ANNEXURE – IV

MCA First Semester

Course id: MCACC101 **Course Title: Computer System Architecture**
Duration of Exam: 3 HOURS **Lectures: 4 hours per week**
Int. Assessment = 20 **Semester Exam. = 80** **Total Marks = 100**

Learning Outcomes:

1. To make students understand the basic structure, operation and characteristics of digital computer.
2. To familiarize the students with arithmetic and logic unit as well as the concept of the concept of pipelining.
3. To familiarize the students with hierarchical memory system including cache memories and virtual memory.
4. To make students know the different ways of communicating with I/O devices and standard I/O interfaces.

UNIT- I

Number System: Binary, Octal, Decimal and Hexadecimal, Inter conversion of Numbers, Binary Arithmetic, Error detection and correction methods using Hamming Technique, ASCII code representation, Rules of addition/subtraction for r's, (r-1)'s complements, BCD, excess–3 codes.
Boolean Algebra & Logic Gates: Basic Theorems and functions, Laws of Boolean Algebra, Simplification of Boolean functions, Karnaugh's maps, Logic gates, AND, OR, NOT, NAND, XOR, NOR, XNOR Gates & their design.

10 Hours

UNIT- II

Combinational Circuits: Introduction, Half & Full adders & Subtractors, BCD adder, Magnitude Comparator, Encoder, decoder, Multiplexer, De-Multiplexer, Parity Generator and Checker.
Sequential circuits: Introduction, Flip-Flops, Registers and Counters.

10 Hours

UNIT- III

Basic Computer Organization: Instruction codes, computer instructions, timing & control, instruction cycles.
Memory reference instruction: Input/output & interrupts, Design of basic computer.
Control Unit: Hardwired vs. micro programmed control unit, Control Memory, Address Sequencing, Micro program Sequencer

10 Hours

UNIT- IV

Central Processing Unit: General register organization, stack organization, instruction format, Addressing Modes Data transfer & manipulation, program control, RISC, CISC.
Introduction to Parallel Processing: Pipelining, Instruction pipeline, Arithmetic pipeline.
Computer Arithmetic: Addition, Subtraction, Multiplication & Division Algorithm(s), Decimal arithmetic units & Operations.

10 Hours

Unit- V

Input-Output Organization: Peripheral Devices, Input-Output Interface, Modes of Transfer – Programmed I/O, Interrupt-Driven I/O, Priority Interrupt, Direct Memory Access (DMA), Input-Output Processor (IOP).
Memory Organization: Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.

10 Hours

Suggested Readings:

1. M. Morris Mano, "Computer System Architecture", Prentice-Hall of India, Pvt. Ltd., 3rd Ed.

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2. William Stalling "Computer Organization and Architecture", Prentice-Hall of India, Pvt. Ltd., 7th Edition, 2005.
3. Carl Hamacher, Zvonko G. Vranesic and Safwat G. Zaky, "Computer Organization", McGraw-Hill, Fifth Edition, 2001.
4. John P. Hayes, "computer Architecture and Organisation", McGraw Hill, 1998.
5. M. Morris Mano, "Digital Design", Prentice-Hall of India, Pvt. Ltd., Third Edition, 2004.
6. Thomas L. Floyd and R.P, Jain, "Digital Fundamentals", Pearson Education, Tenth edition, 2008.
7. Leach Malvino, "Digital Principles and Applications", Tata McGraw Hill, Fifth edition, 2005.

MCA First Semester

Course id: MCACC102 | **Course Title: Programming in C**
Duration of Exam: 3 HOURS | **Lectures: 4 hours per week**
Int. Assessment = 20 | **Semester Exam. = 80** | **Total Marks = 100**

Learning Outcomes (LO):

1. Learn to develop simple algorithms and flow charts to solve a problem.
2. Develop problem solving skills coupled with top down design principles.
3. Learn about the strategies of writing efficient and well-structured computer algorithms/programs.
4. Develop the skills for formulating iterative solutions to a problem.
5. Learn array processing algorithms coupled with iterative methods.
6. Learn text and string processing efficient algorithms.
7. Learn searching techniques and use of pointers.
8. Understand recursive techniques in programming.

UNIT-I

Problem solving, Algorithm, flow chart, coding, compilation and debugging History of C language, Structure of C program, compiling, and running a C program, Errors: syntax, linker and logical errors. Character set of C language, identifiers, keywords, data types, variables, constants, expressions. Operators: Mathematical, Unary, Binary, Relational and Logical operators, Operator precedence and associativity.

10 Hours

UNIT-II

Conditional Control statements: if statement, if else statement, nested if statement, if else if ladder and Ternary operator, Switch case statement, GOTO statement. Looping control Statements: While loop, Do while Loop, For loop, Nested loops etc.

10 Hours

UNIT-III

Functions: Definition, Prototypes, Types of Function, Scope, Call by Value. Storage classes in C, Preprocessor Directives, Macros.

10 Hours

UNIT-IV

Arrays (Single and double dimensional): Definition, Declaration, Accessing, Bound Checking, Passing to function. Strings: Definition, Declaration, Accessing, Passing to function, Standard Library functions.

10 Hours

UNIT-V

Arrays and Pointers: Accessing single dimensional array using Pointers, Accessing 2D array using Pointers, Passing arrays to functions with pointers. Structures &Unions: Declaring, Initializing and

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Accessing structures, Passing structures to functions, Array of Structures, Nested Structures, Unions initialization and accessing the members of a union. 10 Hours

Suggested readings and references:

1. Gottfried. B, Theory and problems of Programming with C Language, Tata Me Graw Hill.
2. Kenneth. A, C Problem Solving and Programming, PHI.
3. Dan Gookin,C Programming, Wiley Dreamtech.
4. Y. P. Kanetkar, Understanding Pointers in C, BPB Publications.
5. Shubhnandan S. Jamwal; Programming in C; Pearson Publications; Ie, 2014
6. H.M. Deitel and PJ. Deitel, C How to Program, PHI

Practicum :

Given the problem statement, students are required to formulate problem, develop flowchart/algorithm, write code, execute and test it. Students should be given assignments on following:

1. To learn elementary techniques involving arithmetic operators and mathematical expressions, appropriate use of selection (if, switch, conditional operators) and control structures
2. Learn how to use functions and parameter passing in functions, writing recursive programs.
3. Write Programs to learn the use of strings and string handling operations.
4. Problems which can effectively demonstrate use of Arrays. Structures and Union. b. Write programs using pointers.
5. Write programs to implement various algorithms
6. Write programs to implement various algorithms

MCA First Semester

Course id: MCACC103 **Course Title: Operating System**
Duration of Exam: 3 HOURS **Lectures: 4 hours per week**
Int. Assessment = 20 **Semester Exam. = 80** **Total Marks = 100**

Learning Outcomes:

1. Describe the important computer system resources and the role of operating system in their management policies and algorithms.
2. To understand various functions, structures and history of operating systems and should be able to specify objectives of modern operating systems and describe how operating systems have evolved over time.
3. Understanding of design issues associated with operating systems.
4. Understand various process management concepts including scheduling, synchronization, and deadlocks.
5. To have a basic knowledge about multithreading.
6. To understand concepts of memory management including virtual memory.
7. To understand issues related to file system interface and implementation, disk management.
8. To understand and identify potential threats to operating systems and the security features design to guard against them.
9. To have sound knowledge of various types of operating systems including Unix and Android.
10. Describe the functions of a contemporary operating system with respect to convenience, efficiency, and the ability to evolve.

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UNIT-I

Introduction: Definition, Functions, Types of operating system, Computer System Structure-operation, I/O structure, storage structure, hardware protection, Operating System Services.

Process Management: Process Concept, Process Scheduling, Operation On Processes, Cooperating Processes, Threads, Inter-Process Communication.

Process Synchronization: The Critical Section Problem, Synchronization Hardware, Semaphores Classical Problems of Synchronization, Critical Regions.

10 Hours

UNIT-II

CPU Scheduling: scheduling criteria, scheduling algorithms: FCFS, SJF, priority scheduling, round robin scheduling, multilevel queue scheduling, multilevel feedback queue scheduling, multiple processor scheduling, real time scheduling.

Memory Management: Logical & Physical Address Space, Swapping, Continuous Allocation (single partition, multiple partitions), Internal, External fragmentation, Paging, Segmentation, Segmentation with Paging.

10 Hours

UNIT-III

Virtual Memory, Demand Paging, Performance of Demand Paging, Page Replacement. Page Replacement Algorithms- FIFO, optimal, LRU, LRU approximation algorithms, counting algorithms Trashing, Demand Segmentation.

Deadlocks: Characterization, Methods For Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery From Deadlock.

10 Hours

UNIT-IV

I/O Management: I/O system, I/O strategies, buffering.

File System Interface: File Concept, Access Methods-sequential, direct, index, Directory Structure single-level, two-level, tree-structured, acyclic-graph, general graph.

File System Implementation: File System Structure, allocation, Methods-contiguous allocation, linked allocation, indexed allocation, Free Space management, Directory Management, Directory Implementation, Efficiency and Performance.

10 Hours

UNIT-V

Secondary Storage Structure: Disk Structure, Disk Scheduling, FCFS, SSTF, SCAN, C-SCAN, Look Scheduling, Selection of A Scheduling Algorithm, Disk Management-disk formatting, boot block, bad blocks.

LINUX/UNIX: Features of LINUX operating system, Components of LINUX, Scheduling, Process and memory management, Basic Linux commands, Overview of Shell script programming.

10 Hours

Suggested Readings

1. Silberschatz, Galvin, "Operating System Concepts", Addison Wesley Publishing company, 1989
2. William Stallings, "Operating System", Macmillan Publishing Company.
3. Deitel H.M., "An Introduction To Operating Syste", Addision Wesley Publishing Company, 1984.
4. Tanenbaum, A.S., "Modern Operating System", Prentice Hall of India.
5. Milenkovic M, "Operating system-concepts and design", McGraw Hill, International edition.

MCA First Semester

Course id: MCACC104
Course Title: Advance Database Management System
Duration of Exam: 3 HOURS
Lectures: 4 hours per week
Int. Assessment = 20
Semester Exam. = 80
Total Marks = 100

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Learning Outcomes(LO):

1. Gain knowledge of database systems and database management systemssoftware.
2. Ability to model data in applications using conceptual modelling tools such as ER Diagrams and design data base schemas based on the model.
3. Formulate, using SQL, solutions to a broad range of query and data updateproblems.
4. Demonstrate an understanding of normalization theory and apply such knowledge to the normalization of a database.
5. Be acquainted with the basics of transaction processing and concurrency control.
6. Familiarity with database storage structures and access techniques.
7. Compare, contrast and analyse the various emerging technologies for databasesystems such as SQL.
8. Analyse strengths and weaknesses of the applications of database technologies to various subject areas.

Unit I

The Relational model of Data: RDBMS theoretical techniques and theoretical concepts, advanced sql programming, Relation, Attributes. Entity, tuples, Domain, Degree, Cardinality, Keys (Candidate, Primary, Super, Foreign),referential integrity, Normalization, distributed relational systems, Security considerations. 10 Hours

Unit II

The extended Entity relationship Model and Object Model: The ER model revisited, complex data types, user defined abstract data types, subclass, super class, inheritance, specialization and generalization, constraints, types of relationship higher than degree two.

10 Hours

Unit III

Schema Refinement: Problems caused by Redundancy, Decompositions, Problems caused by BCNF, Lossless join decomposition, dependency preserving decomposition, schema refinement in data base design, Multi-valued dependencies, Normalization up to 5^{th} Normal form.

10 Hours

Unit IV

Transaction Concepts: Transaction site, Atomicity and durability, concurrent execution, Serializibility, Recoverability, Implementation of Isolation, Testing for Serializability, Lock based Protocol, Timestamp based Protocol, Recovery and Atomicity ,Log based Recovery, Recovery with concurrent transactions.

10 Hours

Unit V

Form of SQL Query: Examples of SQL queries, Nested queries, correlated query set, comparison Operators, Aggregative Operators, NULL values, Logical connectivity, AND,OR,NOT impact on SQL constructs, Outer Joins, Disallowing NULL values.

10 Hours

Suggested Readings:

1. Elmarsi,Navathe,Gupta,"Fundamentals of Database System,Pearson Education.
2. Silberschatz,korth,Sudarshan,"Database system concept,Tata McGrawhill.
3. Singh S.K,"Database system concepts,design and application",Pearson Education,2006.

B:Practicum(credits:04)

Students are required to practice the concepts learnt in the theory by designing and querying a database for a chosen organization (Like Library, Transport etc). The teacher may devise appropriate

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weekly lab assignments to help students practice the designing , querying a database in the context of example database. Some indicative list of experiments is given below.

Experiment 1: E-R Model

Analyze the organization and identify the entities, attributes and relationships in it. .Identify the primary keys for all the entities. Identify the other keys like candidate keys, partial keys, if any.

Experiment 2: Concept design with E-R Model

Relate the entities appropriately. Apply cardinalities for each relationship. Identify strong entities and weak entities (if any).

Experiment 3: Relational Model

Represent all the entities (Strong, Weak) in tabular fashion. Represent relationships in a tabular fashion.

Experiment 4: Normalization

Apply the First, Second and Third Normalization levels on the database designed for the organization

Experiment 5: Installation of Mysql and practicing DDL commands

Installation of MySql. Creating databases, How to create tables, altering the database, dropping tables and databases if not required. Try truncate, rename commands etc.

Experiment 6: Practicing DML commands on the Database created for the example organization

DML commands are used to for managing data within schema objects. Some examples:

SELECT - retrieve data from the a database

INSERT - insert data into a table

UPDATE - updates existing data within a table

DELETE - deletes all records from a table, the space for the records remain

Experiment 7: Querying

practice queries (along with sub queries) involving ANY, ALL, IN, Exists, NOT EXISTS, UNION, INTERSECT, Constraints etc.

Experiment 8 and Experiment 9: Querying (continued...)

Practice queries using Aggregate functions (COUNT, SUM, AVG, and MAX and MIN),GROUP BY, HAVING and Creation and dropping of Views.

MCA Second Semester

Course id: MCACC201 **Course Title: Data structures**

Duration of Exam: 3 HOURS **Lectures: 4 hours per week**

Int. Assessment = 20 **Semester Exam. = 80** **Total Marks = 100**

Learning Outcomes:

1. To be familiar with fundamental data structures and with the manner in which these data structures can best be implemented; become accustomed to the description of algorithms in both functional and procedural styles
2. To have a knowledge of complexity of basic operations like insert, delete, search on these data structures.
3. Ability to choose a data structure to suitably model any data used in computer applications.
4. Design programs using various data structures including hash tables, Binary and general search trees, heaps, graphs etc.
5. Ability to assess efficiency tradeoffs among different data structure implementations.
6. Implement and know the applications of algorithms for sorting, pattern matching etc.

UNIT-I

Data Structures: Arrays and their Applications; Sparse Matrix, Stacks, Application of stacks (converting arithmetic expression from infix notation to polish and their subsequent evaluation, quick sort technique to sort an array, recursion),Queues, Priority Queues,

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Unit-II

Sorting Techniques(Bubble sort, selection sort, insertion) Linked Lists(traversal, insertion, deletion),type(linear, circular, doubly linked, inverted), Trees, Binary Tree, Heap, heapsort, Binary Search Tree, AVL Tree, Hashing.

UNIT –III

Performance Analysis of Algorithms and Recurrences: Time and Space Complexities; Asymptotic Notation, Recurrence Relations.

Divide and Conquer: The General Method, Merge Sort, Quick Sort, Selection sort.

The Greedy Method: The General Method Knapsack Problem, Job Sequencing With Deadlines, Huffman Coding.

UNIT-IV

Graph Algorithms: Breadth-First Search, Depth-First Search, Shortest Paths, Minimum Spanning Trees (Kruskal's Algorithm, Prim's Algorithm).

Dynamic Programming: The General Method Multistage Graphs, All Pairs Shortest Paths, Optimal Binary Search Trees, 0/1 Knapsack, Traveling Salesperson Problem.

UNIT – V

Back Tracking: The General Method, The 8 Queens Problem, Sum Of Subsets, Graph Coloring, And Hamiltonian Cycles.

Complexity Theory: P and NP Class Problems; NP-completeness and Reducibility.

Suggested Readings:

1. Symour Lipschutz, "Theory and problems of Data Structure", St. Schaum's Outline series in Computers, Tata McGraw – Hill.
2. Horowitz, E., and Sahni, S., "Fundamentals of data structures", Computer Science Press.
3. Tanhenbaum, A.M., and Augenstein, M.J., "Data Structures with C", Prentice – Hall.
4. "Tremblay & Sorenson, An introduction to Data Structures with Applications:, Tata McGraw-Hill.
5. Aho, A.V., Hopcraft, and Ullman, J.E., "Data structure and Algorithms", Addison Wesley.
6. Thomas Coremen, Introduction to Algorithms, Second edition, Prentice Hall of India(2007)2nd Ed.
7. Mark Allen Weiss, Data Structures & Data Structures & Algorithm analysis in C, Dorling Kingsley (2002) 3rd ed.

B:Practicum: 4 Credits

Given the problem statement, students are required to formulate problem, develop flowchart/algorithm, write code, execute and test it. Students should be given assignments on following :

1. Write program that uses functions to perform the following:
2. Creation of list of elements where the size of the list, elements to be inserted and deleted are dynamically given as input.
3. Implement the operations, insertion, deletion at a given position in the list and search for an element in the list

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4. To display the elements in forward / reverse order
5. Write a program that demonstrates the application of stack operations (eg: infix expression to postfix conversion)
6. Write a program to implement queue data structure and basic operations on it (Insertion, deletion, find length) and code atleast one application using queues.
7. Write a program that uses well defined functions to Create a binary tree of elements and Traverse the a Binary tree in preorder, inorder and postorder,
8. Write program that implements linear and binary search methods of searching for an elements in a list
9. Write and trace programs to understand the various phases of sorting elements using the methods
   a. Insertion Sort
   b. Quick sort
   c. Bubble sort
10. Write and trace programs to Create a Binary search tree and insert and delete from the tree.
11. Represent suitably a graph data structure and demonstrate operations of traversals on it.

Course id: MCACC202 **MCA Second Semester**

Duration of Exam: 3 HOURS **Course Title: Computer Networks**

Int. Assessment = 20 **Lectures: 4 hours per week**

Semester Exam. = 80 **Total Marks = 100**

Learning Outcomes:

1. Understand the structure of Data Communications System and its components. Be familiarize with different network terminologies.
2. Familiarize with contemporary issues in network technologies.
3. Know the layered model approach explained in OSI and TCP/IP network models
4. Identify different types of network devices and their functions within a network.
5. Learn basic routing mechanisms, IP addressing scheme and internetworking concepts.
6. Familiarize with IP and TCP Internet protocols.
7. To understand major concepts involved in design of WAN, LAN and wireless networks.
8. Learn basics of network configuration and maintenance.
9. Know the fundamentals of network security issues.

Unit I

Introduction to Data communication, Advantages of Networks, Structure of communication networks, Point to Point and Multi-drop Circuits, Data flow and Physical Circuits, Network Topologies, Topologies and design goals, Hierarchical Topology, Horizontal Topology, Star Topology, Ring Topology, Mesh Topology, Network models Channel Speed, bit rate, Baud, Band Width and frequency spectrum, Modem.

Unit II 10 Hours

Connection oriented and connection less Networks, Classification Of Communication protocols, Polling and selection systems, Selective and Group Polling, stop and wait Polling, Multiplexing; Definition, TDM, FDM, Phase Multiplexing, Carrier Sense System. Transmission Media: Guided Media, Unguided Media: wireless, switching, circuit switched networks, datagram networks. Reference Models: OSI Reference Models and TCP/IP Reference Models.

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10 Hours

Unit III

Analog & Digital System: advantages, Signal Conversion, Analog to Digital techniques, Asynchronous and Synchronous transmission, Data Link layer, Design issues, Frame, Error detection and correction, Flow Control, Elementary Data link protocols, Character-Oriented and bit-oriented Protocols, Sliding window protocols. Channel allocation methods, TDM, FDM, ALOHA, Carrier sense Multiple access protocols, Collision free protocols, Ethernet, Token bus, Token ring.

10 Hours

Unit IV

Network Layer, Store and Forward Packet Switching, connectionless and Connection-oriented services, Virtual circuit, Routing Algorithms, Shortest path, Flooding, Link State, Distant vector, Hierarchical, Broadcast and Multicast Routing. Congestion, Congestion control algorithms.

10 Hours

Unit V

TCP/IP Protocol, IP Addresses, Classes of IP Addresses, Subnets, IPv6, Network layer in the Internet and ATM, Internet Control Protocols, ARP, RARP, BOOTP, DHCP, OSPF, BGP. Transport Layer: Protocol Stack-UDP, TCP, SCTP, Transport Services Primitives, Sockets, Socket Programming with TCP and UDP. Applications layer, Name service (DNS) Domain Hierarchy, Name services, Name resolutions, Traditional APPLICATIONs, SMTP, MIME World wide web-HTTP, FTP.

10 Hours

Suggested Readings:

1. Data communication & Networking, Fourth Edition by Behrouza A. Forouzan, TMH.
2. Computer networks, A.S Tanenbaum, 4th edition, Pearson Education.
3. Introduction to Data communications and Networking, W. Tomasi, Pearson education.
4. Data and computer communications, G.S. Hura and M.Singhal, CRC Press, Taylor and Francis Group.
5. An Engineering Approach to Computer networks-S. Keshav, 2nd Edition, Pearson Education.
6. Understanding communications and Networks, 3rd Edition, W.A. Shay, Cengage Learn.
7. Computer Network, S.S.Shinde, New Age International Publisher.
8. Data & Computer communication, William Stallings, Pearson.

MCA Second Semester

Course id: MCACC203 **Course Title: Java programming**

Duration of Exam: 3 HOURS **Lectures: 4 hours per week**

Int. Assessment = 20 **Semester Exam. = 80** **Total Marks = 100**

Learning Outcomes:

1. Knowledge of the structure and model of the Java programming language,
2. Use the Java programming language for various programming technologies
3. Develop software in the Java programming language,
4. Evaluate user requirements for software functionality required to decide whether the Java programming language can meet user requirements

UNIT-I

Introduction: Evolution of OO Methodology, Basic Concepts of OO Approach, Comparison of Object oriented and Procedure Oriented Approaches, Advantages of OOPs, Applications of OOPs. OO concepts: Abstraction, Encapsulation, Inheritance, Polymorphism,

Core Java: Introduction, Operator, Data type, Variable, Arrays, control Statements.

10 Hours

UNIT-II

Methods and Classes, Inheritance, Package and Interface, Exception Handling, Multithread programming, I/O Java Applet, String handling, Networking, Event handling, Introduction to AWT, AWT controls, Layout managers, Menus, Images, Graphics.

10 Hours

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Unit-III

Java Swing: Creating a Swing Applet and Application, Programming using Panes, Pluggable Look and feel, Labels, Texts fields, Buttons, Toggle buttons, Checkboxes, Radio Buttons, View Ports, Scroll Panes, Scroll Bars, Lists, combo box, Progress Bar, Menus and Toolbars, Layered Panes, Tabbed Panes, Split Panes, Layout, Windows, Dialog Boxes, Inner frame. JDBC: The connectivity Model, JDBC/ODBC Bridge, java.sql package, connectivity to remote database, navigating through multiple rows retrieved from a database.

10 Hours

UNIT-IV

Java beans: Application Builder tools, The bean developer kit(BDK), JAR files, Introspection, Developing a simple bean, using Bound properties, The Java Beans API, Session Beans, Entity Beans, Introduction to Enterprise Java beans (EJB), Introduction to RMI (Remote Methods Invocation): A simple client-server application using RMI.

UNIT-V 10 Hours

Java Servlets: Servlet basics, Servlet API basic, life cycle of a Servlet, Running Servlet, Debugging Servlets.

Thread-safe Servlets, HTTP Redirects, Cookies, introduction to Java Server pages (JSP)

Suggested Readings: 10 Hours

1. Margaret Levine Young, "The Complete Reference Internet", TMH.
2. Naughton, Schildt, "The Complete Reference JAVA2", TMH.
3. Balagurusamy E, "Programming in JAVA", TMH.
4. Dustin R. Callway, "Inside Servlets", Addison Wesley
5. Mark Wutica, "Java Enterprise Edition", QUE.
6. Steven Holzner, "Java2 Black book", dreamtech.

B:Practicum:4credits

1. Students are required to implement object-oriented paradigm using JAVA. Below are the list of some of the experiments.
2. Program on strings: Check the equality of two strings, Reverse a string.
3. Program using loops: to find the sum of digits of a given number, display a multiplication table, display all prime numbers between 1 to 1000.
4. Program to demonstrate all math class functions.
5. Program on files : to copy a file to another file using Java to package classes.
6. Program to demonstrate method over-riding and overloading
7. Programs on inheritances.
8. Multi-threaded programming.

MCA Third Semester

Course id: MCACC301 **Course Title: Software Engineering**
Duration of Exam: 3 HOURS **Lectures: 4 hours per week**
Int. Assessment = 20 **Semester Exam. = 80** **Total Marks = 100**

Learning Outcomes(LO):

1. Basic knowledge and understanding of the analysis and design of complex systems.
2. Ability to apply software engineering principles and techniques.
3. To produce efficient, reliable, robust and cost-effective software solutions.
4. Ability to work as an effective member or leader of software engineering teams.
5. To manage time, processes and resources effectively by prioritising competing

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demands to achieve personal and team goals Identify and analyzes the common threats in each domain.

UNIT-1

Software Engineering: Role of Software, Software Engineering, Changing nature of Software, Software Myths, and Terminologies, software development Software Process and desired Characteristics.

Software Life Cycle Models: Build & Fix Model, Component-based development, Formal methods model, Unified Process, Selection of appropriate development process.

10 Hours

UNIT-II

Software Requirements: Analysis & specification, Requirements Engineering tasks, Data Modeling Concepts, Flow Oriented Modeling.

Software Project Planning: Size estimation, Cost Estimation, COCOMO, COCOMO II, and Software risk Management.

10 Hours

UNIT-III

Software Design Engineering: Design concept and Design models, software architecture and data design, mapping data flow into s/w architecture, Designing class based components.

Software Quality Assurance Tasks Goals and Metrics, Software Review techniques: Informal reviews, Formal Technical Reviews, Software Reliability, and Software risk management.

10 Hours

UNIT- IV

Software Testing: approach to Software Testing, Test strategies for conventional software, Validation Testing, System Testing Debugging

Software Testing Fundamentals, Black -Box and White Box testing Basis Path Testing, Object Oriented Testing Methods , Testing for Real Time System

10 Hours

UNIT-V

Introduction: Clean room Software Engineering, Formal Methods , Reengineering; Business proposes reengineering, software reengineering, reverse reengineering , restricting forward reengineering, computer-Aided Software Engineering: Building blocks for CASE, taxonomy of CASE tools.

10 Hours

Suggested Readings:

1. Pankaj Jalote,"An Integrated Approach to Software Engineering "3rd Edition; Narosa Publishing House,2005
2. K.K. Aggarwal and Yogesh Singh," Software Egineering" 3rd Eition , New Age International (P) Ltd,2008
3. R.S Pressman., "Software Engineering- A Practitioner", sixth Edition, McGraw Hills,2008
4. Mall Rajib, "Fundamentals of Software Engnieering"PHI, New Delhi 2005
5. Richard Fairley,"Software Engineering Concepts" Tata McGraw Hills.

MCA Third Semester

Course id: MCACC302 | **Course Title: Theory of Computation**

Duration of Exam: 3 HOURS | **Lectures: 4 hours per week**

Int. Assessment = 20 | **Semester Exam. = 80** | **Total Marks = 100**

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Learning Outcomes:

1. To provide a formal connection between algorithmic problem solving and the theory of languages and automata and develop them into a mathematical (abstract) view towards algorithmic design and in general computation itself.
2. The course should in addition clarify the practical view towards the applications of these ideas in the engineering part as well.
3. Become proficient in key topics of theory of computation, and to have the opportunity to explore the current topics in this area

Unit-I

Introduction: Basic concepts of strings, Symbols, string Concatenation, alphabet, Language, Tree, States, Transition tables, Sets, Relations, Finite Automata, Regular Expressions, Compilers and translators, structure of a compiler, Applications of automata theory.

Unit II 10 Hours

Finite State Systems: Deterministic Finite Automata (DFA) and Non-deterministic finite Automata (NFA), Equivalence of the DFA and NFA, Converting NDFA to equivalent DFA, Minimization of DFA, Finite Automata with Output (Moore and mealy machines), Transformation of a Mealy machine into a Moore Machine, FSM properties and limitations.

Unit III 10 Hours

Regular Expressions: Regular expression designing, Equivalence of finite Automata and Regular Expressions, Algebraic method using Arden's theorem conversion of NFA with ε moves into an equivalent NFA without ε-moves, construction of FA equivalent to a regular expression, Pumping lemma of regular sets, Closure properties of regular sets, Comparison of automata models, APPLICATIONS of regular expressions and Finite automata.

Unit IV 10 Hours

Context free grammars, Derivation Tree (Left and right Derivation), Ambiguous Grammar (Removal of Ambiguity in the CFGs), Grammar simplifications: Reduced Grammar, Removal of ε productions from a Grammar, Nullable Symbols, Removing Unit Productions, APPLICATIONSs of context- free Grammar

Normal Forms: Chomsky Normal Form, Greibach Normal Form, Chomsky Hierarchy

Unit V 10 Hours

Pushdown Automata (PDA), Non-Deterministic PDA, Context-Free Grammars and Push-down Automata, construction of a PDA from the Context-Free Grammar, Properties of Context-Free Languages, PDA with two Stacks. Turing Machines: Turing Machine Model, Representation, Non-deterministic Turing Machines, Recursive and Recursively Enumerable languages. Turing Machine Limitations (Unsolvability), Church's Hypothesis, Universal Turing machines, decidability, Halting problem.

Suggest References: 10 Hours

1. H.R. Lewis and C. H. Papadimitriou – Elements of the Theory of computation, Prentice Hall.
2. J.E. Hopcroft, R. Motwani and J.D. Ullman –Introduction to Automata Theory, Languages and computation, Pearson Education Asia.
3. J. E. Hopcroft, and J. D. Ullman – Introduction to Automata Theory, Languages and computation, Addison Wesley.
4. J.C. Martin – Introduction to Languages and Theory of Computation, Tata Mcgraw Hill.
5. E. V. Krishna Moorthy, "Introductory theory of Computer Science". East West Press Pvt. Ltd., New Delhi.
6. K.L.P. Mishra and N. Chandrasekaran – "Theory of Computations (Automata, languages and Computation)", Prentice Hall.

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7. Rogers H., Theory of Recursive Functions and effective computing, Mcgraw- Hill.

MCA Third Semester

Course id: MCACC303 **Course Title: Python Programming**
Duration of Exam: 3 HOURS **Lectures: 4 hours per week**
Int. Assessment = 20 **Semester Exam. = 80** **Total Marks = 100**

Learning Outcomes:

1. Develop and Execute simple Python programs.
2. Structure a Python program into functions.
3. Using Python lists, tuples to represent compound data
4. Develop Python Programs for file processing

UNIT I

Introduction to Python, Python, Features of Python, Execution of a Python, Program,Writing Our First Python Program, Data types in Python. Python Interpreter and Interactive Mode; Values and Types: int, float, boolean, string, and list; Variables, Expressions, Statements, Tuple Assignment, Precedence of Operators, Comments; Modules and Functions, Function Definition and use, Flow of Execution, Parameters and Arguments.

10 Hours

UNIT II

Operators in Python, Input and Output, Control Statements. Boolean Values and operators, Conditional (if), Alternative (if-else), Chained Conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful Functions: Return Values, Parameters, Local and Global Scope, Function Composition, Recursion

10 Hours

UNIT III

Arrays in Python, Strings and Characters. Strings: String Slices, Immutability, String Functions and Methods, String Module; Lists as Arrays. Illustrative Programs: Square Root, gcd, Exponentiation, Sum an Array of Numbers, Linear Search, Binary Search.

10 Hours

UNIT IV

Functions, Lists and Tuples. List Operations, List Slices, List Methods, List Loop, Mutability, Aliasing, Cloning Lists, List Parameters; Tuples: Tuple Assignment, Tuple as Return Value; Dictionaries: Operations and Methods; Advanced List Processing - List Comprehension; Illustrative Programs: Selection Sort, Insertion Sort, Merge sort, Histogram.

10 Hours

UNIT V

Files and Exception: Text Files, Reading and Writing Files, Format Operator; Command Line Arguments, Errors and Exceptions, Handling Exceptions, Modules, Packages; Illustrative Programs: Word Count, Copy File.

10 Hours

Suggested Readings:

- Mark Lutz, Learning Python
- Tony Gaddis, Starting Out With Python
- Kenneth A. Lambert, Fundamentals of Python
- James Payne, Beginning Python using Python 2.6 and Python

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B. Practicum **4 Credits**

The students are required to verify their ablility to use core programming basics and program design with functions using Python programming language. The teacher shall programs to strengthen the practical expertise of the students. The following is an indicative list of programs that can be practised

1. Write a program to demonstrate different number data types in Python.

2. Write a program to perform different Arithmetic Operations on numbers in Python.

3. Write a program to create, concatenate and print a string and accessing sub-string from a given string.

4. Write a python script to print the current date in the following format "Fri Oct 11 02:26:23 IST 2019"

5. Write a program to create, append, and remove lists in python.

6. Write a program to demonstrate working with tuples in python.

7. Write a program to demonstrate working with dictionaries in python.

8. Write a python program to find largest of three numbers.

9. Write a Python program to construct the following pattern, using a nested for loop

```
*
**
***
****
*****
****
***
**
*
```

10. Write a Python script that prints prime numbers less than 20.

11. Write a python program to define a module to find Fibonacci Numbers and import the module to another program.

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12. Write a python program to define a module and import a specific function in that module to another program.

13. Write a program that inputs a text file. The program should print all of the unique words in the file in alphabetical order.

14. Write a Python class to convert an integer to a roman numeral.

15. Write a Python class to reverse a string word by word.

MCA Third Semester

Course id: MCADSE304 **Course Title: Artificial Intelligence**
Duration of Exam: 3 HOURS **Lectures: 4 hours per week**
Int. Assessment = 20 **Semester Exam. = 80** **Total Marks = 100**

Learning Outcomes(LO):

1. Explain what constitutes "Artificial" Intelligence and how to identify systems with Artificial Intelligence.
2. Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
3. Formalise a given problem in the language/framework of different AI methods (e.g., as a search problem, as a constraint satisfaction problem, as a planning problem, etc).
4. Implement basic AI algorithms (e.g., standard search or constraint propagation algorithms).
5. Design and perform an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.
6. Explain the limitations of current Artificial Intelligence techniques.

Unit-I

Introduction to AI: AI Domains: games, theorem proving, Natural Language Processing, vision and speech processing, robotics, expert systems, AI techniques- search knowledge, abstraction. Problem solving: State space search; Production system, search space control: depth-first, breadth-first search, heuristic search – Hill climbing, best-first search, A* search, AO search, branch and bound.

10 Hours

Unit-II

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Knowledge Representation: Predicate Logic: Unification, modus ponen, resolution, dependency directed backtracking. Rule based Systems: Forward reasoning: conflict resolution, backward reasoning: use of no backtracks. Structured Knowledge Representation: Semantic Nets: slots, exceptions and default frames, conceptual dependency, scripts.

Unit-III 10 Hours

Unicertainity: Non-monotonic reasoning, Logics Implementation, Probability and Bayes theorem- Certainty factors, Bayesian networks, Dempster- Shafer theory

Unit-IV 10 Hours

Natural Language Processing: Definition, Phases Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing. APPLICATIONs of Natural Language Processing

Unit-V 10 Hours

Expert Systems: Features, Characteristics-Architecture-Basic Activities-Stages in development, Structure of a knowledge base, Probability based Expert Systems – Tools, Need and justification for expert systems, knowledge acquisition,

Suggested Readings: 10 Hours

1. E.Rich and K. Knight, "Artificial intelligence", TMH, 2nd Ed., 1992
2. N.J. Nilsson, "Principles of AI", Narosa Publ. House. 1990.
3. D.W. Patterson, "Introduction to AI and Expert Systems", PHI, 1992.
4. Peter Jackson, "Introduction to Expert Systems", AWP, M.A., 1992.
5. R.J. Schalkoff, "Artificial Intelligence – an Engineering Aproach", McGraw Hill Int. Ed., Singapore, 1992.
6. M. Sasikumar, S. Ramani, "Rule Based Expert Systems", Narosa publishing House, 1994.

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MCA Third Semester

Course id: MCADSE305 | **Course Title: R-Programming**
Duration of Exam: 3 HOURS | **Lectures: 4 hours per week**
Int. Assessment = 20 | **Semester Exam. = 80** | **Total Marks = 100**

Learning Outcomes:

1. This course prepares students to gather, describe, and analyze data, and use advanced statistical tools to support decision making.
2. To gather sufficient relevant data, conduct data analytics using scientific methods, and understand appropriate connections between quantitative analysis and real - world problems.
3. Understand the exact scopes and possible limitations of each method to provide constructive guidance in decision making.
4. To Use advanced techniques to conduct thorough and insightful analysis, and interpret the results correctly with detailed and useful information.
5. To make better decisions by using advanced techniques in data analytics.

UNIT-I

Features, how to run R, comments, identifiers, constants, variables, operators, strings, data types: basic data types, vectors, lists, matrices, array, factors, data frames, Connecting R to external interfaces – csv file, Microsoft Excel, MySQL.

10 Hours

UNIT-II

Functions and Packages: function definition, function calling, mathematical function, character functions, statistical functions, packages: installing a package, loading a package.

10 Hours

UNIT-III

Charts and Graphs: bar charts histogram, line graph, pie charts, box plots, scatter plots and strip charts.

10 Hours

UNIT-IV

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Test of Hypotheses: population with known variance, population with unknown variance, population proportion. Non-parametric test: Two samples test, K-samples test. ANOVA- Latin Square Design,

10 Hours

UNIT-V

Correlation Analysis – Karl Pearson, Spearman, Kendall correlation coefficient. Simple Linear Regression, Multiple Linear Regression, Decision Trees.

10 Hours

Suggested Readings:

1. Beginner's Guide for Data Analysis using R Programming, Jeeva Jose, Khanna Publishers, New Dehi, 2018.

MCA Third Semester

Course id: MCADSE304
Duration of Exam: 3 HOURS
Int. Assessment = 20
Semester Exam. = 80
Course Title: Soft Computing
Lectures: 4 hours per week
Total Marks = 100

Unit-I

Soft Computing: Introduction, soft computing vs. hard computing, various types of soft computing techniques, Applications of soft computing techniques, Introduction, Structure and function of a neuron, Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural networks, Difference between ANN and human brain, Characteristics and applications of ANN.

Unit-II

Learning rules, Thresholds and activation functions, Single layer network, Perceptron and its training algorithm, Linear Separability, XOR problem, ADALINE, MADALINE. Introduction to multilayer layer Perceptron, Back propagation neural(BPN) networks

Unit-III

Counter propagation network, Hopfield/ Recurrent network, Associative memory, Hopfield v/s Boltzman machine, competitive learning, Kohonen's self organizing networks, Adaptive Resonance Theory(ART).

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Unit-IV

Introduction to Fuzzy Logic: Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation. Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations, Fuzzy Arithmetic: Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations. Fuzzy Logic: FIS, Fuzzification and de-Fuzzification.

Unit-V

Genetic algorithms(GA): Basic concepts, Conventional Vs. GA, Simple, GA working, encoding, fitness function, reproduction, Selection, crossover, mutation, schema analysis, analysis of selection algorithms; convergence; Reproduction, Crossover, and mutation, Mapping objective functions to fitness form, Fitness scaling. Meta-heuristic search: Overview of ACO, PCO

Text/Reference Books

1. S, Rajasekaran & G.A. Vijayalakshmi Pai, Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications, PHI Publication.
2. S.N. Sivanandam & S.N. Deepa, Principles of SoftComputing , Wiley Publications.
3. Rich E and Knight K, Artificial Intelligence, TMH, New Delhi.
4. Bose, Neural Network fundamental with Graph , Algo.& Appl, TMH.
5. Kosko: Neural Network & Fuzzy System, PHI Publication.
6. Klir & Yuan ,Fuzzy sets & Fuzzy Logic: Theory & Appli.,PHI Pub.
7. Genetic Algorithm, Goldberg

MCA Third Semester

Course id: MCADSE305 | **Course Title: Cloud Computing**
Duration of Exam: 3 HOURS | **Lectures: 4 hours per week**
Int. Assessment = 20 | **Semester Exam. = 80** | **Total Marks = 100**

Learning Outcomes:

1. Analyze the trade-offs between deploying applications in the cloud and over the local infrastructure.
2. Compare the advantages and disadvantages of various cloud computing

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platforms.

3. Deploy applications over commercial cloud computing infrastructures such as Amazon Web Services, Windows Azure, and Google AppEngine.
4. Program data intensive parallel applications in the cloud.
5. Analyze the performance, scalability, and availability of the underlying cloud technologies and software.
6. Identify security and privacy issues in cloud computing.
7. Explain recent research results in cloud computing and identify their pros and cons.
8. Solve a real-world problem using cloud computing through group collaboration.

Unit-I: Distributed Computing and Enabling Technologies. Vision of Cloud Computing, Defining a Cloud. Desired features and benefits, issues and challenges of cloud computing. Exploring the Cloud Computing Stack, Architecture, Applications, deployment models, and service models.

10 Hours

Unit-II: Introduction, Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Need for Virtualization, Pros and Cons of Virtualization Types of Virtualization: Hardware, Storage and Network virtualization, Concept of Hypervisors, Virtual machines provisioning and manageability: VM provisioning process

10 Hours

Unit-III: Distributed Management of Virtual Infrastructures, Server consolidation, Dynamic provisioning and resource management, Resource Optimization and Load Balancing, various load balancing techniques. Broad Aspects of Migration into Cloud, Migration of virtual Machines and techniques. Fault Tolerance Mechanisms.

10 Hours

Unit-IV: Cloud Storage definition, Provisioning cloud storage: unmanaged cloud storage, managed cloud storage. Introduction, Apache Hadoop: Framework to process big data, Master/ Slave architecture, Core components, Map-Reduce Programming Model: Map reduce working, working of mapper, working of reducer, Running Hadoop on cloud, Design of data applications based on Map Reduce in Apache Hadoop.

10 Hours

Unit-V: Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud – Cloud Computing Risk Issues- Security Challenges- Cloud Security and Trust Management Grid of Clouds, Green Cloud, Mobile Cloud Computing

10 Hours

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Suggested Readings:

1. Cloud Computing Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Wiley Publishers 2011.
2. Cloud Computing Bible, Barrie Sosinsky, Wiley Publishers 2010.
3. Cloud Computing: Web-based Applications that change the way you work and collaborate online, Michael Miller, Pearson Education 2008.
4. Mastering Cloud computing, Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, McGraw Hill 2013.
5. Cloud Computing and SOA Convergence in Your Enterprise: A Step-by-Step Guide, David S. Linthicum 2010.
6. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly 2010.
7. Cloud Computing : A Practical Approach, Toby Velte, Antohy T Velte, Robert Elsenpeter, McGraw Hill 2009.

MCA Third Semester

Course id: MCADSE306 **Course Title: Image Processing**
Duration of Exam: 3 HOURS **Lectures: 4 hours per week**
Int. Assessment = 20 **Semester Exam. = 80** **Total Marks = 100**

Learning Outcomes:

1. To familiarize the students with the image fundamentals and mathematical transforms necessary for image processing.
2. To make the students understand the image enhancement techniques
3. To make the students understand the image restoration and reconstruction procedures.
4. To familiarize the students with the image segmentation procedures.

Unit-1

Image Processing Fourier Transform and Z-Transform, Causality and Stability, Toeplit and Circulate Matrics, orthogonal and unitary Matrices and Kroenker product, Markov Processes KI Transform Mean Square Estimates and Orthogonal Principles. 10 Hours

Unit-II

Image Sampling quantization, Band Limited Image Sampling Versus Replication, Reconstruction of image from samples Sampling Theorem, Sampling Theorem for Random Fields, Sampling Optimal Sampling, Nonrectangular Grid Sampling, Sampling Aperture, Display Aperture/Interpolation Functions, Lang range Interpolation, Moire Effect, Image Quantization Uniform Optimal Quantizer, Properties of Mean Square Quantizer, Commands Design Visual Quantization. 10 Hours

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Unit-III

Image Transforms: Two Dimensional Orthogonal and Unitary Transforms and their properties. One Dimensional and Two Dimensional DFT Cosine and Sine Transforms hadamard, slant, IIARR and KI, Transforms and their properties, Approximation to KI Transforms. Image representation by stochastic model, One Dimensional Causal Models, AR and ARMA models, Non Causal Representation Spectral factorization, Image Decomposition 10 Hours

Unit-IV

Image Enhancement and Restoration: Point Operation, Histogram Modeling, Spatial Operations, Transform Operations. MultiSpecial Image Enhancement. Image Observation Models, Inverse and Wiener Filtering FIR wiener Filters, Filtering using Image Transform Casual Models and recursive filtering Maximum entropy restoration. Extrapolation of band limited signal. 10 Hours

Unit-V

Image Analysis and Image Compression: Spatial feature extraction, Edge detection and boundary extraction boundary, region and moment representations structures, Texture, Image Segmentation, Reconstruction from Projections, Pixel Coding, Productive Techniques, Transform Coding Theory, Coding of Image, Coding of two-tone image. 10 Hours

Suggested Readings:

1. Anil Jain: Digital Image Processing, Pearson Publication, New Delhi
2. W.K.Pratt.-Digital Image Processing ,3/e Edn., John Wiley & sons, Inc. 2006
3. M. Sonka et.al Image Processing, Analysis and Machine Vision, 2/e, Thomson, Learning, India Edition, 2007.
4. Gonzalez Woods: Image Processing, Pearson Publication, New Delhi

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MCA Fourth Semester

Course id: MCAEC401 **Course Title: Principles of Management**
Duration of Exam: 3 HOURS **Lectures: 4 hours per week**
Int. Assessment = 20 **Semester Exam. = 80** **Total Marks = 100**

Unit 1

Concepts of Management: Meaning of management, features, Objectives and significance of management.

Unit 2

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Functions of management: Planning, Organizing, staffing, Directing, coordination and meaning of control.

Unit 3

Planning: meaning, nature and advantages of planning, limitations of planning, essentials of good plan.

Unit 4

Organizing and Staffing: Meaning and characteristics of an organization, significance of effective organizing, staffing-meaning and nature.

Unit 5

Direction, coordination and control: direction and coordination-meaning and nature, control-meaning and features and factor determining good control.

Department of Computer Science
Bridge Course

Bridge Course Title: Discrete Mathematics **Bridge Course No: MCABC**
Duration of Exam: 3 hrs **Lectures: 4 Hours per Week**
Internal Assessment: 20 **End-Semester Assessment: 80** **Total Marks: 100**

Learning Outcomes:

1. Understand the notion of mathematical thinking, mathematical proofs, and algorithmic thinking, and be able to apply them in problem solving.
2. Understand the basics of combination, and be able to apply the methods from these subjects in problem solving.
3. Be able to use effectively algebraic techniques to analyse basic discrete structures and algorithms.
4. Understand asymptotic notation, its significance, and be able to use it to analyse asymptotic performance for some basic algorithmic examples.
5. Understand some basic properties of graphs and related discrete structures, and be able to relate these to practical examples.

UNIT-I

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Fundamentals of Set Theory: Set operations, Algebra of sets, combination of sets, Finite and Infinite sets, Classes of sets, Power Sets, Multi sets, Cartesian Product, Representation of relations, Types of relations, Binary Relations, Equivalence relations and partitions, Partial ordering relations and lattices, Mathematics Induction, Principle of Inclusion & Exclusion, Propositions. Function and its types, Composition of function and relations, Cardinality and inverse relations. Functions & Pigeon hole principles.

UNIT-II

Propositional Calculus: Basic operations: AND (^), OR (v), NOT ( ). Truth-value of a component statement, propositions, tautologies, contradictions. Counting Techniques Rules of Sum of products Permutations with and without repetition, Combination.

UNIT-III

Recursion and Recurrence Relation: Polynomials and their evaluation, Sequences, Introduction to AP, GP and AG series, partial fractions, linear recurrence relation with constant coefficients, Homogeneous solutions, Particular solutions, Total solution of a recurrence relation using generating functions.

UNIT-IV

Introduction to Algebraic Structure Definition, elementary properties of algebraic structures, examples of a Monoid, Submonoid, Semigroup, Groups and rings, Homomorphism, Isomorphism and Automorphism, Subgroups and Normal subgroups, Cyclic groups, Intergral domain and fields, Cosets, Lagrange's theorem, Rings, Division Ring.

UNIT-V

Graphs and Trees: Introduction to graphs, Directed and Undirected graphs, Homomorphic and Isomorphic graphs, Subgraphs, Cut points and Bridges, Multigraph and Weighted graph, Paths and circuits, Shortest path in weighted graphs, Eurelian path and circuits, Hamilton paths and circuits. Planar graphs Luler's formula, Trees, Rooted Trees, Spanning Trees & cut-sets, Binary trees and its traversals.

Suggested Readings:

1. Elements of Discrete Mathematics C.L. Liu, 1985, McGraw Hill.
2. Schaum's Outline series: Theory and problems of Probability by S. Lipshutz, 1982, McGraw Hill Singapore.
3. Concrete Mathematics: A Foundation for Computer Science, Ronald Graham, Donald Knuth and Oren Patashik, 1989, Addision-Wesley.

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4. Mathematical Structures for Computer Science, Judith L. Gersting, 1993, computer Science Press
5. Appliled Discrete Structures for Computer Science, Doerr and Levasseur, (Chicago: 1985, SRA)
6. Discrete mathematics by A. Chtewynd and P. Diggle (Modular Mathematics series), 1995, Edward Arnold, London.
7. Discrete Mathematical Structures, B. Koman and R.C. Busby, 1996, PHI 8 Discrete Mathematical Structures with Applications to Computers by Trembley & Manohar, 1995, McGraw Hill.

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