ALIGARH MUSLIM UNIVERSITY, ALIGARH

FACULTY OF SCIENCE

SYLLABUS FOR

M.SC. (COMPUTER SCIENCE)

There shall be one objective type paper of 100 marks comprising 100 Questions with the following breakup:

Digital Logic and Computer Architecture: Number System, Integer and Floating Point representations, Addition and subtraction of signed and unsigned numbers, Multiplication and division of signed and unsigned numbers, CISC and RISC characteristics, Cache memory-Organization and Structure, Cache mapping algorithms, Cache replacement policies, Input/Output techniques, Logic gates, K-map, Product-of-Sums, Combinational Circuits, Binary Adder-Subtractor, Decimal Adder, Binary Multiplier, Multiplexer, Sequential Circuits, Latches, Flip-Flops, Finite state machine.

***Programming concepts*:** C, C++, Java, Python, arithmetic, logical, bitwise and conditional operators, Data, Expressions, Statements, Control Flow, iteration, Functions, Lists, Tuples, Dictionaries, Files, Modules, Packages, Object oriented programming concepts.

Data structures and Algorithms: Arrays, stacks, queues, linked lists, trees, binary search trees, binary heaps, graphs, searching, sorting, time and space complexity, algorithm design techniques: greedy, dynamic programming and divide-and-conquer, linear search, binary search.

Operating System: Operating System and its function, Instruction Execution, Interrupts, Memory Management, Scheduling, etc. Case study of Linux/Unix OS.

Database Management System: Database Systems Concepts & Architecture, Data Models, Schemas & Instances, DBMS Architecture & Data Independence, Database Languages & Interfaces, Data modeling using the Entity-Relationship Approach, Relational Database Design: Function Dependencies & Normalization for Relational Databases, Functional Dependencies, Normal forms based on primary keys (INF, 2NF, 3NF & BCNF), Loss less join & Dependency preserving decomposition, SQL, PL-SQL, Database Security.

Discrete Structures: Set theory, algebraic structures, groups, rings, partially ordered sets, Lattice and Hasse Diagram, propositional and predicate logic, Recurrence relations, graph theory (isomorphism/paths), transport networks, regular languages and grammars, Chomsky Classification of grammars, Finite-state Machines.

Analysis & Design of Information System: System Development Life Cycle, Tools used by System Analyst, Data Flow Diagrams, Feasibility Study and Cost Estimation: Cost-Benefit Analysis. System development life cycle SSAD vs OOAD Unified Process Object orientation, UML Building Blocks and diagrams, System Design, Design Patterns, Software testing and maintenance.

Data Communication and Computer Networks: Fundamentals of Data Communication and Networks; Network models: OSI Model, Peer-to-peer processes, Interfaces, Layers in OSI model, TCP/IP model-Architecture, Layers in TCP/IP model, Similarities; Addressing: Physical, logical and port addressing. Signals: Analog and digital signals: Digital-to-Digital conversion: Line coding schemes; Analog-to-Digital conversion: Modulation and Demodulation; Multiplexing; Wired Media: Magnetic media, Twisted wire-pair, Co-axial Cable, Fiber optics; Wireless media: Infrared, Radio and Microwave Transmission; Satellite Communication: Orbits, Footprints, GEO, MEO and LEO; Error detection and correction; LAN technologies, Cloud and IoT concepts.

Cyber Security: Symmetric and Asymmetric key Cryptography, Application of Cryptography, Network and Internet Security, Software and Web Threats, Digital Signatures, Cybercrime and Law.

Artificial Intelligence and Machine Learning: Artificial Intelligence, AI search techniques, Machine learning, Supervised and unsupervised learning, regression and classification algorithms, clustering algorithms, ML models and algorithms, performance metrics, dealing with text, images and audio, AI/ML tools and libraries.

Web Engineering: Concepts, Principles, Framework, Component. Tools and Technology, Web Engineering Best Practices, Web Engineering Process, Web development tools such as HTML, PHP, MySQL, JavaScript, CSS, and HTML5, Jquery, Ajax and XML. Open-source tools.

Data Science: Data Science pipelines and stages: collection, storage, description, Exploratory Data Analysis (EDA), model evaluation, Major python libraries and frameworks, Public datasets.

Research Methodology and Research Ethics: Overview, types and basic steps, Literature review, Research proposal design, scientific research analysis, research tools and techniques, Academic Ethics.

Algebra: Review of relevant properties of matrices as transformations; Orthogonal transformations; Matrix and Vector Norms, Eigenvalues, Eigenvectors and Eigenvalue problems in dimensionality reduction: the power method, the bisection method, and the QR method From Gauss to LU factorization, Positive definite matrices and Cholesky factorization, Tensor decomposition; and matrix approximations via clustering; Sparse linear algebra: Sparse matrices and sparse solutions.

Binary operations, Definition of group with examples and elementary properties, Subgroups. Order of group, Statement of Lagrange's theorem. Homomorphism of

groups, Kernel of Homomorphism, Definition of isomorphism, Introduction to rings, subrings and fields with examples and elementary properties, Galios fields, Polynomial arithmetic, Elliptic curve arithmetic, Vector spaces. Subspaces, sum of subspaces, Span of a set, Linear dependence and independence, dimension and basis, dimension theorem, Linear transformation and its properties, range and kernel of a linear transformation, rank and nullity of linear transformation, Rank-nullity theorem, inverse of linear transformation.

Number Theory: The number system, Mathematical Induction, Divisibility, Greatest Common Divisors, Euclidean Algorithm, Prime Numbers, Theory of Congruence, etc.

Numerical Computing: Numerical Differentiation and Integration, Solutions of Transcendental and Simultaneous Linear Equations, Interpolation and Approximation:

Descriptive Statistics: Measures of central tendency, Dispersion, Skewnes and Kurtosis, Scatter diagram, Correlation coefficient, Rank correlation, Spearman's and Kendall's measures, Multiple correlations in three variables, Partial correlation in three variables, Regression lines, Regression coefficient and Principal of least squares and curve fitting

Probability Theory: Definition of probability, Discrete and Continuous sample space, Events, Independent and Mutually Exclusive Events, Random Experiment, Conditional Probability, Baye's theorem and its application, Random Variables, mathematical expectation, Chesbyshev's inequality.

Probability Distributions: Uniform, Binomial, Poisson, Geometric, Hypergeometric, Normal Exponential Gamma and Beta Distribution, their means, variances and other properties.