

**Krantiguru Shyamji Krishna Verma
Kachchh University**

Mundra Road, Bhuj – Kachchh



M. Sc. MATHEMATICS

**Curriculum as per UGC Guideline Framed according
to National Education Policy (NEP – 2020)**

With effect from June 2026

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SEMESTER II

Course	Course Code	Title	Course Type	Credit	Internal Marks	External Marks	Total
Major	MJMT201	Algebra II	T	4	50	50	100
	MJMT202	Functional Analysis	T	4	50	50	100
	MJMT203	Number Theory	T	4	50	50	100
	MJMT204	Calculus of Variation and Linear Differential Equations	T	4	50	50	100
	MJMT205	Combined Practical II	P	4	75	75	150
SEC	MNMJ206	Computational Methods	T	2	25	25	50
Total Credits			T/P	22	300	300	600

Internal Assessment 50%**External Assessment 50%**

Semester I



Major: MJMT101

Algebra I

Unit 1

Group, Subgroup, Normal Subgroups, Quotient groups, Homomorphism of groups, Isomorphic groups, Permutation groups, Direct product of groups, Cayley's theorem, Conjugacy relation on a group and its applications, Solvable groups.

Unit 2

Group actions, Sylow's theorem, Finite abelian groups, Simple groups.

Unit 3

Ring, subrings, ring homomorphism, ideals and quotient rings, prime and maximal ideals, Polynomial rings, Field of fractions of an integral domain, Divisibility in rings, Euclidean ring, Principal Ideal rings.

Unit 4

Polynomial ring over a rational field, irreducibility criteria, polynomial ring over a commutative ring, Unique factorization domain.

Text Book:

I. N. Herstein, "Topics in Algebra", John Wiley and Sons Inc., 2nd Edition.

Reference Books:

- (1) Bhattacharya, Jain and Nagpal, "Basic Abstract Algebra", 2nd Edition.
- (2) S. McClane and G. Birkhoff, "Algebra", 2nd Edition,
- (3) N. Jacobson, "Basic Algebra", Hind. Pub. Corp. 1984.
- (4) John Fraleigh, "A first course in Abstract Algebra", Narossa Publishing House, New Delhi.



Major: MJMT102

Real Analysis

Unit 1

Real number system as a complete ordered field, Archimedean property, supremum and infimum of sequence. Sequences and series, convergence, limsup, liminf. Bolzano Weierstrass theorem. Sequences and series of functions, uniform convergence.

Unit 2

Monotonic functions, types of discontinuity, uniform continuity, differentiability, mean value theorem.

Unit 3

Riemann sums and Riemann integral, Integrability of continuous and monotonic functions, Improper Integrals.

Unit 4

Functions of bounded variation, Fourier Series and Fourier Integral.

Text Book:

S. C. Malik, Savita Arora, "Mathematical Analysis", New Age International Publication

Reference Books:

- (1) N. L. Carothers, "Real Analysis", Cambridge University Press.
- (2) T. M. Apostol, "Mathematical Analysis", Narosa Publishing.
- (3) S. Kumaresan, "Topology of Metric Spaces", Narosa Publishing.
- (4) G. F. Simmons, "Introduction to Topology and Modern Analysis", Mc-Graw Hill.
- (5) W. Rudin, "Principles of Mathematical Analysis", Mc-Graw Hill.



Major: MJMT103

Complex Analysis

Unit-1

Complex numbers and its polar and exponential forms, powers and roots, Regions in the complex plane, continuity and differentiability of complex functions, analytic functions, Cauchy-Riemann equations, harmonic Functions of two variables, logarithmic functions and its branches, rectifiable arcs.

Unit-2

Power series and radius of convergence of power series functions, Singularities, zeros of analytic functions, poles, Taylor expansions, Laurent expansions, complex line integral.

Unit-3

Complex counter integral, Cauchy's theorem and Cauchy's integral formula, Liouville's theorem, Morera's theorem, Maximum modulus principle (only statement and examples), Schwarz lemma and Open mapping theorem (only statement and examples).

Unit-4

Residues and residue theorem, residue at poles, evaluations of improper integrals. Conformal mapping and Bilinear transform.

Text Book:

Complex Variables and Applications (Fourth edition) by R V Churchill and James W Brown, McGraw Hill, International Editions.

References:

- (1) John Duncan, The Elements of Complex Analysis, John Wiley & Sons Ltd, London. (1968)
- (2) L V Ahlfors, Complex Analysis, 3rd edition, McGraw Hill, International Editions, New York-1966



- (3) J B Conway, Functions of one complex variables, 2nd edition, Springer Verlag, New York (1973) (Indian edition: Narosa Publication House, New Delhi. (1982))
- (4) Serge Lang, Complex Analysis, Addison- Wesley, Publishing Co. (1997)
- (5) B Choudary, The Elements of Complex Analysis, 2nd edition, New Age International Ltd Publishers, New Delhi. (1992)



Major: MJMT104

Operation Research

Unit-1

Project management: PERT and CPM.

Unit-2

Elementary Queuing theory: Structure of a queuing system, single server queuing models (M/M/1 model)

Unit-3

Theory of Games: Introduction – Minimax (Maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – dominance principle.

Unit-4

Linear programming Problem Solutions: Introduction to LPPs and slack variables, Solution of LPP by Simplex method, Big-M method, Dual Simplex method.

Text Book:

J. K. Sharma, "Operations Research – Theory and Application", 4th Edition, Macmillan Publishers India Ltd.

Reference Book:

- (1) N H Shah, Ravi Gor, Hardik Soni, "Operations Research", Prentice Hall of India.
- (2) F. S. Hiller and G. J. Lieberman "Introduction to Operations Research", Tata McGraw Hill.



SEC: MNMJ106

Advanced Graph Theory

Unit 1

Directed Graphs: definitions and examples, vertex degrees, some special types of digraphs, directed path and connectedness, Euler digraphs, Isomorphic digraphs, matrices A and B of digraphs, adjacency matrix of digraph.

Unit 2

Chromatic number, independent number, chromatic partitioning, chromatic polynomial, Five-color Problem, Application of Graph Theory in Chemistry, Total Pi Electron Energy and Laplacian Energy.

Text Book:

Narsingh Deo, "Graph Theory with applications to Engg. And Computer Science", Prentice-Hall of India Pvt. Ltd.

Reference Books:-

- (1) Douglas B. West, "Introduction to Graph Theory", Pearson.
- (2) John Clark and D.A. Holton, "A first look at graph theory", Allied Publishing Ltd.
- (3) Robin J. Wilson, "Introduction to graph theory", Pearson.
- (4) Santanu Saha Ray, Graph theory with algorithm and Applications, Springer, 2013
- (5) Trinajstić, N. (1992). Chemical graph theory (2nd ed.). CRC Press.



Semester II



Major: MJMT201

Algebra II

Unit 1

Extensions of field, Finite, algebraic and simple field extensions, algebraic and transcendental numbers.

Unit 2

Roots of polynomials, the splitting field of a polynomial over a field, construction with straightedge and compass.

Unit 3

The fixed field of a group of automorphism, the theorem on symmetric polynomials, normal field extension, the Galois group of a polynomial.

Unit 4

The fundamental theorem of Galois Theory, solvability by radicals, Galois group over the rational, finite fields,

Text Book:

I. N. Herstein, "Topics in Algebra", 2nd Edition, Wiley Eastern Ltd., 1975.

Reference Books:

- (1) Bhattacharya, Jain and Nagpal : "Basic Abstract Algebra", 2nd Edition.
- (2) S. McClane and G. Birkhoff : "Algebra", 2nd Edition.
- (3) N. Jacobson : "Basic Algebra", Hind. Pub. Corp. 1984.
- (4) John Fraleigh : "A first course in Abstract Algebra" (3rd Edition), Narossa Publishing House, New Delhi.



Major: MJMT202

Functional Analysis

Unit 1

Metric spaces, completeness, compactness, connectedness.

Unit 2

Normed linear space: definition and examples, continuous linear transformations, spaces $BL(X,Y)$, $BL(X)$ and $BL(X,X)$, l_p & L_p (for $0 \leq p \leq \infty$) Banach spaces.

Unit 3

Hahn-Banach theorem and its applications, open mapping theorem, Dual normed spaces, natural imbedding of normed space into double dual space of normed spaces.

Unit 4

Hilbert space: definition and examples, orthogonal complement, orthonormal set, Bessel's inequality, Projection theorem, Riesz Representation theorem.

Text Books:

- (1) G. F. Simmons, "Introduction to Topology and Modern Analysis", Tata McGraw, 1963
- (2) B. V. Limaye, "Functional Analysis", 2nd Edition, New Age International Ltd. Publishers.

Reference Books:

- (1) S. K. Berberain, "Lectures in Functional Analysis and Operator theory", Springer Verlag.
- (2) Goffman and George Padre, "First course in Functional Analysis", Prentice Hall of India.
- (3) Martin Schechter, "Principles of Functional Analysis" student edition Academic Press, N York.
- (4) J. N. Sharma & A.R. Vasistha, "Functional analysis", Krishna Publication.



Major: MJMT203

Number Theory

Unit 1

Divisibility Theory in integers: The division algorithm, The greatest common divisor, The Euclidean algorithm, Diophantine equation ($ax+by+c=0$)

Unit 2

Primes and their distributions: The fundamental theorem of arithmetic, The Sieve of Eratosthenes, The Goldbach conjecture.

Unit 3

The theory of congruencies: Basic properties of congruence, special divisibility test, linear congruencies.

Unit 4

Fermat's theorem: Fermat factorization method, The little theorem, Wilson's theorem, Euler Phi, τ and σ functions.

Text Book

"Elementary Number Theory", 2nd edition, by David M. Burton (Wm. C. Brown Publishers, 1989).

Reference Books:

- (1) Niven and H. Zukerman "An introduction to the theory of Numbers" 3rd edition, Wiley Eastern University Edition, New Delhi, 1985.
- (2) T. M. Apostol, "Introduction to Analytic Number Theorem", Springer studt edition, 1995.
- (3) Baker Alan, "A concise Introduction to the theory of Numbers", Cambridge, University, press, 1984.
- (4) Rose H. E., "A course in number theory", Oxford University Press, 1988.



Major: MJMT204

Calculus of Variation and Linear Differential Equations

Unit 1

Variation of a functional, Euler-Lagrange equation, Necessary and sufficient conditions for extrema.

Unit 2

Variational methods for boundary value problems in ordinary and partial differential equations.

Unit 3

Linear integral equation of the first and second kind of Fredholm and Volterra type, Solutions with separable kernels.

Unit 4

Characteristic numbers and Eigen functions, resolvent kernel.

Text Books:

- (1) I. M. Gelfand & S. V. Fomin, "Calculus of Variations", Dover Publications.
- (2) Shanti Swarup, "Integral Equations", Krishna Prakashan Media (p) Ltd.

Reference Books:

- (1) Bruce van Brunt, "The Calculus of Variations", Springer.
- (2) Gupta A S, "Calculus of variations with Applications", Phi Publication.
- (3) Rakesh Kumar & Nagendra Kumar, "Differential Equations and Calculus of Variations", CBS Publications.



SEC: MNMJ206

Computational Methods

Unit 1

Numerical solutions of algebraic equations, Method of iteration, Bisection method and Newton-Raphson method, Method of False Position, Rate of convergence, Solution of systems of linear algebraic equations using Gauss elimination, Gauss Jordan elimination, Jacobi and Gauss-Seidel methods. Power method for finding dominant Eigen value.

Unit 2

Numerical integration: Trapezoidal, Simson's $1/3$ & $3/8$ rule, Weddle's rule. Numerical solutions of ODEs using Picard, Euler, modified Euler and Runge-Kutta methods.

Text Book:

S.S. Sastry, "Numerical analysis", Prentice-Hall of India Private Limited.

Reference Books:

- (1) Won Y. Yung & Wenwn Cao, "Applied Numerical Methods", A John Wiley & Sons Pub.
- (2) Jain Mahinder Kumar, "Numerical Methods: Problems and Solutions", New Age International.


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