Uttar Pradesh Rajarshi Tandon Open University

Near Rapid Action Force Campus, Shantipuram Rd, Shantipuram, Phaphamau,
Allahabad, Uttar Pradesh 211013
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Syllabus

for

Master in Computer Science (M.Sc. Computer Science)

(The new course structure and syllabus will be effective from the academic session July 2015-16. Therefore those students who will be enrolled/admitted in first year from session July 2015-16 & onwards will study according to this new syllabus and the students admitted before July 2015-16 will follow old syllabus.)

November 2016

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Master in Computer Science (M.Sc. Computer Science)

1.1 Course Details and Structure

कम्प्यूटर विज्ञान में स्नातकोत्तर (एम.एस.–सी. कम्प्यूटर साइंस)

Master of Computer Science (M.Sc. Computer Science)

कार्यक्रम कोड/ Programme Code	: 706		कार्यक्रम अवधि (वर्षों में)	: न्यूनतम	: 2	अधिकतम	: 4
कार्यक्रम माध्यम/Medium of Instruction	: English/अंग्रेजी		Programme Duration (in yrs.)	: Minimum	: 2	Maximum	: 4
प्रवेश हेतु न्यूनतम अर्हता/Minimum Qualification for Admission	: कम्प्यूटर विज्ञान में तीन वर्षीय स्नातक/ Three Year Bachelor Degree with Computer science		कार्यक्रम शुल्क प्रतिवर्ष / Programme Fee Per Year	: 12000/-			
			अधिन्यास कार्य/ Assignment Work:-		आवश्यक/Essential		

Course code and Details

Semester	Paper No.	Course Code	Title of Course	Credits	Compulsory/Elective
	Compulsory Core Course				
	6026	MSc-CS-01	Discrete Mathematical Structure	3	
	6027	MSc-CS-02	Introduction to Programming Language Through 'C'	3	
First Semester	6028	MSc-CS-03	Digital Computer Fundamentals and Assembly Language Programming	3	Compulsory
	6029	MSc-CS-04	Lab-1 (Based on MSc-CS-02)	3	
	Discipline-Centric Elective Course				
	6030 OR 6031	MSc-CS-05 OR MSc-CS-06	Theory of Computation OR System Analysis & Design	4 OR 4	Elective
Credits 16		**of**	**First**		**Semester**
	Compulsory Core Course				
	6032	MSc-CS-07	Software Engineering	3	
	6033	MSc-CS-08	Object Oriented Programming through 'C++'	3	Compulsory
Second Semester	6034	MSc-CS-09	Computer Networks	3	
	6035	MSc-CS-10	Lab-2 (Based on MSc-CS-08)	3	
	Discipline-Centric Elective Course				
	6036 OR 6037	MSc-CS-11 OR MSc-CS-12	System Software OR Object Oriented Analysis and Design	4 OR 4	Elective
	Open Electives course (Other Discipline) (Any Two paper in Second Semester)				

	6038 OR 6039 OR 6040	MSc-CS-13 OR MSc-CS-14 OR MSc-CS-15	Numerical & Statistical Computing OR Accountancy & Financial Management OR Probability & Distribution	4 OR 4 OR 4	Elective
Credits of Second Semester					**24**
	Compulsory Core Course				
Third Semester	6041	MSc-CS-16	Database Management System	3	Compuls ory
	6042	MSc-CS-17	Operating System	3	
	6043	MSc-CS-18	Core Java	3	
	6044	MSc-CS-19	Lab-3 (Based on MSc-CS-18)	3	
	Discipline-Centric Elective Course				
	6045 OR 6046	MSc-CS-20 OR MSc-CS-21	Computer Graphics OR Design and Analysis of Algorithms	4 OR 4	Elective
Compulsory Foundation Course					
	2702 OR 2703	PGFGS OR PGFHR	Gandhian studies and Peace Education OR Human Right and Duties	Non Credit	Compuls ory
Credits 16	**of**		**Third**		**Semester**
	Compulsory Core Course				
	6047	MSc-CS-22	Project	12	Compuls ory
	Discipline-Centric Elective Course				
	6048 OR 6049	MSc-CS-23 OR MSc-CS-24	Artificial Intelligence OR Parallel Computing	4 OR 4	Elective
Fourth Semester	**Open Electives course (Other Discipline) (Any Two paper in Fourth Semester)**				
	6050 OR 6051 OR 6052	MSc-CS-25 OR MSc-CS-26 OR MSc-CS-27	Correlation, Regression & Statistical Inference OR Mathematical Analysis OR Operation Research	4 OR 4 OR 4	Elective
Credits of Second Semester					**24**
Total 80					**Credits**

1.2 MSc-CS-01 (Discrete Mathematics)

Mathematical Logic Connectives: Statements, connectives (Negation Conjunction, Disjunction), Conditional and Biconditional, Equivalence of formulae and well-formed formulae, Tautologies, Duality law, Functionally complete sets of Connectives.

Some More Connectives: Exclusive OR, NAND, NOR, Two state evices, Gate and Module, Two-level networks, NOR and NAND gates.

Normal Forms and The Theory of Inferences: Various Normal forms, Valid inference using truth tables and direct method of proof, Inference (Rules P and T), Consistency of Premises and indirect method of proof, Automatic proving of theorems.

The predicate Calculus: Predicates, Statement Functions, variables and Quantifiers, Free and bound variables, special valid formulas involving quantifiers.

Graph Theory

Introduction to Graphs: Graph, Applications of Graphs, MTNL's Networking Problem, Travelling Salesman Problem, Satellite Channel Problem, Graph isomorphism, Bipartite graphs, Subgraphs, Paths and walks, Connected Graphs and Cycles, Operations on graphs, Matrix Representation of graphs, Fusion of Graphs.

Trees and Connectivity: Tree, Properties, Bridge or cut Edge, Distance and Centre, Spanning trees, and connector problems, Kruskal's Algorithm, Prim's Algorithm, Computer implementation, cut vertices and connectivity, Shortest Path problems (BFS), Binary trees.

Euler tours, Hamiltonian Cycles, Planar graphs and Digraphs: Euler Tours, Konisberg Bridge problem, Fleury's Algorithm, Hierhozer's Algorithm, Hamiltonian graphs, closure of a graph, two optimal Algorithm, The closet insertion Algorithm, Planar graphs, Directed graphs of digraphs.

Functions, Sets and Relations

Basic Concepts of Set theory: Operations on sets, Venn diagram and some of the Applications of set theory, Cartesian product of sets,

Relations and ordering: Relations, Hasse Diagram.

Functions: Functions, Range and Domain of a function, Functions as Sets of ordered Pairs, Difference between Relations and Functions, Transformation or Operators, Equality of two functions, Graph of a function, Types of functions, Permutation of a set, Product or compositions of Mappings, Binary operations, characteristic functions, Hashing Function and its Application in Computer Science.

Fuzzy Sets: Vagueness, Impreciseness, Fuzzy sets, Basic operations, On Fuzzy sets, Image and Inverse image, I-V Fuzzy sets, Fuzzy relations.

Lattices and Boolean Algebra:

Posets and Lattices: Posets, Lattices as posets, lattices as Algebraic Systems, Sublattices, Complete Lattices, Bounds of Lattices, Modular and Distributive Lattices, Complemented Lattices, chains.

Boolean Algebra: Definition and important properties, sub Boolean Algebra, Atoms, Antiatoms and irreducibles, stone Representation theorem, Bolean Expressions and their Equivalence, Minterns and Maxterms, Canonical Forms and free Boolean Algebras, values of Boolean Expressions, Boolean Functions, Symmetric Boolean Expressions.

Applications of Boolean Algebras: Switching Algebra, Representations of Boolean Functions, Karnaugh Maps, Minimization of Boolean functions, Quine-McCluskey Algorithm.

Applications of Boolean Algebras: Complement and 28 complement of a binary number, Modules and circuit diagrams for 1s and 2s complement. Binary Addition, Binary subtraction, Single Parity Bit Generator, Serial Binary Adder, Finite State machines, Equivalence of States, Equivalence and Reduction of Machines.

1.3 MSc-CS-02 ('C' Programming and Data Structures)

Introduction

Introductory: An overview of C Escape sequences, getting a "feel" for C.

Data types in "C": Variables of type (int, char, float, double,), Enumerated types, the typed

of statement, Identifiers.

Operators and Expressions Inc

Elementary Arithmetic operations and operators, Expressions, L values and P values, Promotion and Demotion of variable types: The cast operator, Print f ( ) and Scan f ( ) functions. Decision Structures in 'C' Boolean operators and Expressions, The goto statement, the if ( ), Statement, the if ( ) – else statement,

Control structures -I: The do – while( ) and while Loops, the Comma Operator, the transfer of Central from within loops, Ternary operator, The Switch case default statement.

Programming in C

Control Structures II: 'The for (;;) loop, one-dimensional Arrays, The sizeof operator, storage classless and scope.

Pointers and arrays: Pointer variables and pointer Arithmetic, Pointers, Arrays and the subscript operator, A Digression on Scan f( ), Multidimensional Arrays.

Functions: Function Prototypes and Declarations, Functions and Scope, Pointers as Function Arguments, String Functions, Multidimensional Arrays as Function Arguments.

Functions II: Recursive functions, Macros, Conditional Compilation, Macros with Parameters, Command line Arguments, Variable length Argument lists, Complicated Declarations, Dynamic Memory Allocation.

Files and Structs, Unions and Bit-Fields: Files and File 70, Structs, the DOT Operator, Extructs and files: f seek ( ), Structs and Function and unions, The Bitwise operators.

1.4   MSc-CS-03 (Digital Computer Fundamentals and Assembly Language Programming)

Hardware Concepts

Introduction and Data Representation: The won Neumann Architecture, Computers: Then and Now, Data Representation, Instruction Execution.

Digital Logic Circuits: Boolean algebra, logic Gates, Combinational circuits, Adders, Sequential circuits, Interconnection Structures.

Memory Organization: Memory System, characteristics Terms for various memory Devices, RAM, External / Auxiliary Memory, High Speed Memories, Cache Memory, Associative Memories.

Input/output Organization: Input/output Module, input/output Techniques, Direct Memory Access (DMA), input/output processors, External interface.

CPU Organization

Instruction Sets: Instruction set characteristics, Addressing schemes, Instruction Format Design.

Register Organization and Micro Operations: Basic Structure of the CPU, an Advanced Structure, Register Organization, Micro Operations, Instruction Execution and Micro Operations.

ALU and Control Unit Organization: ALU Organization, Control Unit Organization, Functional Requirements of a Control unit structure of Control unit, Hardwired Control unit.

Microprogrammed Control Unit: MCU, Wilkes Control, The Microinstruction, Types of Microinstructions, Control Memory Organization, Microinstruction formats, A simple structure of Control Unit, Micro instruction (sequencing, Execution), MachineStartup.

Microprocessor and Assembly Language Programming

Microprocessor Architecture: Microcomputer Architecture, CPU Components, CPU Registers, Instruction set, Addressing Modes, Introduction to Motorola 68000 Microprocessors.

Introduction to Assembly Language: Assembly language Fundamentals, input/output Services, Assembly language Program Development tools.

Assembly Language Programming (Part-I): Simple Assembly Programs (Data transfer, shift operations), Programming with loops and comparisons, Arithmetic and String Operations.

Assembly Language Programming (Part − II): Arrays, Modular Programming, Interfacing Assembly language Routines to High level language programs, Interrupts

1.5   MSc-CS-05 (Theory Of Computation)

Finite Automata and Formal Languages

Finite Automata and Languages: Regular Expressions (Introduction to Defining of languages, Kleene closure Definition, Formal Definition of Regular, Expressions, Algebra of Regular Expressions), Regular languages, Finite automata, Mealy and Moore Machines.

Non-Deterministic Finite Automata: Equivalence of NFA and DFA, Pumping Lemma, Closure properties (Regular Languages and Finite Automata), Equivalence of Regular expression and Finite Automata.

Non-Deterministic Finite Automata: Context Free Grammar: Grammar and its classification, Chomsky, Classification for Grammar, Context free grammar, pushdown Automata (PDA), Non-Context free languages, Pumping Lemma for context free Languages, Equivalence of CFG and PDA.

Turing Machine and Recursive Functions

Turing Machine: Prelude to formal definition, Instantaneous Description and transition diagrams, Turing Machines as Computer of functions, Modular Construction of Complex turing machines, Symbol Writing machines, Right/Left head moving machines.

Turing Machine Miscellany: Extensions –cum-Equivalents of Turing Machine, Universal Turing Machine (UTM), Languages Accepted/Decided by TM, The diagonal language and the universal language, Chomsky Hierarchy.

Recursive Function Theory: Recursive Function Theory Recursive Definitions, Partial, Total and Constant Functions, Primitive Recursive Functions, Intuitive Introduction to primitive recursion, Primitive Recursion is weak Technique, The Techniques of unbounded minimilization, Partial Recursion and u-Recursion.

Complexity of Computability

Computability/Decidability: Decidable and undecidable problems, The halting, problem, Reduction to another undecidable problem, undecidability of post correspondence problem, undecidable problems for context free languages.

Computability/Decidability: Complexity Notations for Growth rates of functions (The Constant Factor in Complexity Measure, Asymptotic considerations, well known Asymptotic growth

rate Notations, The Notation O, The θ Notation, The Notation ω, The Notation W, classification of problems, Reduction, NP-Complete and NP-Hard Problems, Establishing NP-Completeness of problems.

Computability/Decidability: Applications Applications of Finite Automata, Applications of Regular Expressions, Application of Context free grammars (Definition of C-type small language, Definition of Part of HTML), ACM Code of Ethics and Professional Conduct.

1.6   MSc-CS-06 (Systems Analysis And Design)

Introduction to Systems Development

Introduction to SAD: Fundamentals of Systems, Real Time Systems, Distributed Systems, Development of a successful System, various Approaches for Development of information systems (Model Driven, Accelerated approach, Joint Application Development.

System Analyst - A profession: Needs Systems Analysts, users, Analysts in various functional Areas (Systems Analyst in Traditional Business, Systems Analyst in Modern Business), Role of a Systems Analyst, Duties of a Systems Analysts, Qualification of a Systems Analyst.

Process of System Development: Systems Development Life Cycle, Phases of SDLC, Products of SDLC Phrases, Approaches to Development (Prototyping, Joint Application Design, Participatory Design), Case Study (College Library).

Introduction to documentation of Systems: Concepts and process of Documentation, Types of Documentation, Different Standards for Documentation, Documentation and Quality of Software.

Planning and Designing Systems

Process of Systems Planning: Fact Finding Techniques, Need for fact finding, Issues involved in Feasibility Study, Cost Benefit Analysis, Preparing Schedule, Gathering Requirements of System.

Modular and Structured Design: Design principles (Top Down Design, Bottom up Design), Structure Charts, Modularity (Goals of Design, Coupling, Cohesion.

System Design and Modeling: Logical and Physical Design, Process Modelling, Data Modeling (ER Diagram), Process specification Tools (Decision Tables, Decision Trees, Structured English Notation), Data Dictionary.

More Design Issues and Case Tools

Forms and Reports Design: Forms, Reports, Differences between forms and Reports, Process of Designing Forms and Reports, Deliverable and outcomes, Design specifications, Types of Information, General formatting Guidelines, Guidelines for Displaying Contents, Criteria for form Design, Criteria for Report Design.

Physical file Design and Database Design: Introduction to Database Design, Design of Database fields, Design of Physical Records, Design of Physical Files, Design of Database, Case Study (Employee database),

Case Tools for Systems Development: Use of Case Tools by Organizations, Advantages and Disadvantages of CASE Tools, Components of CASE, Types of CASE tools, classification of CASE Tools, Reverse and Forward Engineering, Visual and Emerging Case tools.

Implementation and Security of Systems & MIS

Implementation and Maintenanceof Systems: Implementation of Systems, Maintenance of Systems.

Audit and Security of Computer Systems: Definition of Audit, Audit of Transactions on computer, Computer Assisted Audit Techniques, Computer System and Security Issues, Concurrent Audit Techniques.

Management Information Systems: Role of MIS in an organization, Different kinds of information systems, Expert Systems.

1.7   MSc-CS-07 (Software Engineering)

Software Engineering Concepts

Introduction to Software Product, Component and Characteristics: Software Engineering Phases, Documentation of the Software product, Software process and Models (Software Life Cycle, Requirements analysis and specification, Design and Specification, Coding and module testing).

Introduction to Graphs: Software Process Management: Software Process Management, Human Resource Management, The software team (DD, CD, CC), Organization, information and Decision, Problem Identification, Software crisis, Role of a System Analyst.

Introduction to Graphs: Project Planning and Control Project planning and control, Project Scheduling, Project Standards, Project outsourcing.

Introduction to Graphs: Risk Management Concepts: Introduction and Risk Management Concepts (Managing Risk, Typical Management Risks in software Engineering. Technical Planning, Project Tracking, Delivery Timings, Partial Recovery, Bench mark Testing.

Software Quality Concepts and Case Tools

Software Performance: Customer Friendliness, Software Reliability, Software Reviews, Software upgradation, Software tools and environment, Software Libraries and Toolkits, Software Modules, Reapplication of Software modules, Development tools (Code Generators, Debuggers),

Quality Concepts: Important Qualities of Software product and process (correctness, Reliability, Robustness, user Friendliness verifiability, Maintainability, Reusability, Portability, Data Abstraction, Modularity), Principles of Software Engineering.

Software Methodology an Object oriented concepts: The Evolving role of Software, An Industry perspective , structured Methodologies, Major influencing factors (Evolution of End user computing, Emergence of CASE tools, use of Prototyping and 4GL tools, Relational Database, Object Oriented Programming), using the Methodology, Choosing the Right Methodology, Implementing a Methodology, Current Generation of Software Development tools, Considerations in Application Development.

CASE Tools: Software crisis, An Engineering Approach to Software, CASE tools, factors Affecting Software Development, The Benefits of using CASE.

1.8   MSc-CS-08 (C++ And Object Oriented Programming)

An Introduction to OOP

What is object oriented Programming: Object oriented programming, Paradigm, Advantages of OOP, Applications of OOP, The object orientation, C++

Object Oriented Programming System: OOPS, Class, Inheritance, Abstraction, Encapsulation andinformation Hiding, Polymorphism.

Advanced Concepts: Dynamism, Structuring Programs, Organizing object – oriented Projects. Reusability,

Introduction to object oriented languages: Objective-C, Python, C Sharp, Eiffel, Modula-3, Small talk, Object Rexx, Java, Beta.

An Introduction to UML: UML (Goals, History, use), Definitions, UML Diagrams (Use Case Diagrams, Class diagrams, Interaction Diagrams, Sequence diagrams), State diagram, Activity Diagrams, Physical diagrams.

C++ An Introduction

Overview of C++: Programming Paradigms, Functions andfiles. Concepts of C/C++,

Classes and objects: Definition and Declaration of a class, Scope Resolution Operation, Private and Public member functions, creating objects, Accessing class data members and member functions, Arrays of objects, objects As Function Arguments.

Operator overloading: Operator Functions, Large objects, Assignment and initialization, function call, Increment, Decrements Operator, Friends.

Inheritance-Extending classes: Concept of Inheritance, Base class and Derived class, Visibility Modes, Single inheritance, Multiple Inheritance, Nested classes, Virtual Functions.

Streams and Templates: Output, Input, Files Exception Handling.

1.9   MSc-CS-09 (Computer Networks)

An Introduction to Computer Networks

Network classification and Reference Models: Network, Network Goals, Application of Networks, References Mode, (OSI, TCP/IP), IEEE Standards for LAN.

Data Transmissions and Multiplexing: Transmission Terminology Analog and Digital Data transmission, Transmission media, Multiplexing.

Medium Access Control and Data Link layer: Data link layer, Medium Access Control Sublayer.

Network, Transport and Application layer: Network layer, Routing Algorithms, Congestion Control Algorithms, Transport layer, QOS, TCP/UDP, Application layer, DNS, Remote Procedure Call (RPC), File transfer protocol (FTP) Talnet.

Network Devices and Technology

Network Devices-I: Network Devices, Repeaters Bridges Switches, Hubs.

Network Devices – II: Routers, Gateways, Modem

ISDN: Baseband Broadband Communication, ISDN Services, Advantages of ISDN, ISDN Applications. and

Asynchronous transfer Mode (ATM): Switching Techniques, circuit, Packet, Frame Relay, Cell Relay, ATM as Technology, ATM Layered Architecture in Comparison with OSI Model, ATM Protocol, The ATM Network, The ATM cell, ATM classes of Services, ATM Traffic Control, Benefits of ATM, ATM Applications.

1.10   MSc-CS-11 (System Software)

Programming Concepts and Software Tools

Introduction to Programming Language Concepts: Algorithm, Flowcharting, Problem and its Algorithm, Concept of a Programming Language, Categories of Languages, Elements of a Programming language.

Introduction to Graphs: Introduction to Assembler Advocates of a translator, types of translators, Assembler implementation, Macro processor, Loaders.

Introduction to Graphs: Introduction to Compiler writing Compiler, Approaches to compiler development, compiler Designing Phases, Software tools.

Introduction to Graphs: Graphical user interface: Graphical user interface, Evolution of the human and Machine interaction, Common Graphical user interface terms, functionality of graphical user interfaces, A look at some graphical user interfaces.

Introduction to Graphs: Introduction to a text editor and debugging system Introduction to a text editor, overview of the Editing process, Types of Editors and user interface, Editor structure, Interactive debugging systems, Debugging Functions and Capabilities, Relationship with other parts of the system, user interface criteria.

Fundamentals of operating system

Introduction to operating system: Operating System, Evolution of operating systems, serial processing, Batch processing, Multiprogramming, types of operating System, Batch Operating system Multiprogramming Operating system, Network operating system, Distributed Operating System, Operating System Structure, Layered Structure Approach, Kernel Approach, Virtual Machine, Client Server Model, Future Operating System trends.

Process Management: Process concept Processor scheduling, Types of Schedulers, Scheduling and performance Criteria, Scheduling Algorithms, Interprocess Communications and synchronization, Basic concepts of concurrency, Basic Concepts of Interprocess Communication and Synchronization, Mutual Exclusion, Semaphores, Hardware support for mutual Exclusion, Mechanism for Structured form of Interprocess Communication and synchronization, Deadlocks, System model, Deadlock Characterization and Modelling.

Memory Management: Introduction, single process monitor, Multiprogramming with Fixed partitions, Multiprogramming with dynamic partitions, Paging Address mapping in a paging system, Hardware Support for Paging, Address Translation by Associative Memory, Sharing and Protection in a Paging System, Segmentation, Address Mapping in a Segmented System, Implementation of segment tables, sharing and Protection in a Segmented System, Virtual memory, Advantages of virtual memory, Demand Paging Virtual memory management policies.

File Management: Introduction, File concept, Directories, Disk organization, Disk Space Management methods, Linked List, Bit Map, Disk Allocation Methods, Contiguous Allocation, Non Contiguous Allocation, Disk Scheduling, FCFS, Shortest seek time-first scheduling, scan scheduling, File Protection, Passwords, Access Lists, Access Groups.

UNIX Operating System-I

Theoretical Concepts of UNIX operating System: Introduction, Basic features of Unix operating system, UNIX system Architecture, File Structure processing Environment, CPU Scheduling Memory Management, Swapping, Demand Paging, File System, Blocks and Fragment and Inodes, Directory Structure.

UNIX-GETTNG STARTED I: Introduction, Getting started, user Names and Groups, Logging in, Correcting Typing Mistakes, Format of UNIX commands, changing your Password, Characters with special Meaning, UNIX documentation, Files directories, Current Directory, Locking at the Directory Contents, Absolute and Relative, Pathnames, Some UNIX Directories and Files.

UNIX Getting Started II: Introduction, Looking at file contents, your own directories, file permissions, Basic operations on files, Links between Files, Changing permission modes, standard files, Standard Output, Standard Input, Standard Error, Filters and Pipelines, Processes, Finding out about Processes, stopping Background Processes.

TEXT Manipulation: Introduction, Inspecting files, file statistics, Searching for Patterns, Comparing Files, Operating on files, printing files, Rearranging Files, Sorting files, Splitting files, Translating characters,

Editors: Introduction, General characteristics of vi , Starting up and quitting from vi , Adding text and Navigation, changing Text, Searching for Text, Copying and Moving Text, The Features of ex, The live editors Ex and Ed. starting up and Quitting, Addressing Lines, Looking at Text, Adding, Deleting and changing text, Searching for and replacing text, cut and paste operations, files and Miscellaneous features, The Stream Editor SED, changing several filed in SED, AWK.

UNIX operating System I

User to user Communication: Introduction, Online Communication, Off-line communication.

Shell Programming: Introduction, Programming in the Bourne and the C- shell, wild cards, simple shell programs, variables, Programming Constructs, interactive shell scripts, advanced Features.

Programming Tools: Introduction, The UNIX C compiler, other tools (Lint- the – C verifier, Program Profiles, Program listings), Cross References and Program flow, Maintaining Programs, the source code control system (Initializing a file, Examining and Altering files, Identification Keywords, Miscellaneous Commands). System Administration Introduction, System Administration – A Definition, Booting the system, Maintaining user accounts, file systems and special files, Backups and Restoration.

1.11 MSc-CS-12 (Object Oriented Analysis and Design)

Introduction To Object Oriented Modeling: Object Oriented Modeling., Basic Philosophy of Object Orientation, Characteristics Object Oriented Modeling, Class and Objects, Links and Association, Generalization and Inheritance, An Object Model, Benefits of OO Modeling, Introduction to OOA & Design Tools

Object Oriented Analysis: Object Oriented Analysis, Problem Statement: An Example, Differences between Structured Analysis and Object Oriented Analysis, Analysis Techniques t, Object Modeling, Dynamic Modeling, Functional Modeling, Adding Operations, Analysis Iteration, Refining the Ratio Analysis, Restating the Requirements

USING UML: UML: Introduction, Object Modeling Notations: Basic Concepts, Structural Diagram, Class Diagram, Object Diagram, Component Diagram, Deployment Diagram, Behavioral Diagrams, Use Case Diagram, Interaction Diagram, Activity Diagram, Statechart Diagram,

Modeling with Objects

SYSTEM DESIGN: System Design: An Object Oriented Approach, Breaking into Subsystems, Concurrency identification, Management of a Data Store, Controlling Events Between Objects, Handling Boundary Conditions

OBJECT DESIGN: Object Design for Processing, Object Design Steps, Choosing Algorithms, Selecting Data Structure, Defining Internal Classes and Operations, Assigning Responsibility for Operation, Design Optimization, implementation of Control, State as Location within a Program, State Machine Engine, Control as Concurrent Tasks, Adjustment of Inheritance, Rearranging Classes and Operations, Abstracting Out Common Behavior, Design of Associations, Analyzing Association Traversal, One-way Associations, Two-way Associations

ADVANCE OBJECT DESIGN: Control awl its Implementation, Control as a Stake within Program, Control as a State Machine Engine, Control as Concurrent Task, Inheritance Adjustment, Association: Design, Object Representation, Design Optimization, Design Documentation.

OBJECT MODELING: Advanced Modeling Concepts, Aggregation, Abstract Class, Multiple Inheritance, Generalization and Specialization, Meta Data and Keys, Integrity Constraints, An Object Model.

DYNAMIC MODELING: Events, State and State Diagram, Elements of a State Diagram, Advanced Concepts in Dynamic Modeling, Concurrency, A Dynamic Model

FUNCTIONAL MODELING: Functional Models, Data Flow Diagrams, Features of a DFD, Processes, Data Flows, Actors, Data Stores, Constraints, Control Flows, Design Flaws in DFD, A Sample Functional Model, Relation of Functional to Object and Dynamic Model

IMPLEMENTATION STRATEGIES: Implementation Associations, Unidirectional Implementations, Optional Associations, One-to-One Associations, Associations with Multiplicity 'Many', Bi-directional Implementations, One-to-One and Optional Associations, One-to-Many Associations, Immutable Associations, Implementing Associations as Classes, Implementing Constraints, Implementing State Charts, Persistency

PERFORMANCE EVALUATIONS: Metrics for Performance Evaluation, Running Time, Speed Up, Efficiency, Factors Causing Parallel Overheads, Uneven Load Distribution, Cost Involved in Inter-processor Communication, Parallel Balance Point, Synchronization, Laws For Measuring Speedup Performance, AMDAHL's Law, GUSTAFSON's Law, Sun and Ni's LAW, Tools For Performance Measurement, Performance Analysis, Search-based Tools, Visualisation, Performance Instrumentations

CASE STUDY:INVENTORY CONTROL SYSTEM: Class Diagram, Object Diagram, Generalization and Association Diagram, Collaboration Diagram, Activity Diagram and Events, Use Case Diagram, Deployment Diagram.

1.12 MSc-CS-13 (Numerical And Statistical Computing Fortran 77 And Fortran 90)

Introductory FORTRAN Concept: Character set, Constants and variables, Data Types, Subscripted variables and simple Fortran functions, Fortran Expressions, Naming Fortran Programs, Assignment statement, Fortran Commands.

Data transfer and Program Execution Control: Format Specification for Read and Write statements, Format Commands, Control Commands, Transfer Commands.

Arrays and Repetitive Computations: Arrays, Array storage, Dimension Statement, DO Construct, Nested DO loops, continue statement Implied-DO.

Subprogram: Functions and Subroutines: Subprograms, Functions in FORTRAN, Function Arguments, Subroutines save variables, Function vs. Subroutine Subprograms.

Additional Features of Fortran
Global variables and Additional Features:

Common statements, Equivalence declarations, Data Command, Block Data Subprogram, Declaration External, Character Expressions and Assignment.

File Manipulation: Records and Files, File structures, File Connection, The open and close statements, Preconnected files, File Inquiry, Additional Sequential file manipulation statements, internal files, File Input/output.

FORTRAN 90: Character set, Names, Source Program, Data types and Declarations, Type declaration Commands, Expressions and Assignments, Control and Iterative constructs, Arrays Program Units, Modules, Simple pointers.

Statistical Computations
Presentation of Data: Data and Statistical Data, Frequency distribution, Graphical Representation, Inter-Relationships of Graphs.

Measure of Central Tendency: Measures of Dispersion, Coefficient of variation and coefficient of Dispersion, Moments, Skewness and Kurtosis.

Correlation, Regression and Curve Fitting: Correlation and scatter diagram, Regression, Method of least square, Graphical Representation of Relation between correlation and Regression, Curve fitting.

Probability: Definitions (classical Definition of Probability, Limitation of Classical Definition of Probability, Statistical Definition of Probability, Axiomatic Approach, Simple properties of Probability of an event, Conditional Probability, Bayes Theorem, Boales inequality, Independent Events, Random Variable Expectation or Mathematical Expectation, Properties of Expectation , Distribution, Binomial Distribution, Poisson Distribution, Normal Distribution).

Index Number and Time Series Analysis: Index Number (Price, Quantity, Value Indexes), Chain Base Index Number, Cost for living index, Criteria for a good Index Numbers, Time series, Analysis of Trend, Measurement of Seasonal Components, Cyclical and Random Component, Forecast and its Accuracy.

1.13 MSc-CS-14 (Accounting And Finance For Manager)

Accounting Framework
Accounting and it's Functions: Scope and Emerging Role of Accounting, Accounting as an Information system. Role and activities of an Accountant Accounting Personnel, Nature of accounting Functions for Accounting and Finance.

Accounting Concept's and Standard's: Accounting framework, concept and standards, Changing Nature of GAPP, Attempts towards Standardization and Accounting Standards in

India.

Accounting Information and its Applications: Purposes of Accounting Information, Accounting and Control in Organizations, Profit and Case Balance Distinguished, uses of Earnings Information and uses of Balance sheet.

Understanding Financial Statements

Construction and Analysis of Balance Sheet: Conceptual Basis of a Balance sheet, Constructing a Balance sheet, Form and Classification of items.

Construction and Analysis of Profit and Loss Account: The linkage between Profit and loss account and Balance sheet, Measurement of Income, Preparation of Profit and Loss Account, Indirect Expenses, Methods of Depreciation. Form of Profit and Loss account, Cost of goods sold, Methods of Inventory valuation, Gross Profit, Operating profit Net profit

Construction and Analysis of Fund Flow Statement: Working Capital and its need. Determining working capital Requirements, Sources of funds, Uses of Funds, Factor Affecting Fund, Requirements, Analysing change in Working Capital, Fund Flow Statement.

Accounting and Finance for Managers

Understanding and Classifying Cost's: Cost accounting, costs, Elements of cost, Components of Total Cost. Cost sheet, Classification of Costs, some other concepts of costs.

Absorption and Marginal Costing: Absorption costing, Marginal costing, Absorption Costing and Marginal costing, Differences, Marginal cost. Segregation of semi-variable costs. Contribution, Break even analysis. Utility of Marginal costing, Limitations.

Cost Volume Profit Analysis: Meaning, Interplay and Impact of factors on Profit, Profit Graph, Cost Segregation, Marginal cost and Contribution.

Variance Analysis: Meaning of Variance. Cost variances, Direct Material variances. Direct Labour Variances, Overead Variances, Sales variances Control of Variances, Variance Reporting.

Financial and Investment Analysis:

Ratio Analysis: Classification, The norms for Evaluation, Computation and Purpose Management Uses of the Primary Ratio.

Leverage Analysis: Concept, Measures, and Effects of Financial Leverage, Operating Leverage, Combined Leverage, Financial Leverage and Risk

Budgeting and Budgetary Control

Investment Appraisal Methods: Types of Investment Proposal, Need of Appraisal, Project Report, Methods of Appraisal, Depreciation, Tax and Inflows, Cost of Capital, Limitations of Investment Appraisal Techniques.

Financial Decisions

Management of Working Capital: Significance of Working Capital, Operating Cycle, Concepts of working Capital, Kinds of working Capital, Importance of working capital Management, Determinants of working Capital Needs. Approaches of Managing Working Capital. Measuring working capital working capital Management under Inflation, Efficiency Criteria.

Managing Cash Needs: Need of Cash Determining Optimal Cash Balance, Cash Management And Cash Budgeting.

Capital Structure: Measuring Features of an Appropriate Capital Structure, Determinants of Capital Structure.

Dividend Revision: Forms of Dividend, Dividend Policy: Role of Financial Manager, Role of Board of Directors, Factors Affecting Dividend Decision.

1.14 MSC-CS-15 (Probability and Distribution)

Probability Theory

Random experiments and Probability: Deterministic and random experiments, Sample space, Events, Algebra of Events, Axiomatic definition of Probability, Classical definition of Probability, Statistical definition of probability, Addition Theorem of Probability .

Conditional Probability: Conditional probability, Multiplicative theorem of Probability, Independent events, Partition of sample space, Baye's Theorem.

Probability Distributions and Expectations

Random Variables and Probability Distributions: Definition and types of random variable, Cumulative distribution function and its properties, Probability Mass Function, Probability Density Function.. Definition and types of Mathematical Expectation, Moments in terms of expectation, Mathematical and Multiplication theorems of Expectation, other theorems on expectation.

Inequalities for Moments: Cauchy-Schwartz Inequality, Markov's inequality, Chebyshev's inequality.

Concept of Probability Distributions

Univariate Distributions: Bernoulli Distribution, Binomial Distribution, mean and variance of binomial distribution, Moments, Moments Generating Function, Additive and Multiplicative property, Recurrence relation for moments, Fitting of Binomial Distribution, Poisson Distribution, Poisson Distribution as a limiting case of Binomial Distribution, mean and variance of Poisson distribution, Moments, Moment Generating Function, Additive and Reproductive property, Recurrence relation for moments, fitting of Poisson Distribution.

Discreet Distribution: Geometric Distribution, mean and variance, moment generating function of geometric distribution, Negative Binomial Distribution, Moment Generating Function, Mean and Variance, Recurrence formulae for negative Binomial Distribution, Poisson Distribution as a limiting case of Negative Binomial Distribution, Hyper Geometric Distribution, Mean and Variance, Recurrence relation for Hyper Geometric distribution..

Normal Distribution: Normal Distribution and its parameters, Standard Normal Distribution, Moments, Moments Generating Function, Area Property, properties of normal curve, Standard Scores, Advantages and Characteristics of Z Scores.

Continuous Distribution: Uniform Distribution, Moment Generating Function, Distribution Function, Moments of Uniform Distribution, Exponential Distribution, Moments, Moment Generating Function, Lack of Memory Property.

1.15 MSc-CS-16 (Database Management Systems)

Introductory Concepts of Database Management Systems

Basic Concepts: Introduction, Traditional file Oriented approach, Motivation for database approach database basics, three views of data, The three level Architecture of DBMS Mapping between different levels database Management System facilities, DDL, DML, Elements of a database Management System (DML Pre Compiler, DDL Compiler, File Manager, Database

Manager, query Processor, database Administrator, Data dictionary) , Advantages and disadvantages of database management system.

Basic Concepts: Data base Models and its Implementation: Introduction, File Management System Entity, Relationship (E-R) Model, The hierarchical model, DBTG set, the network model, The Relational model, Advantages and Disadvantages of Relational Approach, Difference between Relational and other models.

Basic Concepts: File Organization for Conventional DBMS Introduction, File Organization, Sequential file organization, Index-sequential file organization (Types of Indexes, Structure of Index Sequential Files, VSAM, Implementation of Indexing through Tree- Structure), Direct file organization, Multi key file Organization (Need for the multiple Access path, multicost , File organization, Inverted file organization, cellular Partitions, comparison and Tradeoff in the Design of Multikey file).

Basic Concepts: Management Considerations: Introduction, Organizational Resistance to DBMS Tools (Political observation, Information transparency, Fear of future potential, Reasons for Success), Conversion from An Old system to a new system, Evaluation of a DBMS, Administration of a database Management System.

Basic Concepts: Enterprise Wide Information System of the Times of India Group (A Case Study) Introduction, organization and Th operating environment unique nature of Th Business, Information System goals and how to achieve the Goal, the Response System and Respnet Choices, Benefits.

RDBMS and DBMS

Relational Model: Concepts, Formal Definition of a Relation, the Codd, Commandments, Completeness.

Relational Model: Normalization Relational Algebra, Relational Functional dependency, Anomalies in a database, Properties of Normalized Relations, 1st NF, 2nd NF, 3rd NF, BCNF, Fifth Normal form examples of Database Design.

Relational Model: Structured Query Language Categories of SQL Commands, Data Definition, Data Manipulation, views.

Relational Model: Distributed Databases Structure of Distributed database, Trade-OFFS in distributing the database, Design of Distributed Databases.

Emerging Trends in DBMS

Introduction to object oriented Database Management System: Next Generation database System, New database applications, object oriented database Management system, Promises and Advantages of object oriented Database Mgt. system, Difference between RDBMS and OODBMS, Alternative object oriented Database strategies.

Introduction to client/Server Database: Evaluation of client/Server, Emergence of client server Architecture, the client/server computing, the critical products, developing on Application, SQL (DDL, DML), Client/Server. Where to Next?

Introduction to Knowledge Databases: Definition and Importance of knowledge, Knowledge base system, Difference between a knowledge base system and a database system, knowledge Representation Schemes.

1.16 MSc-CS-17 (Operating Systems)

Introduction: Operating System, Generation of operating systems, Processors, Memory, Disks, Tapes, I/O Devices, Buses, Mainframe Operating Systems, Server Operating Systems Multiprocessor Operating Systems, Real time, Operating systems, smart card operating systems.

Introduction to Graphs: Operating System Structure: Monolithic systems, Layered systems, Microkernels, client, Server Model, Virtual Machines.

Introduction to Graphs: Processes and Threads: The process Model, process creation, Process Termination Process States Implementation of Processes, Thread usage, The classical thread Model, Hybrid Implementations, Interprocess Communication, Race Conditions, Critical Regions, Mutual Exclusion with busy waiting, sleep and wakeup, semaphores,

Introduction to Graphs: Memory Management: The Notation of an Address Space, Swapping virtual memory, Paging Page labels, speeding up paging, page Replacement Algorithms, The optimal Page Replacement Algorithm, the (FIFO) Page, Replacement Algorithm, The second chance page Replacement Algorithm, The clock Page Replacement Algorithm, Design issues for Paging systems, Implementation Issues, Segmentation.

Deadlocks: Resources, The OSTRICH Algorithm, Deadlock, Avoidance, Deadlock prevention, Deadlock Detection and Recovery.

Security: Basics of Cryptography, protection Mechanisms, Authentication, Malware, Defenses.

Case Study 1: LINUX

Case Study 2:WINDOWS VISTA.

1.17 MSc-CS-18 (Core Java)

Fundamentals of Java Programming

Introduction to Java: Applets and Applications, JAVA Buzzwords, The JAVA Plateform, Java libraries, starting with Java.

Data types, operators and Arrays: Data types in Java, Operators, Java keywords, Mixing Data types, Type Casting, Programming Constructs in Java, Arrays.

Classes and objects in Java: Classes and objects, Constructor, Subclassing, The extends keyword, The instance of operator, static variables and methods, The final keyword, Access Control, Wrapper classes, Inner classes.

Exception Handling: Exception classes, using TRY and CATCH, Handling Multiple exceptions, sequencing Catch blocks, Using Finally, Built-in Exceptions, throwing Exceptions, Catching Exceptions, user defined exceptions.

Packages and Interfaces: Creating Packages, Adding classes to existing Package, interfaces, creating Interfaces, Exceptions.

1.18 MSc-CS-20 (Computer Graphics)

Introduction to Computer Graphics, Display Technologies, Random and Raster Scan, frame buffer, bit plane, input Devices, Graphics Standards, Graphics Hardware. Line and Circle

Drawing Algorithms, Scan Conversion, filling algorithms, clipping, Two and Three Dimensional transformations, Homogeneous Coordinates, Rigid Body and Affine transformations, Parallel and perspective projections, vanishing points, viewing transformation, Hidden line removal method, Curve and Surface: Cubic Spline, Bezier curve, B-Spline Curves, Parametric Surface, Surface of revolution, Sweep surface, Fractal Curves and surfaces. Introduction to Multi-media Technology, Audio System, Image Compression, Data Compression, Digital Motion Video, Authoring tools, Multimedia Applications, Multimedia DBMS.

1.19 MSc-CS-21 (Design and Analysis of Algorithm)

ELEMEMTARY ALGORITHMICS Structure : Introduction, Objectives, Example of an Algorithm, Problems and Instances, Characteristics of an Algorithm, Problems, Available Tools & Algorithms, Building Blocks of Algorithms, Basic Actions & Instructions, Control Mechanisms and Control Structures, Procedure and Recursion, Outline of Algorithmic, Understanding the Problem, Analyzing the Problem, Capabilities of the Computer System, Approximate vs Exact Solution, Choice of Appropriate Data Structures, Choice of Appropriate Design Technology, Specification Methods for Algorithms, Proving Correctness of an Algorithm, Analyzing an Algorithm, Coding the Algorithm

SOME PRE-REQUISITES AND ASYMPTOTIC BOUNDS Structure : Some Useful Mathematical Functions & Notations, Functions & Notations, Modular Arithmetic/Mod Function, Mathematical Expectation, Principle of Mathematical Induction, Concept of Efficiency of an Algorithm, Well Known Asymptotic Functions & Notations, Enumerate the Five Well-Known Approximation Functions and How These are Pronounced, The Notation O, The Notation ω, The θ Notation, The Notation o, The Notation w.

BASICS OF ANALYSIS: Structure, Introduction, Objectives, Analysis of Algorithms Simple Examples, Well Known Sorting Algorithms, Insertion Sort, Bubble Sort, Selection Sort, Shell Sort, Heap Sort, Divide and Conquer Technique, Merge Sort, Quick Sort, Comparison of Sorting Algorithms, Best-Case and Worst-Case Analyses, Various Analyses of Algorithms, Worst-Case Analysis, Best-Case Analysis, Analysis of Non-Recursive Control Structures, Sequencing, For Construct, While and Repeat Constructs, Recursive Constructs, Solving Recurrences, Method of Forward Substitution, Solving Linear Second-Order Recurrences with Constant Coefficients, Average-Case and Amortized Analyses, Average-Case Analysis 3.8.2 Amortized Analysis

DIVIDE-AND-CONQUER: Introduction, Objectives, General Issues in Divide-and-Conquer, Integer Multiplication, Binary Search, Sorting, Merge Sort, Quick Sort, Randomization Quicksort, Finding the Median, Matrix Multiplication, Exponentiation.

GRAPH ALGORITHMS: Introduction, Objectives, Examples, NIM/Marienbad Game, Function For Computing Winning Nodes, Traversing Trees, Depth-First Search, Breadth-First Search, Algorithm of Breadth First Search, Modified Algorithm, Best-First Search & Minimax Principle, Topological Sort

DYNAMIC PROGRAMMING: Introduction, Objectives, The Problem of Making Change, The Principle of Optimality, Chained Matrix Multiplication, Matrix 'Multiplication Using Dynamic Programming.

GREEDY TECHNIQUES

Introduction, Objectives, Some Examples, Formalization of Greedy Technique, Function Greedy-Structure (GV: set): Set, Minimum Spinning Tree, Prim's Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm.

MODELS FOR EXECUTING ALGORITHMS-I: FA: Regular Expressions, Introduction to Defining of Languages, Kleene Closure Definition, Formal Definition of Regular Expressions, Algebra of Regular Expressions, Regular Languages, Finite Automata, Definition, Another Method to Describe FA.

MODELS FOR EXECUTING ALGORITHMS-II: PDFA & CFG: Formal Language & Grammar, Context Free Grammar (CFG), Pushdown Automata (PDA).

MODELS FOR EXECUTING ALGORITHMS - III : TM: Prelude to Formal Definition, Turing Machine: Formal Definition and Examples, Instantaneous Description and Transition Diagram, Instantaneous Description, Transition Diagrams, Some Formal Definitions, Observations, Turing Machine as a Computer of Functions.

ALGORITHMICALLY UNSOLVABLE PROBLEMS: Decidable and Undecidable Problems, The Halting Problem, Reduction to Another Undecidable Problem, Undecidability of Post Correspondence Problem, Undecidable Problems for Context Free Languages, Other Undecidable Problems.

COMPLEXITY OF ALGORITHMS: Notations for the Growth Rates of Functions, The Constant Factor in Complexity Measure, Asymptotic Considerations, Well Known Asymptotic Growth Rate Notations, The Notation O, The Notation ω, The Notation θ, The Notation o, The Notation w), Classification of Problems, Reduction, NP-Complete and NP-Hard Problems, Establishing NP-Completeness of Problems.

1.20   MSc-CS-23 (Artificial Intelligence)

Introduction to Artificial Intelligence: Overview of A.I., Knowledge : General Concepts, Definition and Importance of knowledge, knowledge Based systems, Representation of knowledge, knowledge organization, knowledge Manipulation, Introduction to Lisp, Functions, Predicates and Conditionals, Input, Output and Local variables, Iteration and Recursion, Property lists and Arrays.

Knowledge Representation: Formalized symbolic logics, syntax and Semantics for Propositional logic, Syntax and Semantics for FOPL, Properties of wffs, Inference Rules, The Resolution Principle, Truth Maintenance Systems, Model and Temporal Logics, Fuzzy Logic and Natural Language computations. Associative Networks, Frme Structures, Conceptual Dependencies and Scripts, Objects, class, Message, and Methods, object Oriented Languages and systems.

Knowledge Organization and Manipulation: Preliminary Concepts, Uniformed or blind search, Informed Search, Indexing and Retrieval Techniques, Integrating knowledge in Memory, Measures for Matching, Matching like patterns, Partial Matching, Fuzzy Matching Algorithms, The RETE Matching Algorithm.

Perception Communication, and Expert systems: Commands and Languages, Basic Parsing Techniques, Semantic Analysis and Representation Structures, Natural language Generation, Natural language Systems, Pattern Recognition, The Recognition and classification Process, Learning classification Pattern, Recognizing and understanding speech.

Knowledge Acquisition: Types of Learning, General Learning Model, performance Measures, Perceptions, learning Automata, Genetic Algorithms, Induction Basic Concepts, Inductive Bias, Generalization and specialization, The ID3 system, the LEX system The INDUCE system, Learning structure concepts.

1.21   MSc-CS-24 (Parallel Computing)

INTRODUCTION TO PARALLEL COMPUTING: History of Parallel Computers, Problem Solving in Parallel, Concept of Temporal Parallelism, Concept of Data Parallelism, Performance Evaluation, Some Elementary Concepts, The Concept of-Program, The Concept of Process, The Concept of Thread, The Concept of Concurrent and Parallel Execution, Granularity, Potential of Parallelism, The Need of Parallel Computation, Levels of Parallel Processing, Instruction Level, Loop Level, Procedure Level, Program Level, Dataflow Computing, Applications of Parallel Processing, Scientific Applications/Image Processing, Engineering Applications, Database Query/Answering Systems, AI Applications, Mathematical Simulation and Modeling Applications, India's Parallel Computers, Parallel Terminology used.

CLASSIFICATION OF PARALLEL COMPUTERS: Types of Classification, Flynn's Classification, Instruction Cycle, Instruction Stream and Data Stream, Flynn's Classification, Handler's Classification, Structural Classification, Shared Memory System/Tightly Coupled System, Uniform Memory Access Model, Non-Uniform Memory Access Model, Cache-only Memory Architecture Model, Loosely Coupled Systems, Classification Based on Grain Size, Parallelism Conditions, Bernstein Conditions for Detection of Parallelism, Parallelism Based on Grain Size

INTERCONNECTION NETWORK structure: Network Properties, Design issues of Interconnection Network, Various Interconnection Networks, Concept of Permutation Network, Performance Metrics.

PARALLEL COMPUTER ARCHITECTURE: Pipeline Processing, Classification of Pipeline Processors, Instruction Pipelines, Arithmetic Pipelines, Performance and Issues in Pipeline, Vector Processing, Array Processing, Associative Array Processing, Superscalar Processors, VLIW Architecture, Multi-threaded Processors

PARALLEL ALGORITHMS: Analysis of Parallel Algorithms, Time Complexity, Asymptotic Notations, Number of Processors, Overall Cost, Different Models of Computation, Combinational Circuits, Parallel Random Access Machines (PRAM), Interconnection Networks, Sorting, Combination Circuit for Sorting the String, Merge Sort Circuit, Sorting Using Interconnection Networks, Matrix Computation, Concurrently Read Concurrently Write (CRCW), Concurrently Read Exclusively Write (CREW)

PARM ALGORITHMS: Message Passing Programming, Shared Memory, Message Passing Libraries, Data Parallel Programming, Data Structures for Parallel Algorithms, Linked List, Arrays Pointers, Hypercube Network

PARALLEL PROGRAMMING: Introduction to Parallel Programming, Types of Parallel programming, Programming Based on Message Passing, Programming Based on Data Parallelism, Processor Arrangements, Data Distribution, Data Alignment, The FOR ALL Statement, INDEPENDENT Loops, Intrinsic Function, Shared Memory Programming, Open MP, Shared Programming Using Library Routines, Example Programmes for Parallel Systems

OPERATING SYSTEM FOR PARALLEL COMPUTER: Parallel Programming Environment Characteristics, Synchronization Principles, Wait Protocol, Sole Access Protocol, Multi Tasking Environment, Concepts of Lock, System Deadlock, Deadlock Avoidance, Message Passing Program me Development Environment, UNIX for Multiprocessor System

PERFORMANCE EVALUATIONS: Metrics for Performance Evaluation, Running Time, Speed Up, Efficiency, Factors Causing Parallel Overheads, Uneven Load Distribution, Cost Involved in Inter-processor Communication, Parallel Balance Point, Synchronization, Laws For Measuring Speedup Performance, AMDAHL's Law, GUSTAFSON's Law, Sun and Ni's LAW, Tools For Performance Measurement, Performance Analysis, Search-based Tools, Visualization, Performance Instrumentation

RECENT TRENDS IN PARALLEL COMPUTING: Recent Parallel Programming Model, Parallel Virtual Machine, Grid Computing, Cluster Computing, IA 64 Architecture, Hyper-threading

1.22   MSc-CS-25 (Correlation, Regression And statistical Inference)

Correlation and Regression

Bivariate Data and Correlation: Scatter Diagram, Karl Pearson's coefficient of correlation, Properties of correlation coefficient, limits of correlation coefficient, Effect of change of origin and scale on correlation coefficient.

Regression: Regressions, linear regression model, principal of least square, Regression lines, Regression coefficient, Properties of Regression coefficients.

Correlation and Intra Class Correlation: Rank correlation coefficient, Spearman's rank correlation coefficients, rank correlation coefficient for tied ranks, Intra-class correlation, some remarks on Intra-class correlation.

Theory of Attributes: Combinations, Classes and Class frequencies of Attributes, Dichotomous Classification, Consistency of data, joint distribution of attributes, Contingency tables, Independence and Association of Attributes, Measures of Association, Yates Correction.

Basic Principles of Statistical Inference

Estimation: Point Estimation, properties of a good estimators, Consistency, Unbiased ness, Efficiency, Sufficiency, Confidence Interval Estimation.

Method of Estimation: Procedures of Estimation, Method of Moments, method of Maximum Likelihood, Method of Scoring, Properties of Estimators.

Testing of Hypothesis: Statistical Hypothesis, Simple and Composite Hypothesis, Critical Region, Two kinds of Error, One-tailed and Two-tailed tests, Test of Significance, Most Powerful Test, Uniformly Most Powerful Test .

Test of Significance

Exact Tests and Fisher's transformations: Tests of Significance based on Chi-Square Distribution, Tests of Significance based on t – Distribution, Tests of Significance based on F – Distribution, Tests of Significance based on Fisher's Z - Distribution.

Large Sample Tests: Testing Significance of Mean, Testing Equality of Means, Testing Significance of Proportion, Testing Equality of Proportions, Testing Significance of Standard Deviation, Testing Equality of Standard Deviation.

Non-Parametric Tests: Non Parametric Tests, Sign Test, Wilcoxon Signed- Rank Test, Mann-Whitney U-Test, Run Test.

1.23   MSc-CS-26 (Mathematical Analysis)

Riemann Stieltjes integrals, Fourier series and Functions of bounded variation

Riemann Stieltjes integrals: Absolutely continuous functions. Riemann Stieltjes integrals. Basic theorems. Definitions, Linear properties, integration by parts, change of variable in . Riemann Stieltjes integrals, upper and lower integrals, necessary and sufficient conditions for existence of . Riemann Stieltjes integrals, integral as a function of parameters, differentiation under the integral sign.

Fourier series: Fourier series, orthogonal system of functions, Fourier series of a function relative to an orthogonal system, properties of Fourier coefficients, Reusz- Fischar theorem, convergence and representation problems for Fourier metric series, sufficient conditions for convergence of Fourier series at a particular point.

Bounded Variation: Functions of bounded variation, total variation, function of bounded variation expressed as the difference of increasing functions, continuous functions of bounded variation, Absolutely continuous functions.

Metric spaces & Continuity

Metric spaces: Metric Spaces, open and closed sets, limit and cluster points, Cauchy Sequences and completeness, Convergence of sequences, Completeness of R". Baire's theorem. Cantor's ernary set as example of a perfect set which is now here dense.

Continuity: Continuity and uniform continuity of a function from a Metric space to a Metric space. Open and closed maps, Compact spaces and compact sets with their properties. Continuity and compactness under continuous maps.

1.24   MSc-CS-27 (Operations Research)

Introduction to Operations Research

Operation Research – An Overview: History, Approach, Techniques and Tools, Relationship Between O.R. specialist and Manager, Applications of OR., Phases and Processes of O.R., Study, Limitations of operation Research,

Review of Probability and Statistics: Random Experiment and Probability, Random variable, Probability distribution, Standard Discrete Probability distributions, Continuous Probability Distributions.

Programming Techniques – Linear Programming and Applications:

Linear Programming – Graphical Method: Formulation of a linear programming problem,

Formulation with Different types of constraints, Graphical Analysis, Graphical Solution, Multiple, unbounded solution and in-feasible problems, Application of linear programming in Business an Industry, self-Assessment Exercises.

Linear Programming – Simplex Method: Principle of Simplex Method, Computational Aspect of simplex Method, Simplex Method with Several Decision Variables, Two phase and M-Method, Multiple, unbounded solutions and infeasible problems, sensitivity Analysis, Dual Linear Programming problem.

Transportation Problem: Basic Feasible solution of a transportation problem (The North West Corner Rule, Matrix Minimum Method, Vogel Approximation Method (VAM), Modified Distribution (MODI) Method stepping store Method, Unbalanced Transportation problem, Degenerate Transportation problem, Transshipment problem, Maximization in a transportation problem,

Assignment problem: Unbalanced Assignment problem, Problem with some infeasible Assignments, Maximization in an Assignment problem. Crew Assignment problem.

Programming Techniques Further Applications:

Goal Programming: Concepts of Goal Programming, Goal Programming Model Formulation, Graphical Method of goal programming, the simplex Method of Goal Programming, Application Area of Goal Programming,

Integer Programming: Integer Programming Formulation Techniques, Unimodularity, cutting plane method, Branch and Bound.

Dynamic Programming: Dynamic Programming Methodology, Definitions and Notations, D.P. Applications.

Non-Linear Programming: Solution of a Non-linear Programming problem Convex and Concave function, KUHN TUCKER conditions for Constrained optimization, Quadratic Programming, Separable Programming.

Inventory and Waiting Line Models

Inventory Control – Deterministic Models: Inventory: An Essential Requirement, objectives of inventory, Functions of inventory, Classifications of inventory, Factors Affecting inventory, Inventory Modelling, Deterministic single item inventory models Deterministic Multi item inventory Models.

Inventory Control : Probabilistic Models: Inventory Model with probabilistic Demand, Single period probabilistic Models, Multi-period probabilistic Models, Inventory Control systems, Fixed Order, Quantity system, Periodic Review System, other variants of probabilistic Models.

Queueing Models: Characteristics of A Queueing Model, Notations and symbols, Statistical Methods, in Queueing, The M/M/I System, The M/M/C system, The M/E k /I System, Decision Problems in Queueing.

Game Theory and Simulation:

Competitive situations: Game Theory: Definitions and Explanation of some important terms saddle points, dominance, mixed strategies: Games without saddle points, 2 x n Games, Exploiting an Opponents and Mistakes.

Simulation: Reasons for using simulation, limitations of simulation, steps in the simulation process, Practical Applications of simulation, Hospital Simulation, Simulation and Inventory Control, Computer Simulation.

Case Studies

Case 1: Insulator India Limited

Case 2: Use of Operations Research Techniques: A Case Study of ECS Corporation.