

CURRICULUM

For

POSTGRADUATE DEGREE COURSE IN

BASIC SCIENCES **M.Sc. (MATHEMATICS)** (First Year)

[Proposed from 2018-19]



IIMT UNIVERSITY
MEERUT

IIMT University, Meerut

IIMT UNIVERSITY, MEERUT**Study and Evaluation Scheme M. Sc. in Mathematics****First Year, First Semester**

<i>S. No</i>	<i>Course Code</i>	<i>Subject</i>	<i>Periods</i>			<i>Credit</i>	<i>Evaluation Scheme</i>		
			<i>L</i>	<i>T</i>	<i>P</i>		<i>Internal</i>	<i>External</i>	<i>Total</i>
1	MSM-101	Theory of Ordinary Differential Equations	4	1	-	4	30	70	100
2	MSM-102	Advanced Real Analysis	4	1	-	4	30	70	100
3	MSM-103	Topology	4	1	-	4	30	70	100
4	MSM-104	Advanced Abstract Algebra	4	1	-	4	30	70	100
5	MSM-105	Fundamentals of Computers	4	1	-	4	30	70	100
6	ECC-111/112/113/114	<i>Skill Enhancement Course</i>			2	4	-	100	100
		Total	16	4	-	16	150	450	600

IIMT UNIVERSITY, MEERUT**Study and Evaluation Scheme M. Sc. in Mathematics****First Year, Second Semester**

S. No	Course Code	Subject	Periods			Credit	Evaluation Scheme		
			L	T	P		Internal	External	Total
1	MSM-201	Numerical Analysis	4	1	-	4	30	70	100
2	MSM-202	Complex Analysis	4	1	-	4	30	70	100
3	MSM-203	Probability & Statistics	4	1	-	4	30	70	100
4	MSM-204	Discrete Mathematics	4	1	-	4	30	70	100
5	ECC- 211/212/213/214	Skill Enhancement					100	-	100
		Total	16	4	-	16	220	280	500

Syllabus - Mathematics
Course - Master of Science (M.Sc.)
M.Sc. (1st Semester)

Paper Name – Theory of Ordinary Differential Equations	L	T	P	C	
Paper Code - (MSM-101)		4	1	0	4

Unit I **(09 Lectures)**

Existence, uniqueness and continuation of solutions of a differential equation and system of differential equations. Differential and integral inequalities. Fixed point methods.

Unit II **(09 Lectures)**

Linear systems, properties of homogeneous and non-homogeneous systems, behaviour of solutions of nth order linear homogeneous equations.

Unit III **(09 Lectures)**

Review of power series, Power series solution of second order homogeneous equations, ordinary points, regular singular points, solution of Gauss hypergeometric equations, Hermite and Chebyshev polynomials.

Unit IV **(09 Lectures)**

Boundary value problems for second order differential equations, Green's function and its applications. Eigen value problems, self adjoint form, Sturm –Liouville problem and its applications.

Unit V **(09 Lectures)**

Autonomous systems, phase plane and its phenomenon, critical points and stability for linear and non linear systems, Liapunov's direct method, periodic solutions, limit cycle, the Poincare-Bendixson theorem.

RECOMMENDED BOOKS:

1. Braun, M. "Differential Equations and Their Applications", 4th Ed., Springer 2011
2. Brauer, F. and Nohel, J.A., "The Qualitative Theory of Ordinary Differential Equations", Dover Publications 1989
3. Coddington E.A., "Ordinary Differential Equations", Tata McGraw Hill 2002
4. Deo, S.G., Lakshmikantham, V., and Raghvendra, V., "Text Book of Ordinary Differential Equations", 2nd Ed., Tata McGraw Hill 2010
5. Simmons G.F., "Ordinary Differential Equations with Applications", Tata McGraw Hill 2003

M.Sc. (1st Semester)

Paper Name – Advanced Real Analysis	L	T	P	C
Paper Code - (MSM-102)	4	1	0	4

Unit I (09 Lectures)

Real number system, ordering, bounded sets, order completeness axiom, mathematical induction, well ordering principle; Archimedian property, Dedekind's theorem, complete ordered field, limit point of a set, Bolzano-Weierstrass theorem, open and closed sets, compact sets and Heine-Borel theorem.

Unit II (09 Lectures)

Sequences, Cauchy's first and second limit theorems, Cauchy sequences, Cauchy criterion for convergent sequences, bounded and monotonic sequences, Euler's constant, subsequences, limit superior and limit inferior. Series of real valued functions and their Tests for convergence.

Unit III (09 Lectures)

Limit and continuity, uniform continuity, monotonic functions, functions of bounded variation, absolutely continuous functions, Taylor's theorem (finite form), Lagrange's form of remainder.

Unit IV (09 Lectures)

Sequences and series of real valued functions, their point-wise, absolute and uniform convergence, Cauchy's general principle of uniform convergence, continuity of the limit (sum) function, differentiation and integration of the sequences and series of functions, Weierstrass approximation theorem.

Unit V (09 Lectures)

Riemann integration, Darboux's theorem, necessary and sufficient conditions for integrability, functions defined by integrals, fundamental theorem of calculus, first and second mean value theorems of integral calculus

RECOMMENDED BOOKS:

1. Walter Rudin, Principles of Mathematical Analysis, (3rd edition) McGraw-Hill, Kogakusha, 1976, International student edition.
2. T. M. Apostol, Mathematical Analysis, Narosa Publishing, New Delhi, 1985.
3. J. White, Real Analysis, An Introduction, Addison-Wesley Publishing, Co. Inc., 1968.
4. H. L. Royden, Real Analysis, (4th Edition), Macmillan Publishing Co. Inc. New York,

M.Sc. (1st Semester)

Paper Name – TOPOLOGY	L	T	P	C
Paper Code - (MSM-103)	4	1	0	4

Unit I (09 Lectures)

Definition and examples of topological space, Closed sets, Closure, Dense subset, Neighborhoods, interior, exterior, boundary and accumulation points, Derived sets, Bases and sub-bases. Subspaces, product spaces and relative topology.

Unit II (09 Lectures)

Continuous functions, homeomorphisms, the pasting lemma, Connected and disconnected sets, connectedness on the real line, components, locally connected spaces.

Unit III (09 Lectures)

Countability axioms – First and second countable spaces, Lindelof's theorems, Separable spaces, second countability and separability.

Unit IV (09 Lectures)

Separation axioms – T_0 , T_1 , T_2 , T_3 , $T_3(1/2)$, T_4 , their characterizations and basic properties. Urysohn's lemma and Tietze extension theorem, Statement of Urysohn's metrization theorem.

Unit V (09 Lectures)

Compactness – Continuous functions and compact sets, basic properties of compactness, compactness and finite intersection property, sequentially and countably compact sets, local compactness and one point compactification. Statements of Tychonoff's Product theorem and Stone-Čech compactification theorem.

RECOMMENDED BOOKS:

1. J. R. Munkres, Topology, A First Course, PHI Pvt. Ltd., N. Delhi, 2000.
2. G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill Book Company, 1963.
3. J. Dugundji, Topology, Allyn and Bacon, 1966 (Reprinted in India by PHI).
4. S. Willard, General Topology, Addison-Wesley, Reading, 1970.
5. K D Joshi, Introduction to General Topology, Wiley Eastern Ltd., 1983

M.Sc. (1st Semester)

Paper Name – Advanced Abstract Algebra	L	T	P	C	
Paper Code - (MSM-104)		4	1	0	4

Unit-I (09 Lectures)

Group theory: Definition and some examples of groups, some preliminary lemmas, subgroups, a counting principle, normal subgroups and Quotient groups..

Unit-II (09 Lectures)

Homomorphisms, automorphisms, Cayley's theorem, permutation groups, Sylow's theorems.

Unit-III (09 Lectures)

Ring theory: Definition and examples of Rings, some special classes of Rings, homomorphisms, Ideal and Quotient rings, Maximal Ideal, Integral domain, Principal Ideal domain, unique factorization domain.

Unit-IV (09 Lectures)

Definition of field and some examples, the field of Quotients of an Integral domain, Euclidean rings, polynomial rings..

Unit-V (09 Lectures)

Field Extensions, Algebraic extensions, Splitting fields and algebraic closures, Normal and separable extensions.

RECOMMENDED BOOKS:

1. N. Herstein, Topics in Algebra, New Age International (P) Limited, New Delhi
2. N. Jacobson, Basic Algebra Vols. I &II, W.H. Freeman. 1980
3. S. Lang, Algebra, 3rd Edition, Pearson Education Asia, New Delhi
4. I. S. Luther and IBS Passi, Algebra, Vol. I-Groups, Vol.-II Rings Narosa Publishing House (Vol. I-1996 Vol. II-1996)
5. J. B. Fraleigh, A First Course in Abstract Algebra, Narosa Publishing House, New Delhi.
6. S. K. Jain, A. Gunawardena and P. B. Battacharya, Basic Linear Algebra with

M.Sc. Chemistry I Year: I Semester

Course	Code:	MSM-105	L	T	P
FUNDAMENTALS OF COMPUTERS			4	1	0

1. Introduction**8Hrs.**

Computer: Definition, Characteristics, Applications, Components of Computer System, Storage Devices, Memory; Classification of Computers; **Computer Languages:** High Level, Low Level and Assembly Languages, Translators-Compiler, Interpreter, Assembler, Concept of Editor; Linker and Loader

2. Basic Fundamental of Programming in C**12Hrs.**

Elements of the computer language. Constants and variables. Operations and symbols. Expression Arithmetic assignment statement input and output. Conditional Statements: if statement and nesting if and if-else statement,. Program loops and iterations: use of while, do while and for loops, multiple loop variables, use of break and continue statements.

3. Implementation to the numerical methods**12Hrs**

System of linear equations Gaussian elimination method with pivoting, LU Decomposition methods, Jacobi's iterative method, Gauss-Seidel method, **Solutions of non-linear equations** Bisection method. Newton-Raphson method, Secant method, Regula Falsi method.

4. Uses of Computer and Internet**8Hrs.**

Introduction to MS Office (MS Word, MS Excel, MS Power Point). Lab sessions based on MS Office package, Basic of Computer networks; LAN, WAN; Concept of Internet; Applications of Internet; connecting to internet; What is ISP; Knowing the Internet; Basics of internet connectivity related troubleshooting, World Wide Web; Web Browsing software's, Search Engines; Understanding URL; Domain name; IP Address

Books Suggested:

1. Computers and Common Sense, R. Hunt and J. Shelly, Prentice Hall.
2. Fortran 77, V. Rajaraman, Prentice Hall (India), New Delhi.
3. Computational Chemistry, A.C. Norris.
4. John H. Mathews, Numerical Methods for Mathematics, Science and Engineering, (Prentice Hall International, 2003)
5. Steven C. Chapra and Raymond P. Canale, Numerical Methods for Engineers, (McGraw Hill International Edition, 1998)

M.Sc. (2nd Semester)

Paper Name – Numerical Analysis

L	T	P	C	
	4	1	0	4

Paper Code - (MSM-201)

Unit I**(09 Lectures)**

Errors in computation- Floating point representation of numbers, Significant digits, Rounding and chopping a number and error due to these absolute and relative errors, Computation of errors using differentials, Errors in evaluation of some standard functions, Truncation error. Linear equations-Gauss elimination method, LU Decomposition method, Gauss-Jordan method, Tridiagonal system, Inversion of matrix, Gauss-Jacobi method, Gauss-Seidal method.

Unit II**(09 Lectures)**

Nonlinear equations-Iterative method, Bisection method, Method of false position, its convergence, Secant method, Newton-Raphson method, Convergence of Newton-Raphson method for simple and multiple roots,

Unit III**(09 Lectures)**

Interpolation-Some operators and their properties, Finite difference table, Error in approximating a function by polynomial, Newton forward and backward Difference formulae, Gauss forward and backward formulae, Stirling's and Bessel formulae, Lagrange's method, Divided differences and Newton's divided difference formula.

Unit IV**(09 Lectures)**

Numerical differentiation and integration-Differentiation methods based on Newton's forward and backward formulae, Differentiation by central difference formula, Integration- Methodology of numerical integration, Rectangular rule, Trapezoidal rule, Simpson's 1/3rd and 3/8th rules, Gauss-Legendre quadrature formula.

Unit V**(09 Lectures)**

Ordinary differential equations- Initial and boundary value problems, Solutions of Initial Value Problems, Picard's method, Taylor's method, Single and multistep methods, Euler's and Modified Euler's method, Runge-Kutta second order method and statement of fourth order, Milne's method, Adams-Bashforth method.

RECOMMENDED BOOKS:

1. Radhey S. Gupta, Elements of Numerical Analysis, Macmillan India Ltd. New Delhi (2009).
2. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computations, New Age International (P) Ltd. New Delhi (2003).
3. James B. Scarborough, Numerical Mathematical Analysis, , Oxford- IBH, India
4. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.

M.Sc. (2nd Semester)

Paper Name – Complex Analysis
Paper Code - (MSM-202)

L	T	P	C	
	4	1	0	4

Unit I**(09 Lectures)**

Functions of a complex variable. Complex integration. Limits, continuity, uniform continuity, differentiability and analyticity of functions. Cauchy-Goursat Theorem. Cauchy's integral formula. Higher order derivatives. Morera's Theorem. Cauchy's inequality and Liouville's theorem The fundamental theorem of algebra. Taylor's theorem. Maximum modulus principle. Schwarz lemma.

Unit II**(09 Lectures)**

Bilinear transformations, their properties and classifications. Definitions and examples of conformal mappings Meromorphic functions. The argument principle. Rouché's theorem. Inverse function theorem.(Statement only).

Unit III**(09 Lectures)**

Laurent's series. Isolated singularities. Residues. Cauchy's residue theorem. Evaluation of integrals. Branches of many valued functions with special reference to $\arg z$, $\log z$ and z^a .

Unit IV**(09 Lectures)**

Weierstrass' factorization theorem. Gamma function and its properties. Riemann zeta function. Riemann's functional equation. Runge's theorem. Mittag-Leffler's theorem. Analytic continuation. Uniqueness of direct analytic continuation. Uniqueness of analytic continuation along a curve. Power series method of analytic continuation.

Unit V**(09 Lectures)**

Canonical products. Jensen's formula. Poisson-Jensen formula. Hadamard's three circles theorem. Order of an entire function. Exponent of Convergence. Borel's theorem. Hadamard's factorization theorem.

RECOMMENDED BOOKS:

1. J. B. Conway, Functions of One Complex Variable, Springer-Verlag, International student Edition, Narosa Publishing House, 1980.
2. L.V. Ahlfors, Complex Analysis, McGraw-Hill, 1979
3. H. A. Priestly, Introduction to Complex Analysis, Clarendon Press, 1990
4. R.V. Churchill, Complex Variable and Applications, McGraw Hill

M.Sc. (2nd Semester)

Paper Name – Probability & Statistics	L	T	P	C		
Paper Code - (MSM-203)			4	1	0	4

Unit I (09 Lectures)

Probability: Set theoretic approach, Baye's theorem, Geometric probability, Random experiments, Sample spaces, Random variables, Distribution functions, Joint probability distribution function, Conditional distribution function, Transformation of one and two dimensional Random variables, Mathematical expectation : Covariance, Variance of variables, Chebysheff's inequality.

Unit II (09 Lectures)

Moment generating function, Cumulant generating function and cumulants, Applications and why they are used, Discrete distributions: Geometric, Binomial, Poisson and uniform distributions, Continuous distributions : Normal, Exponential, Gamma, Chi-square ,t , F, Beta , and uniform on an interval.

Unit III (09 Lectures)

Central limit theorem and applications (1) for a sequence of independent, identically distributed random variables (2) to establish normal approximations to other distributions, and to calculate probabilities, Statistical inference and sampling distribution.

Unit IV (09 Lectures)

Correlation and regression: Partial and multiple correlations, Correlation coefficients, rank correlation, Regression lines and its properties.

Unit V (09 Lectures)

Test of significance: (1) Null and alternative hypotheses, Simple and composite hypotheses, Errors, Test statistic. (2) Large sample tests for proportion and mean, Small sample test based on t, F and Chi-square statistics..

RECOMMENDED BOOKS

1. V.K. Rohatgi, A. K. Md. Ehsanes Saleh: An Introduction to Probability and Statistics, Wiley-Interscience
2. Kennedy and Gentle: Statistics Computing, Published by CRC Press, 1980
3. P.L. Mayer: Introductory Probability and Statistical Applications, IBH.
4. A.M. Mood and F. Graybill: Introduction to the Theory of Statistics, TMH, New Delhi.
5. Robert V. Hogg, Allen Craig, Joseph W. McKean: Introduction to Mathematical Statistics, Pearson Education, New Delhi

M.Sc. (2nd Semester)

Paper Name – Discrete Mathematics

L	T	P	C	
	4	1	0	4

Paper Code - (MSM-204)

Unit I**(09 Lectures)**

Formal Logic- Statements, Symbolic Representation of statements, duality, Tautologies and contradictions. Quantifiers, Predicates and Validity of arguments. Propositional Logic. Languages and Grammars, Finite State Machines and their transition table diagrams.

Unit II**(09 Lectures)**

Lattices: Lattices as partially ordered sets, their properties, duality, Lattices as algebraic systems, Sub lattices, Direct products, Bounded Lattices, Complete Lattices, Complemented Lattices and Distributive lattices. Cover of an element, atoms, join and meet irreducible elements.

Unit III**(09 Lectures)**

Boolean Algebras: Boolean Algebras as lattices. Various Boolean Identities. The Switching Algebra example. Sub algebras, Direct products and Homeomorphisms. Boolean forms and their Equivalence. Min-term Boolean forms, Sum of product Canonical forms. Minimization of Boolean functions, Applications of Boolean Algebra to Switching Theory (using AND, OR & NOT gates). The Karnaugh Map method.

Unit IV**(09 Lectures)**

Definition of (undirected) graph, Walk, Path, Circuit, Cycles, Degree of a vertex, Connected graphs, Complete and Bipartite graphs, Planar graphs, Euler's formula for connected Planar graphs, Kuratowski's Theorem (Statement only) and its uses. Colouring of graphs, Five colour theorem and statement of Four colour theorem.

Unit V**(09 Lectures)**

Trees, Cut-sets, Spanning Trees, Fundamentals Cut-sets and minimum Spanning Trees, Prim's and Kruskal's algorithms, Connectivity, Matrix Representation of graphs, Directed Graphs, Indegree and outdegree of a vertex.

RECOMMENDED BOOKS:

1. J. P. Trembley & R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 1997.
2. N. Deo, Graph Theory with Applications to Engineering and Computer Sciences, PHI, New Delhi
3. Seymour Lipschutz, Finite Mathematics, McGraw-Hill Book Co. New –York.
4. J. E. Hopcroft and J.D. Ullman, Introduction to Automata Theory Languages & Computation, Narosa Publishing House, Delhi.
5. C. L. Liu, elements of Discrete Mathematics, McGraw-Hill Book Co.