

N O R T H M A H A R A S H T R A U N I V E R S I T Y,

J A L G A O N - 425 001.

M.Sc. (MATHEMATICS)
(Part II)
SYLLABUS FROM JUNE, 1993

COURSES FOR SEMESTER III and IV

SEMESTER - III

Compulsory Courses.

- MT : 301 - Functional Analysis.
- MT : 302 - Field Theory.
- MT : 303 - Fluid Mechanics.
- MT : 304 - Commutative Algebra.

Optional Courses (Any one)

- MT : 305 - Graph Theory.
- MT : 306 - Mathematical Modelling.

SEMESTER - IV

Compulsory Courses.

- MT : 401 - Real and Complex Analysis.
- MT : 402 - Advanced functional Analysis.
- MT : 403 - Solid Mechanics.
- MT : 404 - Algebraic Topology.

Optional Courses (Any one)

- MT : 405 - Algebraic Geometry.
- MT : 406 - Number Theory.

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MT 301 :- FUNCTIONAL ANALYSIS

1. BANACH SPACES :- Definition and examples. Construction of new normed linear spaces. Convexity of the unit sphere of a normed linear spaces. Linear transformations. Finite dimensional normed Linear spaces. The Hahn-Banach (Spaces) theorem. The natural imbedding. The open mapping theorem. The closed graph theorem. Banach-Steinhaus theorem.
2. HILBERT SPACES :- Definition and examples. Schwarz's inequality. Projection theorem. Orthogonal Sets. Bessel's inequality. Parseval identity. Gram-Schmidt orthogonalization process. The conjugate space, Operators and their adjoints on a Hilbert space. Self-adjoint operators. Normal and unitary operators. projection operators.
3. Finite dimensional spectral theory, the spectral theorem.

Prescribed Book :-

- 1) G.F.Simmons : Introduction to topology and Modern Analysis. (McGraw - Hill book company)

RECOMMENDED BOOKS :

1. B.V. Limaye :- Functional Analysis (Wiley-Eastern)
2. Lusternik, L.A. :- Elements of functional Analysis and Sobolev V.J. Hindustan Publishing Corporation (Friedrick Ungart)
3. Fried man A :- Foundations of Modern Analysis. (Holt Reinhart, Winston)
4. Bachman G. and Narici L. :- Functional Analysis (Academic Press).
5. Berberian S.K. :- Functional Analysis and Operator Theory (Springer)
6. Brown A.L. :- Elements of Functional Analysis. (Van Nostrand)

MT 302 :- FIELD THEORY

Algebraic extensions, Splitting field, Algebraic closure. Separable and Inseparable extensions. Normal extensions. Perfect fields finite fields.

Galois extensions. Fundamental theorem. Roots of Unity Solvability by radicals. Transcendental extensions. Transcendental base.

Prescribed Book

1. N.S. Gopalkrishnan :- University Algebra (Wiley-Eastern).

RECOMMENDED BOOKS :

1. N.Jacobson :- Basic Algebra Vol.1
(Hindustan Publishing Corporation).
2. M.Nagata :- Theory of fields (Marcel-Dekker).

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MT 303 :- FLUID MECHANICS

1. Inviscid Fluid, Stream Lines, Path Lines and stream tubes, Density, Pressure, Hydrodynamic pressure, Bernoulli's theorem. Lagrangian and Eulerian methos.
2. Vorticity, Circulation, Irrotational motion, Equation of Continuity, Rate of change of Linear momentum, Euler's Dynamical equations. Boundary Conditions, Velocity potential, pressure equation. Impulsive motion, Acyclic and cyclic irrotational motion, Kinetic energy of an infinite mass of liquid.
3. Motion in two dimensions, stream function, Rankine's method, complex potential, Complex Velocity Stagnation point, the Circle theorem, Streaming motion past a sphere, cavitation, Flows past a moving sphere, Blasius theorem,
4. Circulation about a cylinder, Aerofoil, theorem of Kutta and Jaukowski, Two dimensional sources and sinks. Combination of sources and streams. Doublets. The method of images. Images system for a source outside a Circular cylinder.
5. Axisymmetrical fluid motion, Stoke's stream function. Stoke's Viscosity law. Navier - stoke's equations, Reynold's number.

RECOMMENDED BOOK :

1. Theoretical Hydrodynamics :- L.M. Milne-Thomson
(Mac Millan Publishing Company)

REFERENCE BOOK

1. Advanced Fluid Dynamics :- Roy Singhania and Grewal
(S.Chand and Comp. New Delhi).

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MT 304 :- Commutative Algebra

Revision of fundamental concepts in Rings and Modules. Nil radical, Jacobson radical, Operations on ideals Nakayami Lemma Extensions and contraction.

Exact sequences, Tensor product of modules, Exactness properties of tensor product. Rings and modules of fractions. Local properties. Extended and contracted ideals in ring of fractions.

Integral dependence, The going up theorem. Integrally closed integral domains, The going down theorem. Valuation ring.

Primary decomposition in Noetherian rings, Artin rings. Discrete valuation ring and Dedekind domains.

RECOMMENDED BOOKS

1. Introduction to commutative Algebra
by Atiyah M.F. and I.G. Mac Donald.
2. Commutative Algebra by N.S. Gopalkrishnan.

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MT 305 :- Graph Theory

- 1) Graphs, Adjacency and Incidence, Complete graph, Regular graph, Bipartite Graph, Isomorphism of Graphs, Matrices & Graphs, Degree sequences.
- 2) Subgraphs, Induced subgraphs, Complement of a graph. The Ramsey numbers, Union and sum of graphs. Connected and disconnected graphs, product of graphs, Line graphs.
- 3) Walks, Path, trail, and cycle (Circuit), Connectivity, Menger's Theorem (Both forms), Halls Marriage problem, .
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Blocks, Weighted graph, Shortest path algorithm.

4. Trees, Centres, Spanning trees, Fundamental cycle
Fundamental cutset. Labelled trees, spanning tree algorithm.
5. Eulerian graph, Chinese Postman Problem, Hamiltonian graph.
The Travelling salesman problem.
6. Planarity and Coloring, Colouring of planar graphs, The
Four colour Theorem, Chromatic polynomials.
7. Directed graphs, Connected digraph, Directed trees,
Eulerian digraph, Tournaments, Flows & Networks. Max-flow
Min-Cut theorem.

PRESCRIBED BOOK :

1. N.S. Bhave & T.T. Raghunathan ; Elements of Graph Theory
Gaaj Prakashan,

RECOMMENDED BOOKS :

1. Narsingh Deo ; Graph Theory with applications to
engineering and Computer Science
(Prentice Hall of India.)
2. Frank Harary ; Graph Theory
Narosa Publishing House.

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MT 306 MATHEMATICAL MODELLING :

1. Mathematical Modelling :- Need, Technique, Classification
and Simple illustrations, Mathematical modelling through
geometry, algebra, trigonometry and calculus. Limitations
of Mathematical modelling.
2. Mathematical Modelling through ordinary differential
equations, Linear and non-linear growth and decay models.
Compartment models. Mathematical modelling in Dynamics
and geometric problems.
3. Mathematical modelling through systems of ordinary differential
equations of the first order, Mathematical modelling in
population, dynamic epidemics, Compartment models in economics
medicine, battles, international trade dynamics.
4. Mathematical Modelling through partial differential equations,
Model for traffic flow on a highway, Mathematical modelling
in terms of wave equation.

Prescribed Books

1. Mathematical Modelling :- J.N. Kappor,
Wiley Estern Ltd.

MT 401 : REAL AND COMPLEX ANALYSIS

1. Complex Measures :-
Total Variation, Absolute Continuity, Lebesgue decomposition theorem. Randon-Nikodym theorem and its consequences, Hahn decomposition theorem. Bounded linear functions on L^p
2. (Knowledge of elementary properties of holomorphic functions to be assumed). Poisson Integral. Harnack's theorem. Harmonic function. Schwarz reflection principle.
3. Statement of Schwarz's lemma and study of its consequences. Phragmen Lindel of theorem. Hausdorff- Young theorem.
4. Normal families, Riemann Mapping theorem, The family of Univalent functions.
Weierstrass Factorization theorem. Mittag-Leffler theorem. Jensen's formula. Muntz-Szasz theorem. Natural boundary. Ostrowski theorem. Hadamard theorem. Monodromy theorem. Picard's theorem.

Prescribed Books

1. W.Rudin - Real and Complex Analysis (Tata McGraw Hill)
2. J.B. Conway : Functions of one complex variable
(Springer - Verlag Graduate Text)

RECOMMENDED BOOKS :

1. L.V. Ahlfors :- Complex Analysis (McGraw Hill)
2. R.A. Silverman :- Complex Analysis (Houghton, Mifflin Co.)

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MT 402 ADVANCED FUNCTIONAL ANALYSIS

1. TVS, Separation properties, Linear mappings, finite dimensional spaces, metrization, Boundedness and Continaty, Seminorms and local convexity, quotient spaces, Weak

topologies, Weak convergence, Reflexive Banach Spaces, Compact convex sets.

2. Fixed point theorems & their applications. Banach contraction principle and its generalization, Schauder's fixed point theorem, Application of Banach Contraction Principle. Browder's fixed pt. them.
3. Strickly convex Normed linear space, Uniformly convex space, Best approximation, Approximation, Approximately Compact sets, proximal set, Boundedly compact sets, Normal structure, Weakly compact sets, Best simultaneous approximation.
4. Banach Algebras :- Preliminaries, Invertibility in Banach algebra with unity, Resolvent and spectrum, Gelfand representation theorem,
5. C^* - Algebras :- Preliminaries, Commutative C^* algebra, Gelfand Naimark representation theorems.

PRESCRIBED BOOKS

1. W. Radin :- Functional Analysis (Tata McGraw Hill)
2. G.F. Simmons :- Introduction to topology & Modern Analysis (McGraw-Hill book Company)

RECOMMENDED BOOKS

1. A.H. Siddiqi :- Functional Analysis with applications (Tata-McGraw Hill)
2. Gottfried Kothe :- Topological Vector spaces-I (Springer Verlag)
3. A.R. Robertson and W.J. Robertson :- Topological vector spaces (Combridge University Press)
4. S.K. Berberian :- Functional Analysis and operator Theory (Springer).

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MT 403 SOLID MECHANICS

1. Stress, Complementary property of shear, Equations of equilibrium, strain components, Compatibility.
2. One dimensional stress distribution, Three dimensional Hooke's law for isotropic materials.
3. Stress Variations for plane stress, principal stresses and principal axes, Mohr's Circle. Equations for plane strain, properties.
4. Shear Force, Axial force and Bending moment formulation of shear and Bending moment equations, Differential equations for equilibrium.
5. Pure Bending of Symmetric beams, Normal stress, Shear stress in transversely loaded beams, stress concentrations for bending.
6. Deflection of Symmetric beams, statically indeterminate beams, superpositions methods.
7. Three dimensional formulation for stresses, Tensor invariants, Tensor notation, Equations for strain and properties.

REFERENCE BOOKS

1. Solid Mechanics :- S.A.M. Kazimi
Tata McGraw Hill Company.

RECOMMENDED BOOKS

1. Introduction to solid Mechanics :- Irving H. Shames,
(Prentice Hall of India
Pvt.Ltd, New Delhi-11000)

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MT 404 (ALGEBRAIC TOPOLOGY)

Geometric Complexes, Polyhedra, Orientation Simplicial homology of polyhedra, Examples of homology groups, Euler-Poincare formula, Pseudomanifolds, Homology of S^2 .

Simplicial approximation, Brouwer's fixed point theorem and related results.

Homology of maps, Fundamental groups, Covering homotopy for S^1 , Relation between first homology and fundamental group

PRESCRIBED BOOK

1. F.H.Croom : Basic Concept of Algebraic Topology
(Springer under graduate Text).

RECOMMENDED BOOK :

1. Mayer J. :- Algebraic Topology (Prentice-Hall).
2. I.M.Singar and J.A. Thorpe :- Lecture Notes on
elementary topology and differential
geometry (Springer Verlag).
3. E.H.Spanier :- Algebraic Topology
(Tata McGraw Hill).

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MT : 405 ALGEBRAIC GEOMETRY

Affine space, Affine algebraic sets, Irreducible components
fo an algebraic set. Hilbert Nullstellensatz, Affine variety
coordinate ring, polynomial maps, Rational functions.

Affine plane curves, multiple points and tangent lines.
Intersection number.

Projective space, projective algebraic set, Projective
variety,

Projective plane curve, Bezout's Theorem, Max Noether's
fundamental theorem and its applications.

RECOMMENDED BOOK

- 1) Algebraic Courves :- As introduction to Algebraic
Geometry.

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By Willaim Fulton.

- 2) Algebraic Geometry by Hartshorne.

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MT 406 NUMBER THEORY

1. Revision :- Divisibility, g.c.d., l.c.m., prime numbers,
The fundamental theorem of arithmetic, The Euclidean algorithm,
The g.c.d. of more than two numbers;
2. Arithmetic function and Direchlet multiplication. The Mobius
function $\mu(x)$ The Euler function $\phi(x)$. The Direchlet.

Product of arithmetic functions, Dirichlet inverses and the Mobius inversion formula. The Mangoldt function $\Lambda(n)$, Multiplicative functions, Multiplicative functions and Dirichlet multiplication, The inverse of a completely multiplicative function, Liouville's function $\lambda(n)$, The divisor function $\sigma(n)$, Generalized convolutions.

3. Congruences : Congruences, Residue classes and complete residue systems. Linear congruences, Reduced residue systems and Euler Fermat theorem, Polynomial congruences mod p , Lagrange's theorem and its applications. The chinese remainder theorem and its applications, Polynomial congruences with prime power moduli.
4. Quadratic Residues and Quadratic Reciprocity law :-
Quadratic residues, Legendre's symbol and its properties, Evaluation of $\left(\frac{1}{p}\right)$ and $\left(\frac{2}{p}\right)$ Gauss lemma, The quadratic reciprocity law and its applications, The Jacobi symbol.
5. Primitive Roots :- The exponent of a number mod m , primitive roots, Primitive roots and reduced residue systems, The non existence of primitive roots and mod 2^n for $n \geq 3$. The existence of Primitive roots mod p , and p^{2n} for odd primes p and $n \geq 1$. The non-existence of primitive roots in the remaining cases. The number of primitive roots mod m . The primitive roots and quadratic residues. The Index calculus.

$\sqrt{p^n}$ and
mode

PRESCRIBED BOOKS :

1. T.M. Apostol :- Introduction to Analytic Number Theory (Springer International student Edition)

RECOMMENDED BOOKS

1. Ivan Niven and H.S.Zuckerman :- An Introduction to the theory of numbers (Wiley Eastern University Edition).

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