout, The waits-for graph, Distributed Locking, Centralised lock systems, Primary-copy locking, Transaction Management in Multi-Database System, Long-Duration Transactions, High Performance Transaction Systems.
Unit 7	**Concurrency Control:** Introduction, Enforcing Serialisability by Locks, Locks, Locking scheduler, Two phase locking, Locking Systems with Several Lock Modes, Architecture for a Locking Scheduler, Two-part scheduler, The lock table, Managing Hierarchies of Database Elements, Concurrency Control by Timestamps, Timestamp resolution, Timestamp locking, Concurrency Control by Validation, Database Recovery Management.
Unit 8	**Parallel Database Architectures for Parallel Databases:** Introduction, Parallel Database, Advantages of parallel database, Disadvantages of parallel database, Parallelism in Database Management System, Parallel Query Evaluation, Parallel query processing, When to implement parallelism, How parallel-execution works, Parallelised SQL statements, Parallelising Individual Operations, I/O Parallelism, Partitioning techniques (number of disks = n), Comparison of partitioning techniques, Inter-Query Parallelism, Intra Query Parallelism, Intra partition parallelism, Inter partition parallelism, Inter Operation and Intra Operation Parallelism, Design of Parallel Systems.
Unit 9	**Object Oriented DBMS:** Introduction, Object Oriented Paradigm, OODBMS Architectural Approaches, Distributed client - server approach, Data access mechanism, Object clustering, Heterogeneous operation, Object Identity, Procedures and Encapsulation, Object Oriented Data Model, Relationships, Identifiers, Basic OODMS Terminology, Basic Interface and Class Structure, Type Hierarchies and Inheritance, Type Extents and Persistent Programming Languages.
Unit 10	**Distributed Databases**: Introduction, Introduction of Distributed Databases, DDBMS architectures, Functions of distributed database management system, Components of distributed database management system, Homogeneous and Heterogeneous Database, Distributed Data Storage, Data fragmentation, Data replication, Advantages and Disadvantages of Data Distribution, Advantages of data distribution, Disadvantages of data distribution, Distributed Transaction, Commit Protocols, Components of atomic commit, Two phase commit, Concurrency Control, Recovery of Distributed Database, Directory Systems, DDBMS Transparency Features, Distribution Transparency.
Unit 11	**Object Relational and Extended Relational Databases**: Introduction, Object Relational Database, Reasons behind the development of ORDBMS, Advantages of ORDBMS, Disadvantages of ORDBMS, Characteristics of object relational databases, Extension Techniques in RDBMS, Standards for OODBMS Products and Applications, ODMG-93 standards, ODMG Smalltalk

	binding, SQL3, Nested Relations and Collections, Storage and Access Methods, Implementation Issues for Extended Type, Comparing RDBMS, OODBMS and ORDBMS.
Unit 12	**XML Query Processing**: Introduction, XML Query Languages, XML-QL, Lorel, Quilt, XQL, XQuery, Approaches for XML Query Languages, Query processing for relational structure, Query processing on storage schema, XML Database Management Systems.
Unit 13	**Database Application**: Introduction, Active Database, Design principles for active rules, Starburst, Oracle, DB2, Application of active database (Active DB), Temporal Database, Multimedia Database, Video Database Management, Storage management for video, Video pre-processing for content representation and indexing, Image and semantic-based query processing, Real-time buffer management.

Reference Books

1. Gupta, G. K. *Database Management System*. Tata McGraw-Hill Education.
2. Rob, Peter, et al. "*Database systems: Design, implementation." Management*. Seventh Edition. Course Technology.
3. Silberschatz, Abraham, Henry F. Korth, and S. Sudarshan. "*Database system concepts*." McGrawHill, New York.

Course code: DCA6105	**Course Title: Computer Architecture**
Unit 1	**Fundamentals of Computer Architecture:** Computational Model, Evolution of Computer Architecture, Process and Thread, Concepts of Concurrent and Parallel Execution, Classification of Parallel Processing, Parallelism and Types of Parallelism, Levels of Parallelism.
Unit 2	**Fundamentals of Computer Design:** Changing Face of Computing, Computer Designer, Technology Trends, Quantitative Principles in Computer Design, Power Consumption.
Unit 3	**Instruction Set Principles:** Classifying instruction set architecture, Memory Addressing, Address Modes for Signal Processing, Operations in the instruction sets, Instructions for Control Flow, MIPS Architecture.
Unit 4	**Pipelined Processor:** Pipelining, Types of Pipelining, Pipelining Hazards, Data Hazards, Control Hazards, Techniques to Handle Hazards, Performance Improvement Pipeline, Effects of Hazards on Performance.
Unit 5	**Design Space of Pipelines:** Design Space of Pipelines, Pipeline Instruction Processing, Pipelined Execution of Integer and Boolean Instructions, Pipelined Processing of Loads and Stores.
Unit 6	**Instruction-Level Parallelism and its Exploitation:** Dynamic Scheduling, Overcoming Data Hazards, Dynamic Scheduling Algorithm – The Tomasulo Approach, High performance Instruction Delivery, Hardware-based Speculation.
Unit 7	**Exploiting Instruction –** Level Parallelism with Software Approach: Types of Branches, Branch Handling, Delayed Branching, Branch Processing, Branch Prediction, The Intel IA-64 Architecture and Itanium Processor, ILP in the Embedded and Mobile Markets.
Unit 8	**Memory Hierarchy Technology:** Memory Hierarchy, Cache Addressing Modes, Mapping, Elements of Cache Design, Cache Performance, Shared Memory organization, Interleaved Memory Organisation, Bandwidth and Fault Tolerance, Consistency Models.
Unit 9	**Vector Processors:** Use and Effectiveness of Vector Processors, Types of

	Vector Processing, Vector Length and Stride Issues, Compiler Effectiveness in Vector Processors.
Unit 10	**SIMD Architecture:** Parallel Processing: An Introduction, Classification of Parallel Processing, Fine-Grained SIMD Architecture, Coarse-Grained SIMD Architecture.
Unit 11	**Vector Architecture and MIMD Architecture:** Vectorisation, Pipelining, MIMD Architectural Concepts, Problems of Scalable Computers, Main Design Issues of Scalable MIMD Architecture.
Unit 12	**Storage Systems:** Introduction, Types of Storage Devices, Connecting I/O devices to CPU/Memory, Reliability, Availability and Dependability of Storage System, RAID, I/O Performance Measures.
Unit 13	**Scalable, Multithreaded And Data Flow Architecture:** Multithreading, Principles of Multithreading, Scalable and Multithreaded Architecture, Computational Models, Von Neumann- based Multithreaded Architectures, Dataflow architecture, Hybrid Multithreaded Architecture.
Unit 14	**Case Study:** Basic Features Of Current Architectural Trends, DSP Processor, Dual Core Technology, Case Study 1: Architecture Of Pentium Microprocessors, Case Study 2: Choosing A DSP Processor, Case Study 3: Tenasys Intime* RTOs Intel® Coretm Duo Processor.

Reference Books

1. Hwang, Kai. "*Advanced Computer Architectum with Parallel Programming*."
2. Godse, D. A. & Godse, A. P., *Computer Organisation*. Technical Publications..
3. Hennessy, J. L., Patterson, D. A. & Goldberg D. *Computer Architecture: A Quantitative Approach*, Morgan Kaufmann.

Course code: DCA6130	**Course Title: Programming in C – Practical**
Unit 1	**Introduction to C Programming:** Introduction**,** Features of C and its Basic Structure, Simple C Programs, Constants, Concept of an Integer and Variable
Unit 2	**Operators and Expressions:** Introduction, Arithmetic Operators, Unary, Relational and Logical Operators, Conditional Operator, Bitwise Operators, Increment and Decrement Operators, Size.
Unit 3	**Data Types and Input/Output Operators:** Introduction, Floating-point Numbers, Type Cast Operator, Type Char, Keywords, Character Input and Output, Formatted Input and Output, gets() and puts() functions.
Unit 4	**Control Statements and Decision Making:** Introduction, Goto Statement, If Statement, Conditional Expression, Switch Statement, Types of Loop, Do While, For.
Unit 5	**Functions:** Basic, Prototype, Recursion.
Unit 6	**Storage Classes:** Introduction, Storage Classes and Visibility, Automatic or Local Variables, Global Variables, Static Variables, External Variables.
Unit 7	**Arrays and Strings:** Introduction, One dimension and Multi dimension array, Strings.
Unit 8	**Pointers:** Basic, Pointers and One-dimensional Arrays, Null Pointers, Pointers and Strings, Pointers and Two-dimensional Arrays.
Unit 9	**Structures and Unions:** Introduction, Basics of Structures, Structures and Functions, Arrays of Structures, Pointers to Structures, Self-Referential Structures, Unions.
Unit 10	**File management:** Introduction, Defining and Opening a file, Closing Files,

	Input/Output Operations on Files, Error Handling during I/O Operations, Random Access to Files, Command Line Arguments.
Reference Books 1. Balagurusamy, E. *Programming in ANSI C*, 8/e. McGraw-Hill Education.	

Course code: DCA6131	**Course Title: Advanced DBMS- Practical**
Unit 1	**RDBMS and SQL:** Introduction, Relational Query Languages, SQL, Integrity Constraints, Entity integrity, Domain integrity, Referential integrity, Data Definition Statements, Creating relations in SQL, Adding and deleting tuples, Destroying and altering relations, Data Manipulation Language, SELECT statement, Subquery, Querying multiple relations, Functions, GROUP BY, Updating the database, Views, Embedding SQL Statements, Transaction Processing, Dynamic SQL.
Unit 2	**Normalisation:** Introduction, Functional Dependency, Anomalies in a Database, Redundancy, Inconsistency, Update anomalies, The Normalisation Process, First normal form, Second normal form, Third Normal form, Boyce-Codd normal form, Fourth normal form, Fifth normal form.
Unit 3	**Query Optimisation**: Introduction, Query Execution Algorithm, External sorting, Implementing the SELECT operation, Methods to implement JOIN operation, Project and Set operations implementation, Aggregate operations implementation, Heuristics in Query Optimisation.
Unit 4	**Transaction Processing**: Introduction, Serialisability and Recoverability, Cascading rollback, Recoverable schedules, Managing rollbacks using locking, View Serialisability, Resolving Deadlocks, Deadlock detection by timeout. Cursor, Exception Handling, Procedures, Triggers.
Reference Books 1. Gupta, G. K. *Database Management System*. Tata McGraw-Hill Education. 2. Rob, Peter, et al. "*Database systems: Design, implementation." Management*. Seventh Edition. Course Technology. 3. Silberschatz, Abraham, Henry F. Korth, and S. Sudarshan. "*Database system concepts*." McGrawHill, New York.	

Second Semester

Course code: DCA6201	**Course Title: Operating System**
Unit 1	**Structure:** Introduction, Definition and Functions of Operating System, Evolution of Operating Systems, Simple Batch Operating Systems, Multi-programmed Batched Operating Systems, Time-sharing Operating Systems, Personal Computer Operating Systems, Multi-processor, Operating Systems, Distributed Systems, Real-time Systems, Operating System Structures.
Unit 2	**Architecture**: Introduction: Objectives, Operating System as an Extended Machine, Layered Approach, Micro-Kernels, UNIX Kernel Components, Modules, Introduction to Virtual Machines, Virtual Environment and Machine Aggregation, and Implementation Techniques.
Unit 3	**Process Management:** Objectives, Process State, Process Control Block, Process Scheduling, Operation on Processes, Co-operating Processes, Threads.
Unit 4	**CPU Scheduling:** Basic Concepts of Scheduling, Scheduling Algorithms.

Unit 5	**Process Synchronization:** Interprocess Communication, Critical-Section Problem, Semaphores, Monitors, Hardware Assistance, Evaluation of CPU Scheduling Algorithms
Unit 6	**Deadlocks:** System Model, Deadlock Characterization, Deadlock Handling, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection.
Unit 7	**Memory Management:** Logical vs. Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation.
Unit 8	**Virtual memory:** Need for Virtual Memory Technique, Demand Paging, Concept of Page Replacement, Page Replacement Algorithms, Thrashing.
Unit 9	**File System Interface and Implementation:** Concept of a File, File Access Methods, Directory Structure, Allocation Methods, Free Space Management, Directory Implementation.
Unit 10	**Input – Output Architecture:** I/O Structure, I/O Control Strategies, I/O Address Space.
Unit 11	**Operating Systems in Distributed Processing:** Centralized and Distributed Processing, Network Operating System (NOS) Architecture, Functions of NOS, Global Operating System (GOS), Remote Procedure Call (RPC), Distributed File Management.
Unit 12	**Security and Protection:** Attacks on Security, Computer Worms, Computer Virus, Security Design Principles, Authentication, Protection Mechanism, Encryption, Security in Distributed Environment.
Unit 13	**Multiprocessor Systems:** Introduction, Multiprocessor Classification, Multiprocessor Interconnections, Types of Multiprocessor Operating Systems (MOS),MOS Functions and Requirements, Operating System Design and Implementation Issues. Windows Operating Systems: Windows NT Architecture, Windows 2000 Architecture, Common Functionality.

Reference Books

1. Abraham, Silberschatz. Operating Systems Concepts/Abraham Silberschatz; Peter Baer Galvin; Greg Gagne. No. 005.12 S719o.
2. Tanenbaum, Andrew S. *Distributed operating systems*. Pearson Education India.
3. Tanenbaum, Andrew S., and Herbert Bos. *Modern operating systems*. Pearson.

Course code: DCA6202	**Course Title: Advanced Data Structure**
Unit 1	**Data Structures Basics:** Structure and Problem Solving, Data Structures, Data Structure Operations, Algorithm: Complexity and Time- Space Tradeoff.
Unit 2	**Algorithm Complexity:** Mathematical Notation and Functions, Algorithm Notation, Control Structures, Complexity of Algorithm, Rate of Growth.
Unit 3	**Linked List:** Linked List and its representation in memory, Traversing a Linked List, Searching a Linked List, Memory Allocation and Garbage Collection, Insertion into Linked list, Deletion from a Linked list, Types of Linked List.
Unit 4	**Stacks and Queues:** Stack, Applications of Stack, Queue. Trees and Binary Trees: Definition and Concepts, Binary Tree: Definition and Concepts, Types of Binary Tree, Traversal on Binary Tree, Representation of Binary Tree.
Unit 5	**Binary Search Tree:** Conversion of General Tree to Binary Tree, Sequential and Other Representations of Binary Tree, Concept of Binary Search Tree (BST), Operations on BST.
Unit 6	**Balanced Trees:** Definition and Structure of AVL Tree, Operations on AVL Tree, Definition and Structure of B-Tree, Operations on B-Tree, Applications of B-Tree.

Unit 7	**Graphs:** Basic Concepts about Graphs, Matrix Representation of Graphs, List Structures, Other Representations of Graphs, Algorithms for Graph Traversal, Spanning Trees.
Unit 8	**Applications of Graphs:** Topological Sorting, Weighted Shortest Path – Dijkstra's Algorithm, Minimum Spanning Tree (MST), Introduction to NP-Completeness.
Unit 9	**Dynamic Storage Management:** Introduction, Memory Management, First-fit Storage Allocation, Storage Release, Buddy Systems, Garbage Collection.
Unit 10	**Searching and Sorting Techniques:** Sequential Searching, Binary Searching, Bubble sort, Merge sort, Selection sort, Heap sort.
Unit 11	**File Structures:** External Storage Devices, Introduction to File Organization, Sequential Files, Indexed Sequential Files, Direct Files.
Unit 12	**External Sorting Techniques:** External Sorting, Sorting on Disks, Generating Extended Initial Runs. External Searching Techniques: External Searching, Introduction to Static Hashing, Organizing direct files with hashing, Collision Resolution Methods, Dynamic Hashing Techniques.

Reference Books

1. Tremblay, Jean-Paul, and Paul G. Sorenson. "*An introduction to data structures with applications*." McGraw-Hill Computer Science Series, New York: McGraw-Hill.
2. Patel, R. B., and M. M. S. Rauthan. "*Expert Data Structures with C++*."
3. Samanta, Debasis. *Classic data structures*. Vol. 2. Prentice Hall India.

Course code: DCA6203	**Course Title: Web Technologies**
Unit 1	**Web Basics:** Internet and World Wide Web, URL, web browsers, web servers, and Basic protocols of Internet.
Unit 2	**HTML:** Structure of HTML document, Text basics, rules, Images and multimedia, document layout, links and webs, formatted lists, cascading style sheets (CSS), forms, tables, frames and executable content. Dynamic HTML: Introduction of DHTML, CSS of DHTML, Event handling, and data binding. XML Introduction: Anatomy of an XML document, XML declaration, element tags, element markup, attribute markup elements and attributes, developing advanced DTDs.
Unit 3	**XML Programming:** XML objects, checking validity, creating XML links, advanced addressing, viewing XML in browsers, processing, event-driven programming, XML programming and scripting. XML Presentation Technology: XML with existing style sheet technologies, creating XML schema choices and creating elements and types in XML. XML Processors: DOM and SAX, Introduction to Java Script, Object in Java Script, and Dynamic HTML with Java Script. XML Http Request: the XML Http Request Object, events for the XML Http Request Object, and exceptions for the XML Http Request Object.
Unit 4	**AJAX Introduction:** AJAX components and handling dynamic HTML with AJAX. AJAX Using XML and XML Http Request: Ajax Using XML and XML Http Request, Accessing, creating and Modifying XML Nodes, Loading XML Data into an HTML Page, Receiving XML Responses, Handling response XML.

Unit 5	**PHP Introduction:** PHP, Anatomy of a PHP document, AJAX with PHP – Sending data to PHP with Ajax, PHP code and the complete AJAX example. AJAX with Databases**:** AJAX with databases, pulling data from a database.
Unit 6	**Active Server Page:** Scripting objects, ASP components, Data store Access, using Record sets and building Script components for ASP.

Reference Books

1. J. C. Jackson, "*Web Technologies: A Computer Science Perspective*", Pearson Education.
2. H. Chan, R. Lee, T. Dillon, E. Chang, "*E-commerce, Fundamentals and Applications*", John Wiley & Sons.

Course code: DCA6204	**Course Title: Advanced Computer Network**
Unit 1	**Introduction, Protocols and Standards**: Introduction, Computer Networks, Types of topology, Categories of network, Network Models, OSI model, Internet model, Comparison of the OSI & the TCP/IP reference models, Addressing, Network Hardware Components.
Unit 2	**Multiplexing and Local Area Network:** Introduction, Multiplexing, Frequency division multiplexing, Wave length division multiplexing, Time division multiplexing, LAN Technologies, Ethernet, Token Ring, Fiber distributed data interface (FDDI), Switching, Circuit switching, Packet switching, Message switching.
Unit 3	**Optical Networking**: Introduction, SONET/SDH Standards, T1/E1, SONET/SDH hierarchy, SONET STS-1 frame structure, SONET STS-3 frame structure, SONET/SDH devices, Dense Wavelength Division Multiplexing (DWDM).
Unit 4	**Integrated Service Digital Network:** Introduction, Analog Vs. Digital Network, Integrated Service Digital Network (ISDN), Goal and structure of ISDN, ISDN devices, Standard channel types and interfaces, ISDN standards, Broadband ISDN, B-ISDN services.
Unit 5	**Asynchronous Transfer Mode**: Introduction, ATM Protocol Architecture and Logical Connection, Logical connection, Virtual channel connection, Control signaling, ATM Cells, Generic flow control (GFC), Header error control, ATM Service Categories, Real time services, Non-Real time services, ATM Adaption Layer (AAL), AAL protocols, Congestion Control in ATM Networks, Traffic characterization, Congestion control.
Unit 6	**Packet Switching Protocols**: Introduction, X.25 Networks, Structure and goals of X.25 networks, Addressing in X.25 networks, Protocol stack of X.25 networks, Frame Relay Networks, Frame Relay Architecture, User Data Transfer, Call Control.
Unit 7	**Internet protocols:** Introduction, Internet Protocol (IP), Transmission Control Protocol, User Datagram Protocol, Internet Control Message Protocol, Hyper Text Transfer Protocol.
Unit 8	**Routing in Internet**: Introduction, Unicast Routing Protocols, Intra-Domain Routing, Distance vector routing, Link state routing, Broader Gateway protocol (BGP), BGP Routing, BGP message types, Inter-Domain Routing Protocol (IDRP), Multicast Routing Protocols, Distance Vector Multicast Routing Protocol (DVMRP), Multicast Open Shortest Path First Protocol (MOSPF).
Unit 9	**Network Management**: Introduction, Network Management System, Network management problems, Network management system architecture, Simple Network Management Protocol (SNMP), SNMP Message Format.

Unit 10	**Network Security**: Introduction, Basics of Cryptography, Symmetric Key Encryption, Data encryption standard (DES), Double DES, Triple DES, Public Key Encryption, RSA algorithm, Digital Signatures.
Unit 11	**Web Security and Traffic Management Basics**: Introduction, Web Security Requirements, Secure Socket Layer (SSL), SSL architecture, SSL protocol, Traffic Management, Quality Characteristics for Network, Network characteristics and requirements.
Unit 12	**Quality of Service and Queue Analysis**: Introduction, Applications and Quality of Service, Overview of probability and stochastic processes, Queue Analysis, Queuing model, M/M/1 model, Basic queuing relationship, Queue Management Algorithms, FIFO algorithm, Priority queuing, Weighted queuing, Hybrid algorithm of queuing, Feedback.
Unit 13	**Multimedia Over Internet**: Introduction, Quality of Service Aspects of Multitasking, Group membership protocol, Multicast backbone (MBone), Categories of multicast applications, Multicast Transport Protocol, Multicast addressing, MTP packet format, MTP's QoS, Resource Reservation Protocol (RSVP), RSVP traffic types, RSVP operation, RSVP messages, Real-Time Transport Protocol (RTP).
Unit 14	**Enterprise Network Security**: Introduction, Demilitarized Zone (DMZ), Network Address translation, Destination network address translation (DNAT), Secure network address translation (SNAT), Port Forwarding, Filtering, Packet Filtering, Application Gateway.

Reference Books

1. Kahate, Atul. *Cryptography and network security.* Tata McGraw-Hill Education, 2013.
2. Buckwalter, Jeff T. *Frame relay: technology and practice*. Addison-Wesley Professional.
3. Perros, Harry G. *Connection-oriented networks: SONET/SDH, ATM, MPLS and optical networks*. John Wiley & Sons.
4. Peterson, Larry L., and Bruce S. Davie. *Computer networks: a systems approach*. Elsevier.
5. Olifer, Natalia, and Victor Olifer. *Computer networks: Principles, technologies and protocols for network design.* New York, NY, USA: John Wiley & Sons.

Course code: DCA6205	**Course Title: Communication Skills**
Unit 1	**Language and Communication:** Concept of Communication, Process of Communication, Barriers of Effective Communication, Types of Communication.
Unit 2	**Oral Communication:** Advantages and Disadvantages of Oral Communication, One-to-One Oral Communication.
Unit 3	**Listening Skills:** Meaning of Listening, Types of Listening, Barriers to Effective Listening, Strategies for Effective Listening, Semantic Markers.
Unit 4	**Reading Skills:** Definition and Meaning of Reading, Purpose of Reading, Types of Reading, SQ3R Technique of Reading.
Unit 5	**Writing Skills:** Paragraph, Static Description, Process Description, Describing Facts and Figures.
Unit 6	**Business Writing:** Business Letter Writing, Types of Business Letter, Job Application, Other Business Communication.
Unit 7	**Organisational Documents:** Memo, Circulars and Notices.

Reference Books

1. Green, David. Contemporary English Grammar Structures Composition. Madras: Macmillan India Limited.
2. Introduction to Management. ICFAI Center for Management Research.
3. Kahn, John Ellison (Ed.). Reader's Digest: How To Write and Speak Better. London: The Reader's Digest Association Limited.
4. Sharma R.C. and Mohan Krishna. Business Correspondence and Report Writing: A Practical Approach to business and Technical Communication. Tata McGrawHill: New Delhi.
5. Thomson, A.J, Martinet, A.V. A Practical English Grammar. Delhi: Oxford University Press.

Course code: DCA6230	**Course Title: Advanced Data Structures using C++ - Practical**
Unit 1	**Linked List:** Linked List and its representation in memory, Traversing a Linked List, Searching a Linked List, Memory Allocation and Garbage Collection, Insertion into Linked list, Deletion from a Linked list, Types of Linked List.
Unit 2	**Stacks and Queues:** Stack, Applications of Stack, Queue. Trees and Binary Trees: Definition and Concepts, Binary Tree: Definition and Concepts, Types of Binary Tree, Traversal on Binary Tree, Representation of Binary Tree.
Unit 3	**Binary Search Tree:** Conversion of General Tree to Binary Tree, Sequential and Other Representations of Binary Tree, Concept of Binary Search Tree (BST), Operations on BST.
Unit 4	**Balanced Trees:** Definition and Structure of AVL Tree, Operations on AVL Tree, Definition and Structure of B-Tree, Operations on B-Tree, Applications of B-Tree.
Unit 5	**Graphs:** Basic Concepts about Graphs, Matrix Representation of Graphs, List Structures, Other Representations of Graphs, Algorithms for Graph Traversal, Spanning Trees.
Unit 6	**Applications of Graphs:** Topological Sorting, Weighted Shortest Path – Dijkstra's Algorithm, Minimum Spanning Tree (MST), Introduction to NP-Completeness.
Unit 7	**Dynamic Storage Management:** Introduction, Memory Management, First-fit Storage Allocation, Storage Release, Buddy Systems, Garbage Collection.
Unit 8	**Searching and Sorting Techniques:** Sequential Searching, Binary Searching, Bubble sort, Merge sort, Selection sort, Heap sort.

Reference Books

1. Tremblay, Jean-Paul, and Paul G. Sorenson. "*An introduction to data structures with applications*." McGraw-Hill Computer Science Series, New York: McGraw-Hill.
2. Patel, R. B., and M. M. S. Rauthan. "*Expert Data Structures with C++*."
3. Samanta, Debasis. *Classic data structures*. Vol. 2. Prentice Hall India.
4. Balagurusamy, E. *Object Oriented Programming with C++, 6e*. Tata McGraw-Hill Education.

Course code: DCA6231	Course Title: Web Technologies-Practical
Unit 1	Programing based on HTML, HTML with CSS, and DHTML with JavaScript, Servlet, JSP and Database Connectivity of Web pages. Creation of XML document using DOM Parser and (b) SAX parser. Implement the following web applications using (a) PHP, (b) Servlets and JSP. Create new Internet Connection, Create new Email Account and Website validation. Tomcat Server for Servlets and JSP. AJAX based Web application: Ajax Using ,HTML, DHTML, XML and XML Http Request.
Unit 2	**PHP:** PHP document, AJAX with PHP – Sending data to PHP with Ajax, script on server side, Arrays, function and forms, advanced PHP.
Unit 3	**ASP:** Scripting objects, Data store Access, using Record sets and building Script components for ASP.
Reference Books 1. J. C. Jackson, "*Web Technologies: A Computer Science Perspective*", Pearson Education. 2. H. Chan, R. Lee, T. Dillon, E. Chang, "*E-commerce, Fundamentals and Applications*", John Wiley & Sons.	

Second Year
Third Semester

Course code: DCA7101	Course Title: Probability and Statistics
Unit 1	**Probability**: Introduction, Features of Random Experiment, Definitions: Sample Space, Event, Mutually Exclusive Events, Kolmogorov's axioms of Probability, Exhaustive Event, Independent Event, Mutually and Pair wise independent Event, Additional theorems of Probability, Multiplication theorem of Probability for independent events, Conditional Probability, Baye's Theorem.
Unit 2	**Random Variables:** Introduction, One-dimensional Random Variable, Discrete and Continuous random variables, Distribution Function, Distribution Function of discrete random variables, Distribution Function of continuous random variables, Two-dimensional random variables, Discrete and Continuous random variables, Joint Density Function, Marginal and Condition probability distribution.
Unit 3	**Mathematical Expectation:** Introduction, Mathematical expectation of one dimensional random variable, Mathematical expectation of two dimensional random variable, Properties of Expectation (Mean) of single variable, Variance, Covariance, Conditional Expectation and Conditional Variance.
Unit 4	**Moment generating function:** Introduction, Moments from Moment generating function, Properties of Moment generating function, Cumulants, Properties of Cumulants, Characteristic function, Properties of Characteristic function.
Unit 5	**Measures of Central Tendency**: Introduction, Requisites of a Good Average, Types of Averages, Mathematical Average, Arithmetic Mean, Geometric Mean, Harmonic Mean, Positional Average, Median, Mode, Quartiles, Deciles, Percentile.
Unit 6	**Measure of Dispersion**: Introduction, Requisites of Ideal Measure of Dispersion, Types of Measures of Dispersion, Absolute Measure of Variation, Quartile Deviation, Mean Deviation, Standard Deviation, Coefficient of variation.
Unit 7	**Distribution:** Introduction, Bernoulli Trials, Binomial Distribution, Poisson

	Distribution, Continuous Distribution.
Unit 8	**Correlation and Regression**: Introduction, Correlation, Types of correlation, Methods of measurement of correlation, Partial Correlation, Multiple Correlation, Regression, Regression Analysis, Regression Lines, Regression coefficient, Angle between two regression lines, Multiple Regression.
Unit 9	**Index Number**: Introduction, Problems in the construction of Index number, Types of Index Number, Different methods of computing an Index number, Simple Aggregate method, Simple Relative method, Weighted relative method, Weighted aggregate Index numbers, Test of Good Index Number.
Unit 10	**Time Series**: Introduction, Role of Time series Analysis, Components of Time Series, Measurement of Trends, Measurement of Seasonal Variations, Measurement of Cyclical Variations, Measurement of irregular variations.
Unit 11	**Sampling Theory**: Introduction, Population and Sample, Universe or Population, Types of Population, Sample, Advantages of Sampling, Sampling Theory, Law of Statistical Regularity, Principle of Inertia of Large Numbers, Principle of Persistence of Small Numbers, Principle of Validity, Principle of Optimisation, Terms Used in Sampling Theory, Errors in Statistics, Measures of Statistical Errors, Types of Sampling, Probability Sampling, Non-Probability Sampling, Determination of Sample Size, Central Limit Theorem.
Unit 12	**Hypothesis Testing:** Introduction, Testing Hypothesis, Null and Alternate Hypothesis, Interpreting the Level of Significance, Hypotheses are accepted and not proved, Selecting a significance level, One–Tailed and Two–Tailed Tests, Tests of Hypothesis Concerning Large Samples, Testing Hypothesis about population Mean, Testing Hypothesis for the Difference Between Two Means, Test of Hypothesis Concerning Attributes, Testing Hypothesis about a population Proportion, Testing Hypothesis about Difference Between Two Proportions.
Unit 13	**Tests of Significance Based on t, F and Z Distribution:** Introduction, t- test Distribution, Properties of student's t- distribution, Applications of t- distribution, F – Test Distribution, Z- Test Distribution.

Reference Books

1. Holcomb, Zealure C. *Fundamentals of descriptive statistics*. Routledge.
2. Goos, Peter, and David Meintrup. *Statistics with JMP: graphs, descriptive statistics and probability*. John Wiley & Sons.
3. Marczyk, Geoffrey, and David DeMatteo. *Essentials of research design and methodology*. John Wiley & Sons.

Course code: DCA7102	**Course Title: Programming in Java**
Unit 1	**Introduction to Java**: Introduction, History of Java, Features of Java, Java Virtual Machine (JVM), Java Runtime Environment (JRE), Java Development Kit (JDK), Security in Java.
Unit 2	**Java Basics:** Introduction, Keywords, Working of Java Including Comments, Data Types in Java, Primitives Data Types, Abstract/Derived Data Types, Variables in Java, Using Classes in Java, Declaring Methods in Java, Code to Display Test Value, The main() Method, Invoking a Method in Java, Java Generics, Generic Methods, Generic Classes, Saving, Compiling and Executing a Java Program's Saving.
Unit 3	**Operators and Control Statements:** Introduction, Operators, Arithmetic Operators, Increment and Decrement Operators, Comparison Operators,

	Logical Operators, Operator Precedence, Control Flow Statements, If-else Statement, Switch Statement, For Loop, While Loop, Do-While Loop, Break Statement, Continue Statement.
Unit 4	**Arrays and Strings:** Introduction, String Handling, Special String Operations, Character Extraction, String Comparison, Searching Strings, String Modification, StringBuffer.
Unit 5	**Inheritance, Package and Interface:** Introduction, Inheritance, Types of Relationships, What is Inheritance, Why Generalize? Implementing Inheritance in Java, Access Specifiers, The Abstract Class, Packages, Defining a Package, Understanding CLASSPATH, Interface, Defining an Interface, Some Uses of Interfaces, Interfaces versus Abstract Classes, Nested Classes, Non Static Nested Class or Inner Class, Static Class.
Unit 6	**Exception Handling**: Introduction, Definition of an Exception, Exception Classes, Common Exceptions, Exception Handling Techniques.
Unit 7	**Streams in Java:** Introduction, Streams Basics, The Abstract Streams, Stream Classes, Readers and Writers, Random Access Files, Serialization, Stream API.
Unit 8	**Event Handling:** Introduction, Components of an Event, Event Classes, Event Listener, Event-Handling, Adapter Classes, Inner Classes, Anonymous Classes.
Unit 9	**Other Features in Java:** Introduction, Assertion, Variable Argument (Varargs), Java Static Import, Autoboxing and Unboxing, Java Enum, Java Annotation, Java Custom Annotation.
Unit 10	**Java Swing and JavaFX**: Introduction, Java Foundation Classes, Java Swing Packages, Swing Component Classes, Swing Components, JavaFX – Architecture, Layout Pane.
Unit 11	**Java Database Connectivity (JDBC):** Introduction, Java Data Base Connectivity, Database Management, Mechanism for connecting to a backend database (ODBC), Loading the ODBC driver.
Unit 12	**RMI, CORBA and Java Beans**: Introduction, Remote Method Invocation (RMI), RMI Terminology, Common Object Request Broker Architecture (CORBA), Java Beans, The BeanBox, Running the BeanBox.
Unit 13	**Java Server Pages and Servlets**: Introduction, Java Server Pages (JSP), How does JSP look, How to test a JSP, Servlets, History of Web Application, Web Architecture Servlet Life Cycle.
Unit 14	**Networking in Java**: Introduction, Networking in Java, URL Objects.

Reference Books

1. Eckel, Bruce. *Thinking in JAVA*. Prentice Hall Professional.
2. Horstmann, Cay S., and Gary Cornell. *Core Java* 2: Volume I, Fundamentals. Pearson Education.
3. Campione, Mary, and Kathy Walrath. *The Java Tutorial: Object-Oriented Programming for the Internet (Book/CD)*. Addison-Wesley Longman Publishing Co., Inc.
4. Hall, Marty. *More servlets and JavaServer pages*. Prentice Hall PTR.

Course code: DCA7103	**Course Title: Advanced Software Engineering**
Unit 1	**Introduction:** Principles, characteristics and applications.
Unit 2	**Software Process and Life Cycle Models:** Software process, project and product, process assessment, software process capability maturity waterfall

	model, incremental model, spiral model, prototyping model, object-oriented model, agile model. Software Requirements: functional requirements, non-functional requirements, user requirements and system requirements. Software Requirement Engineering Process: feasibility study of software requirements, requirements elicitation, requirements analysis and requirements validation. Software Reliability: Software reliability metrics, programming for reliability and software reuse.
Unit 3	**Software Design:** Basics of software design, data design, architectural design, component level design, user interface design and Object Oriented Design. Module, modularization and design techniques.
Unit 4	**Software Implementation:** Structured coding techniques, coding styles, coding methodology, code verification techniques, coding tools, code documentation, coding standards and guidelines. Software re-engineering, Change management configuration management, maintenance tools and techniques.
Unit 5	**Software Testing Strategies:** Black-box and white box testing, validation and debugging. Software quality assurance, software reviews, formal technical reviews and the ISO 9000 quality standards.
Unit 6	**Software Project Management:** Project planning, project scheduling, project staffing and people capability maturity model.

Reference Books

1. R.S. Pressman, "Software *Engineering: A Practitioners Approach*", McGraw Hill.
2. Sommerville, "*Software Engineering*", Addison Wesley.
3. A. P. Mathur, "*Fundamentals of Software Testing*", Pearson Education.

Course code: DCA7104	**Course Title: Analysis and Design of Algorithm**
Unit 1	**Introduction to Algorithm:** Concept of Algorithm, Role of Algorithm in Computing, Types of Algorithm, Fundamental Data Structures. Analysis of Algorithm Efficiency**:** Complexity of algorithm, Methodologies for Analyzing Algorithms, Pseudocode**.**
Unit 2	**Mathematical Aspects and Analysis of Algorithms:** Asymptotic Notations, Recursion, Analysis of Non-Recursive/Recursive Algorithms. Empirical Analysis of Algorithms
Unit 3	**Brute Force Method:** Brute force algorithm, Selection Sort and Bubble Sort, Sequential Search and Brute Force String Matching, Exhaustive Search.
Unit 4	**Divide and Conquer:** Merge sort, Quick sort, Binary Search, Binary Tree Traversals and Related Properties. Decrease and Conquer: Concepts of Decrease and Conquer, Insertion Sort, Depth-First search, Depth-First search, Breadth-First Search, Topological Sorting. Transform and Conquer: Presorting, Gaussian Elimination, Balanced Search Trees, Balanced Search Trees, Heaps and Heap sort. Space and Time Tradeoffs: Sorting, Horspool's algorithm, Boyer-Mo Dynamic Programming ore algorithm, Hash function, B-Tree technique.
Unit 5	**Dynamic Programming:** Dynamic programming Vs divide and conquer, Fibonacci Numbers, Binomial Coefficient, Warshall's and Floyd's Algorithms, Optimal Binary Search Trees, Knapsack Problem.
Unit 6	**Greedy Technique:** Introduction to Greedy Technique, Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Huffman Trees. Limitations of Algorithm Power: Decision Trees, P, NP and NP – Complete Problems, Cook's theorem. Coping with the Limitations of Algorithm Power: Backtracking, Branch and Bound, Approximation Algorithms for NP-Hard Problems.

Reference Books
1. Coreman, Liesorson, Rivest, "*Design and Analysis of Algorithms*", PHI. 2. Horowitz and Sahini, "*Fundamentals of Computer Algorithms*", Galgotia. 3. Hopcroft and Ullman, "*Design and Analysis of Algorithms*", Wesley.

Electives – I

Course code: DCA8141	**Course Title: Wireless and Mobile Communication**
Unit 1	**Introduction to mobile communication and computing:** Application and significance of mobile communications, Mobile and wireless devices, Reference Model of communication.
Unit 2	**Wireless Transmission:** Frequencies, types of signals and antennae, signal propagation and multiplexing techniques. Modulation and spread Spectrum technology, cellular systems used for mobile communications. Wireless Medium Access Control: Specialized MAC, medium accessing technique e.g. SDMA, FDMA, TDMA, CDMA.
Unit 3	**Wireless Telecommunication Systems:** Architecture of a GSM, GSM – TDMA/ FDMA frame, logical channels in GSM system, GSM protocol layers, mechanism of localization and calling. Handover in GSM system, High Speed Circuit Switched Data and General Packet Radio Service.
Unit 4	**Universal Mobile Telecommunication System:** System architecture, UMTS radio interface and UTRA Network, Wireless LANs: characteristics of wireless LANs, comparison of infrared and radio transmission technologies, Architecture of an infrastructure based IEEE 802.11. Mobile Network Layer: Mobile IP technology, goals, assumptions and requirements of Mobile IP. Dynamic Host Configuration Protocol.
Unit 5	**Mobile Transport Layer:** Traditional TCP protocol, Indirect TCP, Snooping TCP and Mobile TCP. Fast retransmit/fast recovery, Transmission/ time-out freezing, methods of improving the TCP for wireless domain, Selective retransmission and Transaction oriented TCP, TCP Over 2.5/3G wireless networks. Data Processing and Mobility: effect of mobility of the mobile nodes, execution models for mobile database system**.**
Unit 6	**Mobile Ad hoc Networks:** Properties and applications of a MANET, routing algorithms used in MANETs, security aspects in MANETs. 4G Technology: WiMAX, and HSPA. HTML5 on Mobile Devices
Reference Books 1. Andrea Goldsmith, "*Wireless Communications*", Cambridge University Press. 2. J. Schiller, "*Mobile Communication*" 2/e, Pearson Education. 3. "*Wireless Communication and Networks: 3G and Beyond*", 2/e, McGraw Hill Education (India) Private Ltd, New Delhi.	

Course code: DCA8142	**Course Title: Open Source DB Systems**
Unit 1	**Introduction**: Concepts and components of a database management system, Join Algorithms, Transaction management, Concurrency control and availability.
Unit 2	**Software Development Using Open Source Systems:** Tools, components, methodologies and development of applications using the Open Source, analyze the forking of software, drafting of software license, Open Source Licensing, Contract and Copyright Law: software licensing and Warranties.
Unit 3	**Relational Model, Languages and Systems:** Characteristics of relational model, relational algebra, views, constraints and indexes in SQL. Open Source Database System: overview of SAPDB, SQLite, Firebird, PostgreSQL, and

	MySQL.
Unit 4	**MySQL:** Administration, stored procedure, triggers, view, functions and hosting concepts.
Unit 5	**PHP Basics:** Installing, basic scripting, building blocks e.g. variables, data types, constants, operators and PHP structures e.g. data structures and control structures. PostgreSQL: ORDBMS, Berkeley postgres project, SQL language and the advance features. InnoDB data management: join algorithm, transaction management, and concurrency control and data availability in InnoDB. Data management in Berkeley DB, Experimental evaluation: testing environment and the benchmark.
Reference Books 1. S. Korth, "*Database System Concepts*", Mc-GrawHill, 6th Edition. 2. R. Elmasri and S. Navathe, "*Fundamentals of Database Systems*", Pearson Education. 3. C. Jackson, "*Web Technologies Technologies: A Computer Science Perspective*", Pearson Education.	

Course code: DCA8143	**Course Title: Cryptography and Network Security**
Unit 1	**Introduction:** Basic concepts of computer security, OSI security architecture, security attacks and services, security mechanisms and Network Security Model. Encryption Techniques and Symmetric Ciphers: Cryptography, Symmetric cipher model, Substitution techniques and Transposition techniques. Block Cipher Principles and Data Encryption Standard: Differential and linear cryptanalysis and Block Cipher design principles**.**
Unit 2	**Advanced Encryption Standard:** RSA algorithm, Diffie-Hellman key exchange, elliptic curve arithmetic and its cryptography. Cryptographic Hash Functions: Applications, requirements and Secure Hash Algorithm.
Unit 3	**Digital Signatures:** Attacks on digital signatures, digital Signature Standard and digital signature schemes. Key Management and Distribution, public key infrastructure.
Unit 4	**Authentication Protocols:** Principles of remote user authentication, user-authentication protocols, authentication services. IP Security: TCP/IP, IP security overview, Internet Key Exchange (IKE) and Virtual Private Networks.
Unit 5	**Web Security:** SSL/TLS and SET. Wireless Network Security: IEEE 802.11 wireless LAN overview, IEEE 802.11i Wireless LAN security, wireless application protocol overview and wireless transport layer security concepts.
Unit 6	**Intruders and Malicious Software**: Viruses and worms. Firewalls: Requirement of firewalls, design principles, firewall types and firewall configuration.
Reference Books 1. William Stallings, "*Cryptography and Network Security*", Second Edition, Prentice-Hall. 2. A. Kahate, "*Cryptography and Network Security*", Tata Mc-Graw Hill.	

Course code: DCA7130	**Course Title: Java Programming-Practical**
Unit 1	**Java Basics:** Introduction, Keywords, Working of Java, Including Comments, Data Types in Java, Primitives Data Types, Abstract/Derived Data Types, Variables in Java, Using Classes in Java, Declaring Methods in Java, Code to Display Test Value.

Unit 2	**Operators and Control Statements:** Introduction, Operators, Arithmetic Operators, Increment and Decrement Operators, Comparison Operators, Logical Operators, Operator Precedence, Control Flow Statements, If-else Statement, Switch Statement, For Loop, While Loop, Do-While Loop, Break Statement, Continue Statement.
Unit 3	**Arrays and Strings:** Introduction, String Handling, Special String Operations, Character Extraction, String Comparison, Searching Strings.
Unit 4	**Inheritance, Package and Interface:** Introduction, Inheritance, Types of Relationships, What is Inheritance, Why Generalize? Implementing Inheritance in Java.
Unit 5	**Event Handling:** Introduction, Components of an Event, Event Classes, Event Listener, Event-Handling.
Unit 6	**Streams in Java**: Introduction, Streams Basics, The Abstract Streams, Stream Classes, Applets.
Unit 7	**Event Handling:** Components of an Event, Event Classes, Event Listener, Event-Handling. Java Swing: Java Foundation Classes, Java Swing Packages, Swing Component Classes, Swing Components.
Unit 8	**Java Database Connectivity (JDBC):** Introduction, Java Data Base Connectivity, Database Management, Mechanism for connecting to a backend database (ODBC).

Reference Books

1. Eckel, Bruce. *Thinking in JAVA*. Prentice Hall Professional.
2. Horstmann, Cay S., and Gary Cornell. *Core Java* 2: Volume I, Fundamentals. Pearson Education.
3. Campione, Mary, and Kathy Walrath. *The Java Tutorial: Object-Oriented Programming for the Internet (Book/CD*). Addison-Wesley Longman Publishing Co., Inc.
4. Hall, Marty. *More servlets and JavaServer pages*. Prentice Hall PTR.

Course code: DCA7131	**Course Title: Seminar (2 Credits)**

Seminar has been introduced to enable the students to carry out a literature survey, and hone their presentation and report preparation skills. Seminar is included to inculcate an active learning platform wherein students can develop the ability to read critically and conceptually, and therefore develop and present a report. Topics chosen for seminar should be related to Computer Applications or Information Technology. The seminar should also help students to speak and write well. Student is required to identify a mentor (faculty) to complete his seminar requirement. As part of the requirement, the student needs to prepare a Report in consultation with the mentor.

Fourth Semester

Course code: DCA7230	**Course Title: Project work**

The project work is part of the MCA program which will give a hands on experience to the students for developing quality software applications. While working on the project, a student should involve himself in all the stages of the software development life cycle (SDLC) like requirements analysis, systems design, software development/coding, testing and documentation, with an overall emphasis on the development of reliable software systems.
The primary emphasis of the project work is to understand and gain knowledge of the principles of software engineering practices, and develop good understanding of SDLC.
It is advised that students develop their project for solving problems of software industry or any research organization. Topics selected should be appropriate enough to justify as an

MCA project.

Electives – II

Course code: DCA8241	**Course Title: Advanced Web Programming**
Unit 1	**HTML Basics:** introduction of HTML, HTML elements, creation of simple web pages using HTML, tags.
Unit 2	**XML Programming:** XML basic formats, different XML tools, validating XML document and XML Namespace, XSLT transforms, XPath, validating XML document with schemas and XSL-FO Namespace, SOAP, architecture and advantages of web services and web services description languages. XML and Database: storage of data extracted from an XML document in a relational database, XML publishing methods, Sarissa and Drag and Drop concepts.
Unit 3	**Asynchronous JavaScript and XML:** Aspects of XML Http Request object, synchronous and asynchronous data retrieval, elements and properties of CSS, server side technology and concept of frameworks and toolkits. Ajax–Object Oriented JavaScript: object oriented feature of JavaScript, MVC design pattern, components of JSON like JSON syntax and parser.
Unit 4	**J2ME**: Java platforms, components of J2ME, process to develop Mobile Information Device Profile and MIDlet user interfaces.
Unit 5	**Introduction to HTML5:** History, features and elements of HTML5 including markup, media, canvas, form, and input type elements. Audio and Canvas, Form Elements and Attributes. HTML5 for Mobile Applications.
Reference Books 1. Shelly Powers, "*Dynamic Web Publishing*", Techmedia. 2. K. Jamsa, K. King, "*HTML & Web Design*", TMH Publications. 3. Wiley, "*Beginning Visual C# 2008*", Wrox Publication.	

Course code: DCA8242	**Course Title: Cloud DB System**
Unit 1	**Introduction to Distributed and Cloud Computing:** From collaborative to the Cloud Functioning of Cloud Computing, Differences between Distributed computing and Cloud computing. Relational Database Management Systems: Properties, Overview of Relational Query Optimization, System catalog in a Relational DBMS.
Unit 2	**Distributed Database:** Concepts, Data Fragmentation, Replication, Structure of Distributed Database, trade-offs in Distributing the Database, Allocation Techniques for Distributed Database Design, Design of Distributed Databases. Query Processing in Distributed Databases: Concurrency, database recovery management and the distributed Oracle environment.
Unit 3	**Cloud Architectures:** Cloud architectures, Cloud Storage, Cloud Services. Distributed file systems and Cache consistency: RPC and RMI communication. Network File System, Andrew File System. Distributed File System and Web Services: Introduction to XML, SOAP, WSDL, UDDI, Connecting database to the Web, Web search and retrieval, XML, Semantic Web, concept of Service-Oriented Architecture. Cloud Architecture, cloud computing industrial applications. Cloud Computing Technology, security issues associated with the cloud computing technology. Accessing the Cloud: Platforms, Web Application Framework, Web Hosting Services, Proprietary Methods, Web Applications-

	API's in Cloud Computing, Browsers for Cloud Computing. Information Storage in Cloud Computing: Storage as a Service, Storage Providers, cloud data security and its merits and demerits.
Unit 4	**Cloud Data Management:** Cloud security issues, data control mechanisms and cloud data storage as a service. Types of Clouds: Private Clouds, Hybrid Clouds, Community cloud, various services provided by the vendor. Cloud Computing Standards: Best Practices and Standards, Practical Issues.
Unit 5	**Cloud Governance:** IT Governance, working of governance which includes monitoring and measuring the performance at regular intervals.
Reference Books 1. R. K.Buyya, J. Broberg, A. M. Goscinski, "*Cloud Computing: Principles and Paradigms*", Wiley and Sons Publications. 2. A.Jain, Mahajan, "*The Cloud-DBA Oracle: Managing Oracle database in the cloud*", Apress, (1e).	

Course code: DCA8243	**Course Title: Storage Management**
Unit 1	**An overview of Data Storage Technology:** History of Data Storage, Storage I/O Basics, I/O stack, Storage technologies such as DAS, NAS and SAN. Data Protection, Backup and Restore: data protection and its need, Data loss and business risks, designing storage systems for backup and recovery, different Backups such as Tape Backup, Disk-to-disk backup and Disk-to-disk to tape backup.
Unit 2	**Data Security:** Concepts of defence, encryption and attacks, storage system security, DAS and SAN security. Information Life cycle management: Structured and unstructured information, Information context, ILM schema and Regulatory concerns.
Unit 3	**Storage Networks:** Requirements for Network storage, network storage architectures and its functions, design SAN and NAS applications. Devices and Subsystems in Storage Networks: Disk Drives, Tape Drives, Functions of storage Subsystems. Data Redundancy: RAID Fundamentals, Redundant I/O Path Elements, and also Data Redundancy and Mirroring.
Unit 4	**File system:** File System Structures, File System Constructs, functions, Fundamentals of Network File Systems. Introduction to Storage Virtualization: Files and Records, file attributes, Systematic Organization of Files and File System Strategies. Data on disk: Volume Management, SCSI Protocol and Logical Units. Abstracting Physical Storage: Storage Metadata Integrity, Logical Volume Management, Storage Metadata Servers and Server-Based Storage APIs. Fabric-Based Virtualization: Array-Based Virtualization, Array-Based Data Replication, Array-Based Point-in-Time Copy and Distributed Modular Array Virtualization.
Unit 5	**Virtualization Appliances and Services:** Black Box Virtualization, In-Band Virtualization Appliances, Out-of-Band Virtualization Appliances, Heterogeneous Mirroring and Heterogeneous Data Replication.
Unit 6	**Virtualized SAN File Systems:** Conventional File Systems, Distributed File Systems and Virtualizing File Systems, Disk-to-Disk-to-Tape and Virtualizing Tape Systems.
Reference Books 1. M. Portnoy," *Virtualization Essentials*", Sybex (1e). 2. R. Spalding," *Storage Networks: The Complete Reference*", McGraw Hill Education.	

5.3. Duration of the programme

Programme	Level	Duration	Maximum duration for completion	Credits
MCA	Master‘s Degree	2 years	(2+ 2) years (As per UGC Notification on Specification of Degree, 2014)	93 Credits

5.4. Faculty and support staff requirement

Academic Staff	Number available to meet the required delivery norms
Programme Coordinator	1 member
Course Coordinator	1 member
Course Mentor	1 member per batch of 250 students

5.5. Instructional delivery mechanisms

The Directorate of Online Education of MUJ comprises of faculty members and staff who are well versed in Distance Education and Online delivery.

An Academic calendar depicting dates for all major events during each semester will be prepared by faculty members and shared with students through LMS, at the beginning of each academic session.

Apart from providing content in the form of Self Learning Material, enough e-learning resources in the form of Audio and Video content will be provided to students. Regular engagement of students will be ensured through the following means:

- Conduct of Webinars/live lectures/online lectures/Virtual Class
- By encouraging them to participate in mandatory Discussion Forums to stimulate their thinking, and to be able to fearlessly express their views in forums. These discussion forums will be moderated by faculty to provide equal opportunity for everyone to participate, as well as to ensure maintenance of decorum of the forum.
- Through periodic formative assessments

Regular evaluation of content learnt will be provided for, through Self-Assessment Questions within the SLM, as well as quizzes on the LMS. The quizzes can be taken any number of times, so that they reach a stage of being able to answer questions without errors, which is a reflection of their understanding of the concept. .

Effort will be made to provide case studies to enhance their analytical ability and make right decisions.

Link to National Portals (SWAYAM/NPTEL) will be provided, as also link to University's digital library portal.

All links to additional reading will be provided in the LMS. Interested students can study beyond the confines of the syllabus.

5.6. Identification of media–print, audio or video, online, computer aided

LMS provides for all audio video content (e-learning material, e-pubs, faculty-led video sessions, virtual classrooms and discussion boards), dashboard of their progress in learning, comparison with their peers in terms of learning, regular notifications regarding upcoming Webinars/virtual classes, Assignments, Discussion Forum participations and Examinations. It also provides an opportunity for raising queries if any, and seek answers to the same, by chat bot or course mentors.

5.7. Student Support Services

The Student Support services will be facilitated by the Directorate of Online Education, Manipal University Jaipur, Rajasthan which includes the pre-admission student support services like counselling about the programme including curriculum design, mode of delivery, fee structure and evaluation methods. Post-admission student support services include guiding students towards accessing e-identity card, LMS portal, Academic calendar and academic delivery. Examinations support staff shall answer queries pertaining to conduct of end-semester examinations, evaluation and issue of certificates.

6. Procedure for Admission, Curriculum Transaction and Evaluation

The purpose of Online education by Manipal University, Jaipur is to provide flexible learning opportunities to students to attain qualification, wherever learners are not able to attend the regular classroom teaching. Academic programmes offered for such candidates under Online Learning mode will be conducted by Directorate of Online Education-Manipal University, Jaipur with support of the various University schools. The programmes/courses may be termed Online mode for award of Degree. Eligibility criteria, programme/course structure, curriculum, evaluation criteria and duration of programme shall be approved by Board of Studies and Academic Council which are based on UGC guidelines.

Candidates seeking admissions in any programme offered by Directorate of Online Education-Manipal University, Jaipur shall fill up online application form available on DOE-MUJ website. Before applying, candidates must check eligibility criteria for programme that they are interested in. Details about Eligibility criteria, programme structure, curriculum, duration, and fee structure are available on the website.

6.1. Procedure for Admission

6.1.1 Minimum Eligibility Criteria for admission

Candidate must have a 10 + 2 + 3 years bachelor degree from recognized University/ Institution or equivalent qualification as recognized by Association of Indian Universities (AIU) or other competent body in Computer Applications/Computer Science/Information Technology with a minimum 50% (45% for Reserved category) marks in aggregate.

Candidates from other streams like Science/Business Administration/ Business management/ Arts & Humanities/Commerce should have completed 10 + 2 + 3 years bachelor degree from recognized University or equivalent qualification as recognized by Association of Indian Universities (AIU) or other competent body with Mathematics at 10+2 level with a minimum 50% (45% for Reserved category) marks aggregate in graduation.

Such candidates need to attend and complete Bridge Course in Fundamentals of Computer and IT along with their Semester 1 courses.

Important Instructions:

- All admissions shall be provisional until and unless candidates meet the eligibility criteria.
- Admission will stand cancelled if a candidate does not meet eligibility criteria, or there is failure to pay programme/course fees.
- Admission will stand cancelled, if candidate does not submit proof of eligibility within stipulated time given by Directorate of Online Education-Manipal University, Jaipur.
- Directorate of Online Education-Manipal University, Jaipur has the right to make necessary changes from time to time as deemed fit in Eligibility criteria, programme/course structure, curriculum, duration, fee structure and programme announcement dates. All changes will be notified on website.

- Candidates should carefully read all instructions given in Programme prospectus before start of application form.

6.1.2. Fee Structure and Financial assistance policy

Suggested Fee for MCA programme is INR 1,20,000/- (One Lakh Twenty Thousand only)

A scholarship of upto 25% on tuition fees will be provided to Divyang students and students from Public Sector Undertaking / Defence background.

6.2. Curriculum Transactions

6.2.1. Programme Delivery

Manipal University, Jaipur has state-of-the-art mechanism for online mode of Academic delivery to ensure quality education. Faculty members at MUJ offer expert guidance and support for holistic development of the students. Faculty members are not mere facilitators of knowledge but they also mentor students to make learning more engaging and maintain high retention level. The programme will be delivered with an aim to provide expertise and ensure that students excel in their domains. The features of programme delivery are:

- Online Mode of Academic Delivery
- Periodic review of Curriculum and Study material
- Live Interactive lectures from faculty / Course coordinators
- Continuous Academic and Technical support
- Guidance from Course Co-ordinators
- Learning and delivery support from Course Mentors

6.2.2. Norms for Delivery of Courses in Online Mode

S. No.	**Credit value of the course**	**No. of Weeks**	**No. of Interactive Sessions**		**Hours of Study Material**		**Self-Study hours including Assessment etc.**	**Total Hours of Study (based on 30 hours per credit)**
			Synchronous Online Counselling/ Webinars/ Interactive Live Lectures (1 hour per week)	**Discussion Forum/ asynchronous Mentoring (2 hours per week)**	**e-Tutorial in hours**	**e-Content hours**		
1.	2 Credits	6 weeks	6 hours	12 hours	10	10	22	60
2.	4 Credits	12 weeks	12 hours	24 hours	20	20	44	120

6.2.3**. Learning Management System to support Online mode of Course delivery:**

LMS Platform has been built to help learners reach their potential in their chosen programme. It is a secure, reliable learning experience tool that works consistently on Web and Mobile devices. Its simple interface makes it easy for instructors to design courses, create content and grade assignments. It provides a great mobile experience due to the responsive design which is paired with purpose-built native apps. It provides seamless accessibility to ensure all tools are standards-compliant and easy for students to navigate using assistive technologies. It provides 24 X 7 learning experience to facilitate learning as per the pace chosen by learners. Digital portfolio functionality allows students to document and share their learning journey as it happens, on both web and mobile platforms.

6.2.4**.** Course Design

The Course content is designed as per the SWAYAM guidelines using 4-quadrant approach as detailed below to facilitate seamless delivery and learning experience

(a) Quadrant-I i.e. e-Tutorial, that contains – Faculty led Video and Audio Contents, Simulations, video demonstrations, Virtual Labs

(b) Quadrant-II i.e. e-Content that contains - Portable Document Format or e-Books or Illustration, video demonstrations, documents as required.

(c) Quadrant-III i.e. Discussion forums to raise and clarify doubts on real time basis by the Course Coordinator and his team.

(d) Quadrant-IV i.e. Self-Assessment, that contains MCQs, Problems, Quizzes, Assignments with solutions and Discussion forum topics.

6.2.5**.** Academic Calendar

Sl No.	**Event**	**Batch**	**Last Date (Tentative)**
1	Commencement of semester	January	1st January
		July	1st July
2	Enrol student to Learning Management system	January	Within 2 working days of fee confirmation
		July	
3	Assignment Submission	January	March end and April end
		July	September end and October end
4	Submission of Synopsis (Applicable during Pre final semester)	January	30th April
		July	30th October
5	Project Report Submission	January	30th April
		July	30th October

	(Applicable during Final semester)		
6	Webinars / Interactive Live Lectures and Discussion Forum for query resolution	January	Mar to May
		July	September to November
7	Admit Card Generation	January	3rd week of May
		July	3rd week of Nov
8	Term End Examination	January	2nd week of June (TEE June)
		July	2nd Week of December (TEE December)
9	Result Declaration of End Term Examination	January	Last week of August
		July	Last week of February

6.3. Evaluation

The students' learning in a course would be evaluated based on Internal assignments, students' response sheets, and semester end examinations. University adopts rigorous process in development of question papers, question banks, assignments and their moderation, conduct of examinations, evaluation of answer scripts by qualified teachers, and result declaration. The Directorate shall frame the question papers so as to ensure that no part of the syllabus is left out of study by a learner.

The evaluation shall include two types of assessments-continuous or formative assessment in the form of assignments, and summative assessment in the form of end semester examination or term end examination which will be held with technology supported remote proctored examination tool.

However, we shall be considering the guidelines issued by the Regulatory bolides from time-to-time about conduct of examinations.

The examinations shall be conducted to assess the knowledge acquired during the study. There shall be two systems of examinations viz., internal and external examinations. In the case of theory courses, the internal evaluation shall be conducted as Continuous Internal Assessment via Student assignments preparation, quizzes. The internal assessment shall comprise of maximum of 30 marks for each course (One Assignment for a two-credit paper and two assignments for a four-credit paper). The end semester examination shall be of three hours duration for each course at the end of each semester.

6.3.1. Question Paper Pattern

Time: 3 Hours

Max. Marks: 70

Part A - (Multiple Choice Questions) - 10 x 2 Marks = 20 Marks

Part B - (Short Answers) - Answer any 4 (out of 6) 4 x 5 Marks = 20 Marks

Part C – (Long Answers) – Any 3 (out of 4) x 10 Marks = 30 Marks

6.3.2. Distribution of Marks in Continuous Internal Assessments

The following procedure shall be followed for awarding internal marks for theory courses. Student must submit two assignments for 4-credit paper (one assignment for 2-credit paper), each carrying 30 marks and average of both will be considered as internal assessment marks.

6.3.3. Passing Minimum

The students are considered as passed in a course if they score 40% marks in the Continuous Evaluation (IA) and Term-End Examinations (TEE) individually. If a student fails in any one component (failure to get 40% marks either in IA or TEE), then he/she will be required to re-appear for that component only (IA or TEE as the case may be).

6.3.4. Marks and Grades

Based on the total marks obtained for each course in Internal Assessment and Term End examinations, student will be awarded grade for that course. The following table gives the marks, grade points, letter, grades and classification to indicate the performance of the candidate.

Range of Marks	**Grade Points**	**Letter Grade**	**Description**
≥90 to ≤100	10	A+	Outstanding
≥80 to <90	9	A	Excellent
≥75 to <80	8	B+	Distinction
≥70 to <75	7	B	Very Good
≥60 to <70	6	C+	Good
≥50 to <60	5	C	Average
≥40 to <50	4	D+	Below Average
<40	0	F	Re-appear
ABSENT	0	AAA	ABSENT

For a semester:

Grade Point Average [GPA] = $\sum_i C_i G_i / \sum_i C_i$

Grade Point Average =

$$\frac{\text{Sum of the multiplication of grade points by the credits of the courses}}{\text{Sum of the credits of the courses in a semester}}$$

C_i = Credits earned for the course i in any semester
G_i = Grade Point obtained for course i in any semester.

n refers to the semester in which such courses were credited

For the entire programme:

Cumulative Grade Point Average [CGPA] = $\sum_n \sum_i C_{ni} G_{ni} / \sum_n \sum_i C_{ni}$

$$\text{CGPA} = \frac{\text{Sum of the multiplication of grade points by the credits of the entire programme}}{\text{Sum of the credits of the courses for the entire programme}}$$

7. Requirement of the Laboratory Support and Library Resources

7.1. Laboratory Support

For practical courses (programming and coding) in syllabus, Learners will have access to lab guide for unguided exercise and online tools to carry out practice of suggested exercises. Video tutorials will be provided for better understanding of concepts and methods to practice. Lab based virtual classrooms in Learning portal will guide students about the laboratory support to the learners in order to carry out practical exercise covered in the programme. There shall be provision of a practical guide made available for learners.

7.2. Library Resources

Directorate of Online Education, Manipal University Jaipur, Rajasthan has excellent Library facility with adequate number of copies of books in relevant titles for MCA programme. The Central Library of Manipal University, Jaipur is also having good source of reference books. The books available at both the libraries are only for reference purpose and lending services. In addition, reference books as prescribed will be procured. The Digital library access will also be made available to students who are enrolled into online mode of education. In addition, the university membership on Swayam/ NPTEL/ Knimbus will also be made available to students. Complete e-Learning resources to course would be made available on Learning management System for learning along with e-tutorial lectures. Further, expert lectures/workshops/ webinars by industry experts would also be conducted for the students.

8. Cost Estimate of the Programme and the Provisions

The cost estimate of the Programme and provisions for the fund to meet out the expenditure to be incurred in connection with M.B.A. Programme as follows:

Sl. No.	Expenditure Heads	Approx. Amount
1	Programme Development (Single Time Investment)	49,00,000 INR
2	Programme Delivery (Per Year)	6,00,000 INR
3	Programme Maintenance (Per Year)	27,00,000 INR

9. Quality assurance mechanism and expected programme outcomes

The quality of the programme depends on scientific construction of the curriculum, strong-enough syllabus, sincere efforts leading to skilful execution of the course of the study. The ultimate achievement of MCA programme of study may reflect the gaining of knowledge and skill in management area. Gaining of knowledge and skills in IT may help the students to get new job opportunities, upgrading their position not only in employment, but also in the society,

The benchmark qualities of the programme may be reviewed based on the performance of students in their end semester examinations. Also, the feedback from the alumni, students, parents and employers will be received and analysed for further improvement of the quality of the programme.

Manipal University, Jaipur has constituted Centre for Internal Quality Assurance (CIQA), which will assist Director, Directorate of Online Education to conduct periodic review and assessments and assist the Directorate to implement necessary quality measures and effectiveness in programme delivery. CIQA is constantly involved in reviewing all materials prepared by DOE, including syllabus, SLMs and e-learning content. CIQA will be involved in conducting studies to measure effectiveness of methods adopted for learning. As we proceed further, CIQA will involve in benchmarking quality of academic delivery, and perform various analyses, and guide all stakeholders towards upgrading quality constantly.

Centre for Internal Quality Assurance Committee (CIQAC) chaired by the Vice Chancellor consisting of internal and external experts oversees the functioning of Centre for Internal Quality Assurance and approve the reports generated by Centre for Internal Quality Assurance on the effectiveness of quality assurance systems and processes.

In addition to CIQA, as per the guidelines of National Assessment and Accreditation Council (NAAC), Manipal University, Jaipur has constituted Internal Quality Assurance Cell (IQAC), in which academicians, industry representatives and other stakeholders are nominated as members. The IQAC is a part of the institution's system and work towards realisation of the goals of quality enhancement and sustenance, as quality enhancement is a continuous process. The prime task of the IQAC is to develop a system for conscious, consistent, and catalytic improvement in the overall performance of institutions. The work of the IQAC is the first step towards internalization and institutionalization of quality enhancement initiatives.. IQAC's elementary motive is to promote measures for institutional functioning towards quality enhancement through internalization of quality culture and institutionalization of best practices.

The guidelines on quality monitoring mechanism prescribed by the UGC have been adopted by the Centre for Internal Quality Assurance for conducting institutional quality audits, to promote quality assurance and enhance as well as spread best-in-class practices of quality assurance. University has setup an effective system for collecting feedback from the stakeholders regularly to improve its programmes. The University will conduct self-assessments regularly and use the results to improve its systems, processes etc. and finally quality of programmes.