<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper No.</th>
<th>Course Code</th>
<th>Title of Course</th>
<th>Credits</th>
<th>Compulsory/Elective</th>
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<tbody>
<tr>
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<tr>
<td>First Semester</td>
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<td></td>
<td>6026</td>
<td>MSc-CS-01</td>
<td>Discrete Mathematical Structure</td>
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<td></td>
<td>6027</td>
<td>MSc-CS-02</td>
<td>Introduction to Programming Language Through 'C'</td>
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<td>6028</td>
<td>MSc-CS-03</td>
<td>Digital Computer Fundamentals and Assembly Language Programming</td>
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<td>6029</td>
<td>MSc-CS-04</td>
<td>Lab-1 (Based on MSc-CS-02)</td>
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<td>Discipline-Centric Elective Course</td>
<td>6030</td>
<td>MSc-CS-05</td>
<td>Theory of Computation</td>
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<td>Elective</td>
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<tr>
<td></td>
<td>6031</td>
<td>MSc-CS-06</td>
<td>System Analysis &amp; Design</td>
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<td>Credits of First Semester</td>
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<td>Second Semester</td>
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<tr>
<td></td>
<td>6032</td>
<td>MSc-CS-07</td>
<td>Software Engineering</td>
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<td></td>
<td>6033</td>
<td>MSc-CS-08</td>
<td>Object Oriented Programming through 'C++'</td>
<td>3</td>
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<td></td>
<td>6034</td>
<td>MSc-CS-09</td>
<td>Computer Networks</td>
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<td>6035</td>
<td>MSc-CS-10</td>
<td>Lab-2 (Based on MSc-CS-08)</td>
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<td>Discipline-Centric Elective Course</td>
<td>6036</td>
<td>MSc-CS-11</td>
<td>System Software</td>
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<td></td>
<td>6037</td>
<td>MSc-CS-12</td>
<td>Object Oriented Analysis and Design</td>
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<tr>
<td>Open Electives course (Other Discipline) (Any Two paper in Second Semester)</td>
<td>6038</td>
<td>MSc-CS-13</td>
<td>Numerical &amp; Statistical Computing</td>
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<td>Elective</td>
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<td>6039</td>
<td>MSc-CS-14</td>
<td>Accountancy &amp; Financial Management</td>
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<td></td>
<td>6040</td>
<td>MSc-CS-15</td>
<td>Probability &amp; Distribution</td>
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<td>Credits of Second Semester</td>
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<td>Third Semester</td>
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<td></td>
<td>6041</td>
<td>MSc-CS-16</td>
<td>Database Management System</td>
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<td>Compulsory</td>
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<td>6042</td>
<td>MSc-CS-17</td>
<td>Operating System</td>
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<td>6043</td>
<td>MSc-CS-18</td>
<td>Core Java</td>
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<td>6044</td>
<td>MSc-CS-19</td>
<td>Lab-3 (Based on MSc-CS-18)</td>
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<td>Discipline-Centric Elective Course</td>
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### Compulsory Foundation Course

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>6045 OR 6046</td>
<td>MSc-CS-20 OR MSc-CS-21</td>
<td>4 OR</td>
</tr>
<tr>
<td></td>
<td>Computer Graphics</td>
<td>OR</td>
</tr>
<tr>
<td></td>
<td>OR Design and Analysis of Algorithms</td>
<td>4</td>
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</table>

**Elective**

### Credits of Third Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>2703</td>
<td>PGFHR Human Right and Duties</td>
<td>Non Credit</td>
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**Compulsory**

### Compulsory Core Course

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
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</thead>
<tbody>
<tr>
<td>6047</td>
<td>MSc-CS-22 (L) Practical Lab Based on MSc-CS-29</td>
<td>4</td>
</tr>
<tr>
<td>6053</td>
<td>MSc-CS-28 Principal of Programming Language</td>
<td>4</td>
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<tr>
<td>6054</td>
<td>MSc-CS-29 Web Technology</td>
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**Discipline-Centric Elective Course**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>6048 OR 6049</td>
<td>MSc-CS-23 OR MSc-CS-24 Artificial Intelligence OR Parallel Computing</td>
<td>4 OR 4</td>
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</table>

**Elective**

### Open Electives course (Other Discipline) (Any Two paper in Fourth Semester)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>6050 OR 6051</td>
<td>MSc-CS-25 OR MSc-CS-26 OR MSc-CS-27 Correlation, Regression &amp; Statistical Inference OR Mathematical Analysis OR Operation Research</td>
<td>4 OR 4 OR 4</td>
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</table>

**Elective**

### Credits of Fourth Semester

| Credits | 24 |

### Total Credits

| Credits | 80 |

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**MSc-CS-01 (Discrete Mathematics)**

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

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


**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, Sub-graphs, 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, Prims Algorithm, Computer implementation, cut vertices and connectivity, Shortest Path problems (BFS), Bintarytrees.

**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, Imageand Inverse image, I-V Fuzzy sets, Fuzzy relations.

**Lattices and Boolean Algebra:**

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

**Boolean Algebra:** Definition and important properties, sub Boolean Algebra, Atoms, Anti-atoms and irreducibles, stone Representation theorem, Boolean Expressions and their Equivalence, Minterms 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.

MSc-CS-02 (Introduction Programming Language through C)

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, Printf and Scanf 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 Scanf, 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, Extracts and files: fseek, Structs and Function and unions, The Bitwise operators.

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

**Introduction and Data Representation:** The von 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.

**Micro-programmed 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), Machine Startup.

**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

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: Complexity Notations for Growth rates of functions (The Constant Factoring Complexity Measure, Asymptotic considerations, well known Asymptotic growth Rate Notations, The Notation O, The \( \theta \) Notation, The Notation \( \omega \), The Notation W, classification of problems, Reduction, NP-Complete and NP-Hard Problems, Establishing NP-Completeness of problems.

Computability/Decidability: 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
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).


**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


**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 Modeling, Data Modeling (ER Diagram), Process specification Tools (Decision Tables, Decision Trees, Structured English Notation), Data Dictionary.

More Design Issues and Case Tools

**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 Maintenance of 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.

**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:** Project Planning and Control Project planning and control, Project Scheduling, Project Standards, Project outsourcing.


**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, Re-application 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, ObjectOrientedProgramming), using the Methodology, Choosing the Right Methodology, Implementing a Methodology, Current Generation of Software Development tools, Considerations in Application Development.


**MSc-CS-08 (Object Oriented Programming through 'C++')**

**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 and information 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 and files.

**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.

**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 Sub layer.

**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) Telnet.

**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.


**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


Memory Management: Introduction, single process monitor, Multiprogramming with Fixed partitions, Multiprogramming with dynamic partitions, Paging Address mapping in a paging


**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-GETTING 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 II**
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.

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


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, SunandNi'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.

**MSc-CS-13 (Numerical and Statistical Computing)**

**BLOCK-1 Numerical Computing-I**

Unit 1 Floating Point Arithmetic and Errors, Floating Point Representation, Sources of Errors, Propagated Errors.
Unit 2 Solution of Non-Linear Equations, Bisection Method, Regula-Falsi Method, Secant Method, Newton-Raphson Method, Successive Iteration Method.


**BLOCK-2 Numerical Computing-II**

Unit 1 Interpolation Differences – Forward and Backward Differences, Newton’s – Forward and Backward Difference Formulas, Lagrange’s Interpolation.

Unit 2 Numerical Integration Newton – Cotes Formulas, Composite Formulas, Gaussian Quadrature.

Unit 3 Numerical Solution of ODE, Euler's Method, Runge Kutta Method.

**BLOCK-3 Statistical Computing**

Unit 1 Probability Distribution: Discrete Distribution, Binomial Distribution, Poisson Distribution, Continuous Distribution, Uniform Distribution, Exponential Distribution, Normal Distribution, Chi-square Distribution

Unit 2 Pseudo Random Number Generation: Uniform Distribution, Method of Generation (Discrete Case), Inversion Method (Exponential Distribution), Acceptance and Rejection.

Unit 3 Regression: Linear Regression Model, Least Square for Parameter Estimation, Goodness-of-Fit, Residual Analysis, Non-Linear Regression.

**MSc-CS-14 (Accountancy And Financial Management)**

**Accounting Framework**

**Accounting and its 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 Controlling 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


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.


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


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

Budgeting and Budgetary Control


Financial Decisions

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.
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.


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

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: Enterprise Wide Information System of the Times of India Group (A Case Study) Introduction, organization and The operating environment unique nature of The 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.

**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:** 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.

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**MSc-CS-18(Core Java)**

**Fundamentals of Java Programming**

**Introduction to Java:** Applets and Applications, JAVA Buzzwords, The JAVA Plate form, 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, Sub classing, 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.

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**MSc-CS-20(Computer Graphics)**

media Technology, Audio System, Image Compression, Data Compression, Digital Motion Video, Authoring tools, Multimedia Applications, Multimedia DBMS.

MSc-CS-21 (Design and Analysis of Algorithms)


**SOME PRE-REQUISITES AND ASYMPTOTIC BOUNDS Structure**: 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 $\omega$, The $\theta$ Notation, The Notation $o$, The Notation $\omega$.


**GRAPH ALGORITHMS**: Introduction, Objectives, Examples, NIM/ Marien
bad 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


**GREEDY TECHNIQUES**

**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).


**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.


**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 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.

**MSc-CS-24(Parallel Computing)**

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


**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)


**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 Programme 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, SunandNi’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

**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 estimator, Consistency, Unbiasedness, 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


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.

Fourierseries: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 ternary 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.

MSc-CS-27(Operation 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,


**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 and 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 Modeling, 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.


**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.

**MSc-CS-28 (PRINCIPLES OF PROGRAMMING LANGUAGES)**

**Block 1:** Importance of programming languages, brief history and features, attributes of good programming language, binding and binding time.

**Block -II:** Elementary and structured data types, their specifications, representations and Implementation of numbers, vectors and arrays, record, character string, variable data size, data structure, sets, input files, Encapsulation and information hiding, sub programs, Type definition and abstract data types, Implicit and explicit sequence control, Recursive sub-programs, exception and exception handlers, Co-routines and scheduled subprograms, task and concurrency exception, Name and reference environment, static dynamic block structure.

**Block III:** local data and local referencing environments, Dynamic and static scope of shared data, Block structure, parameters and their transmission, Task and shared data storage requirement for major runtime elements, Program and system controlled storage management, Static and stack based storage management, Fixed size and variable size heap storage management.
MSc-CS-29 (Web Technology)

Block - I
History of the Internet and World Wide Web - III ML 4 protocols - RCM, SMTP, POP), MIME, IMAP. Introduction to JAVA Scripts - Object Based Scripting for the web, Structures - Functions - Arrays - Objects.

Block - II

Block - III

Block - IV
Introduction, Servlet, Overview Architecture - Dandling II P Request - Go and post request - redirecting request multi-tier applications - ISP - Overviews - Objects - scripting - Standard Actions - Directives. Brief survey of Web 2.0 technologies, introduction to Semantic web and other current technologies