

**Department of Mathematics**  
**Faculty of Natural Science**  
**Jamia Millia Islamia, New Delhi-25**

**Syllabus of P.G. (Semester – I)**

**M.Sc. Mathematics with Computer Science, Semester – I**

<b>S. No.</b>	<b>Code</b>	<b>Title</b>	<b>Unit</b>	<b>Credit</b>
1	MTM-1.1	<a href="#"><u>Real Analysis</u></a>	4	4
2	MTM-1.2	<a href="#"><u>Abstract Algebra</u></a>	4	4
3	MTM-1.3C <sub>1</sub>	<a href="#"><u>Discrete Mathematical Structures</u></a>	4	4
	MTM-1.3C <sub>2</sub>	<a href="#"><u>Computer Organization and Architecture</u></a>	4	4
4	MTM-1.4	<a href="#"><u>Computer Fundamentals &amp; C Programming</u></a>	4	4
5	MTM-1.5	<a href="#"><u>Numerical Analysis</u></a>	4	4
6	<i>Lab-I</i>	<i>Programming in C</i>	-	2

## M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.1	Real Analysis	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

**Unit-I** Outer and inner Lebesgue measure, Lebesgue measurable sets, Properties of measurable sets, Borel sets and their measurability, Non-measurable sets, Cantor's ternary sets and their properties.

**Unit-II** Measurable function, Characteristic function, Step function, Continuous function, Set of measure zero, Borel measurable function, The structure of measurable function.

**Unit-III** Riemann integral and its deficiency, Lebesgue integral of bounded function, Comparison of Riemann and Lebesgue integrals, Properties of Lebesgue integral for bounded measurable function, The Lebesgue integral for unbounded functions, Integral of non-negative measurable functions, General Lebesgue integral, Improper integral.

**Unit-IV** Point wise convergence, Convergence almost everywhere, Uniform convergence almost everywhere, Convergence in measure, F. Reisz's theorem on convergence a.e., D.F. Egoroff's theorem, Lebesgue bounded convergence theorem, Lebesgue dominated convergence theorem, Fatou's lemma, Monotone convergence theorem.

$L^p$ -space, Properties of  $L^p$ -space, Holder's inequality, Minkowski's inequality and Schwartz's inequality, Convergence in the mean, Riesz-Fischer theorem.

### References:

1. Royden, H.L., Real Analysis (2nd ed.) The Macmillan Co., new York (1968)
2. Jain, P.K. & Gupta V.P., Lebesgue measure and Integration Willey Eastern Ltd., New Age Int. Ltd., New Delhi, (1994)
3. Inder K. Rana, An Introduction to measure and integration, Narosa Publishing House, Delhi, (1997)
4. D. Somasundaran, A Second Course in Mathematical Analysis, Narosa Publishing House, N.Delhi, (2010)

## M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.2	Abstract Algebra	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

**Unit-I** Groups, order of an element of a group, Subgroups, Cyclic groups, Cosets, Normal subgroups, Quotient groups, Homomorphisms, Isomorphisms Permutation groups.

**Unit-II** Cayley's Theorem, Automorphisms, Normalizer and centre, Conjugate classes, Class equation and its applications, Direct products, Sylow's theorems, Finite abelian groups, Normal Series and Solvable Groups.

**Unit-III** Rings, Subrings, Ideals, Integral Domain and their properties, Quotient Rings, Ring Homomorphisms, Isomorphisms, Ring of Polynomials and their properties.

**Unit-IV** Principal Ideal Domain, Euclidean Domain, Unique Factorization Domain, Primitive Polynomials, Gauss' lemma, Eisenstein's criterion for Irreducibility.

### References:

1. I. N. Herstein, Topics in Algebra, John Wiley & Sons. 2006.
2. Surjeet Singh and Qazi Zameeruddin, Modern Algebra, Vikas Publications., 2003.
3. N. Jacobson, Basic Algebra Vol I & II (2<sup>nd</sup> Edition), Dover Books on Mathematics. 1984.
4. D. A. R. Wallace, Groups, Rings and Fields, Series: Springer Undergraduate Mathematics Series, 2001.
5. N. H. McCoy: Theory of rings, Chelsea Pub. Co., 1973.

## M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.3C <sub>1</sub>	Discrete Mathematical Structures	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

**Unit-I** Relations and Functions, Equivalence Relations, Partial Order, Recurrence Relations, Solutions of Linear homogeneous Recurrence Relations, Introduction to Mathematical Logic, Propositional Calculus.

**Unit-II** Lattices and Boolean algebra, Boolean Functions, Cononical Form (Disjunctive Normal Form) of a Boolean function, Karnaugh Maps.

**Unit-III** Graphs and their representations, Walk, Path, Cycle, Circuit, Eulerian Graphs, Connected Graphs, Planar Graphs, Trees, Spanning trees, Binary Tree Traversals.

**Unit-IV** Linear codes, Hamming Code, Generator and parity check matrix, Hamming distance standard array and Syndrome decoding, introduction to cyclic codes.

### References:

1. Discrete Mathematics, K.A. Ross, Charles R.W. Wright, Prentice Hall Inc.
2. Discrete Mathematical Structure for Computer Sciences, Bernard Kolman / Robert C. Bus, Prentice Hall of India.
3. Theory of Error Correcting Codes, F.J. Mac. Williams / N.J.A.Sloane, North Holland Pub. Co.
4. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, Prentice Hall of India.

## M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.3C <sub>2</sub>	Computer Organization and Architecture	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

**Unit-I** Number Systems, Binary Arithmetic, Fixed-point and Floating-point representation of numbers, Codes, Complements, Character Representation – ASCII, EBCDIC. Boolean Algebra: Basic Definitions, Axiomatic definition of Boolean Algebra, Basic theorems and Properties of Boolean Algebra, Boolean functions, Canonical and Standard Forms.

**Unit-II** Basic Gates – AND, OR, NOT, Universal Gates – NAND, NOR, Other Gates – XOR, XNOR etc. NAND, NOR implementations of digital circuits, Simplification Of Boolean Expressions: Formulation of simplification problem, Karnaugh Maps, Minimal, Combinational Logic Design Procedure, Adders, Subtractors, Code Conversion, Decimal Adder, Magnitude Comparator, Decoders, Encoder, Multiplexers, De-multiplexer.

**Unit-III** Flip-Flops, Clocked RS, D type, JK, T type, State table, state diagram and state equations. Flip-flop excitation tables. Design Procedure, Design of sequential circuit and Counters, Shift registers, Synchronous Counters.

**Unit-IV** Primary Memory, Secondary memory, Cache memory, Memory Hierarchy, Basic architecture of computer, Bus structures, Von Neumann concept. Overview of Microprogramming, Addressing modes, Pipelining, Synchronous and Asynchronous Data transfer, DMA data transfer.

### References:

1. M.Morris Mano : Computer System Architecture, Prentice Hall of India.
2. William Stalling, “Computer Organization and Architecture” Pearson Education 15 / 36 V.
3. Andrew S. Tanenbaum, Structured Computer Organization, Prentice Hall of India Pvt. Ltd.
4. J. P. Hayes “Computer Architecture and Organization” McGraw Hill Education India.
5. M. Morris Mano, ‘Computer Engineering Hardware Design’, PHI.
6. V.Rajaraman, T. Radhakrishnan, An Introduction to Digital Computer Design, Prentice Hall of India Pvt. Ltd.
7. Nicholas Carter, Schaum’s Outlines Computer Architecture, Tata MH.
8. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, “Computer Organization”, 5th Edition, Mc Graw-Hill Education India
9. M.Morris Mano, ‘Digital Logic and Computer Design’, PHI. 10. Donald e Givone, Digital principles and Design, TMH (Unit II and V)
10. Donald e Givone, Digital principles and Design, TMH (Unit II and V)

## M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.4	Computer Fundamentals & C Programming	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

**Unit-I** Introduction to Computers, Program, Software, Algorithms, Flow Charts. Introduction to C, Character Set, C Token, Identifier & Keyword, Constants, Variables, Data Types, Data Declaration & Definition, Operators & Expression - Arithmetic, Relational, Logical, Increment & Decrement, Bit wise, Assignment, Conditional.

**Unit-II** Precedence & Associativity of Operators, Type Conversions - Implicit and Explicit, Console I/O, Control and Selection Statements - If, Nested if, if-else-if, The Alternative -Conditional Expression, Switch, Nested Switch, Iteration Statements for loop, while loop, do-while loop, break, continue, goto statements. Single dimensional and Multi-dimensional Arrays - Accessing array elements, Initializing an array, Strings using arrays.

**Unit-III** Pointers – Introduction, Declaration of Pointer, Initializing Pointer, De-referencing Pointer, Pointer to Pointer, Array of Pointers, Strings using pointers.

Introduction to functions, User-Defined Function, Function Prototype, Definition of Function, Arguments & local variables, Returning and Calling Function by reference & Call by value, Passing Arrays & Strings to Function, Returning Multiple Values, Recursive Functions.

**Unit-IV** Storage Class & Scope, Structures, Declaration and Initializing Structure, Accessing Structure members, Structure, Assignments, Arrays of Structure, Passing Structure to function, Structure Pointer, Unions, Enumeration, File handling: Introduction, Opening a File, Closing a File, Input/ Output Operations on Files, Command Line Arguments.

### References:

1. Sinha, P.K. & Sinha, Priti, “Computer Fundamentals”, BPB, 2007.
2. Rajaraman, V., “Fundamentals of Computers”, PHI, 2010.
3. E Balaguruswamy, Programming in ANSI C, Tata McGraw Hill, 2011.
4. Gottfried, Byron S., Programming with C, Tata McGraw Hill, 2011.
5. Yashwant Kanetker, Let us C, BPB, 2007.
6. Yashwant Kanetker, Pointers in C, BPB, 2007.
7. R G Dromey, How to Solve by Computer, Pearson Education, 2007.
8. Deitel & Deitel, C: How to Program, Pearson Education, 2003.

## M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.5	Numerical Analysis	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

**Unit-I** Newton-Raphson method for Complex roots, Solution of system of nonlinear equations by Seidal Iteration method, Newton-Raphson method. Lagrange's form of interpolating polynomial, Existence and uniqueness of interpolating polynomial, Hermite, Piecewise and Cubic spline interpolation.

**Unit-II** Approximation: Weighted least squares approximation, Method of least squares for continuous functions, Gram-Schmidt orthogonalization process, Approximation of functions using Chebyshev polynomials. Numerical integration: Romberg's method, Guass Quadrature formula and error estimation.

**Unit-III** Numerical solution of Initial Value Problems: Runge-Kutta method of order four for system of equations, second and higher order differential equations, Boundary Value problems by Shooting method, Finite difference method, Convergence of finite difference scheme, Stability Analysis.

**Unit-IV** Numerical solution of partial differential equations: Parabolic equations- explicit methods and Crank-Nicolson method with stability analysis. Elliptic equations- Standard five point formula, Jacobi's iteration method and Leibmann's method, Hyperbolic equations: Explicit finite difference method.

### References:

1. Gerald & Wheatlay: Applied Numerical Analysis, Pearson.
2. M. K. Jain, S.R.K Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering Computations*, New Age Int., New Delhi.
3. G.D. Smith, *Numerical Solutions of Partial Differential Equations*, Clarendon Press Oxford.
4. S.D. Conte & Carl De Boor, *Elementary Numerical Analysis*, McGraw Hill, NY
5. Naseem Ahmad, *Fundamentals Numerical Analysis with error estimation*