

NORTH MAHARASHTRA UNIVERSITY, JALGAON.

Mathematics : M.A./M.SC.,
Syllabus from June, 1992.

There will be 20 courses in four Semesters, Out of these 16 courses will be University Courses and the remaining 4 will be departmental courses. The four departmental courses will be distributed equally between the third and fourth semesters only.

UNIVERSITY COURSES

Semester - I

MT 101 : Advanced Calculus
MT 102 : Topology I
MT 103 : Algebra I
MT 104 : Differential Equations
MT 105 : Classical Mechanics

OR

MT 106 : Computer Programming (Fortran-77)

Semester - II

MT 201 : Measure and Integration
MT 202 : Topology II
MT 203 : Algebra II
MT 204 : Complex Analysis
MT 205 : Mathematical Methods I

or

MT 206 : Programming and Numerical Methods.

Semester - III (Any three)

MT 301 : Functional Analysis
MT 302 : Commutative Algebra
MT 303 : Algebraic Number Theory
MT 304 : Mathematical Methods II
MT 305 : Fluid Mechanics

Semester - IV (Any three)

MT 401 : Algebraic Topology
MT 402 : Algebraic Geometry
MT 403 : Banach Algebra
MT 404 : Solid Mechanics
MT 405 : Environmental Dynamics and Pollution.

DEPARTMENTAL COURSES

(Any two)

Semester-III

Semester-IV

MT 306 : Algebraic Number Theory-1	MT 406 : Algebraic Number Theory, II
MT 307 : Topological Vector Spaces-I	MT 407 : Topological Vector Spaces-II
MT 308 : Operator Theory -I	MT 408 : Operator Theory-II
MT 309 : Applied Functional Analysis	MT 409 : Bio Mechanics.
MT 310 : Graph Theory-I	MT 410 : Graph Theory-II

Semester-III

- MT 311 : Geometry - I
- MT 312 : Special Functions-I
- MT 313 : Computer Science-I
- MT 314 : Operations Research-I
- MT 315 : Topics in Algebra-I
- MT 316 : Mathematical Logic-I
- MT 317 : Relativity-I
(General)
- MT 318 : Quantum Mechanics-I
- MT 319 : Harmonic Analysis
- MT 320 : Mathematical Coding
Theory.

Semester-IV

- MT 411 : Geometry-II
- MT 412 : Special Functions-II
- MT 413 : Computer Science-II
- MT 414 : Operations Research-II
- MT 415 : Topics in Algebra-II
- MT 416 : Mathematical Logic-II
- MT 417 : Relativity-II
(General)
- MT 418 : Quantum Mechanics-II
- MT 419 : Thermo dynamics
- MT 420 : Mathematical Modelling.

University Courses

MT-101 : Advanced Calculus :

Functions of Several variables :

Linear transformations of Euclidean n-space Differentiability of functions of several variables. The Chain rule, Partial and directional derivatives. The gradient, continuously differentiable functions, Inverse and Implicit function theorem, Jacobians, Derivatives of higher order.

Integration of differential forms.

Integration, Primitive mappings, Partitions of Unity, Change of variables, differential forms, Basic K-forms and their product., Change of variable.

Prescribed Book :

- 1) Walter Rudin : Principles of Mathematical Analysis.
(Mc Graw Hill, International Student, 3rd Edition).

Recommended Books :

- 1) T.M. Apostol - Mathematical Analysis (Revised Edition)
(Addison-Wesley).
- 2) M. Spivak - Calculus of Manifolds
(W.A. Benjamin, Inc. New York).
- 3) Nickerson, Spencer and Steenrod- Advanced Calculus.
- 4) A.Devinatz- Advanced Calculus (Holl, Rinhardt and Winton).

MT-102 : Topology-I

- 1) Partially ordered sets, well ordered sets, Axiom of Choice, Zorn's Lemma, Well ordering principle.
- 2) Metric spaces, Open spheres, Open sets,
- 3) Sequences of Metric spaces, Cauchy Sequences, Convergence.
- 4) Completeness, Baire's theorem, Completion of Metric Spaces.
- 5) Continuity, homeomorphism, isometry.
- 6) Compactness, Totally bounded sets, Arzela Ascoli theorem.
- 7) Contraction principle, Existence theorem for differential equations.
- 8) Connectedness, finite product of connected spaces.

References :-

- i) G.F. Simmons : Introduction to topology & modern analysis, Mc Graw Hill. (Tokio-Japan).
- ii) R. Munkres Topology, A first course. (Prentice Hall of India, New Delhi) (1984).
- iii) J. Dieudonne : Foundations of modern analysis (Revised edition) (Academic Press)
- iv) Royden H.L. Real analysis.

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MT 103 : Algebra-I :-

Review of groups, subgroups, homomorphisms, Solvable groups, Sylow Theorems.

Rings, ideals, quotient rings, Euclidean domains, Principal ideal domains, Unique factorisation domains.

Extension fields, splitting fields, fundamental theorem of Galois theory, Constructibility by ruler and compass, Solvability by radicals, Structure of finite fields.

Prescribed book :-

1. N.S. Gopalkrishnan, University Algebra, Wiley-Eastern, 1988.

References :-

- 1) I.N. Herstein, Topics in Algebra, Wiley-Eastern, 1988.
- 2) N. Jacobson, Basic Algebra, Vol. I, Hindustan Publishing Corporation, 1984.

MT-104 : Differential Equations.

1. Power Series Solution :-

Linear equations and power series. Ordinary points and singular points. Solutions near an ordinary point. Regular singular point. Indicial equation.

Illustrate the method by Bessel and Legendre polynomials. State results for other polynomials like Laguerre, Hermite, Hypergeometric. (Ref. (2)).

2. P.D.E. of first order :-

Origin, Cauchy problem, linear equations of first order, integral surfaces passing through a given curve, surfaces orthogonal to a given system of surfaces. Non-linear p.d.e. of first order. Cauchy's method of characteristics, Compatible systems of first order equations. Charpit's method, special types, solutions satisfying given conditions. Jacobis' method.

3. P.D.E. of Second order :- Origin, applications in physics, characteristic curves of second order equations, characteristics of equations in three variables, solutions of linear Hyperbolic, parabolic and elliptic equations of separation of variables.

Prescribed Books :-

1. Snedden : Elements of Partial differential equations.
2. Simmons : Differential Equations.

Recommended Books :-

1. Arfken : Mathematical Methods for Physics.
New York : Academic Press.
2. Cousant & Hilbert : Methods of Mathematical Physics
Vol.1 & Vol.2, New York,
Interscience.

MT-105 Classical Mechanics

D'Alemberts Principle and Lagranges' equations and examples
Hamilton's principle, Extension of Hamilton's principle to nonholonomic systems. Orthogonal transformations. The Cayley-Klein parameters and related quantities. Finite rotations. Rate of change of a vector. Inertia tensor and its eigenvalues. Moment of inertia, Principal axis transformation. The heavy symmetrical top with one point fixed.

Legendre transformations and the Hamiltons equations of motion, Derivation of Hamilton's equations from variational principle. The principle of least action.

The equations of canonical transformation. Poisson bracket and other canonical invariants.

Prescribed Book :-

- 1) H. Goldstein : Classical Mechanics,
(Addison Welley) Chapters 1,2,4,5,8,9.

Recommended Books:-

1. Corben and Steble-Classical Mechanics
(John Wiley Press).
2. Landon and Lifschitz - Mechanics.
(Pergamman Press).
3. Marion: Classical Dynamics (Academic Press).
4. Sudarsen & Mukunda- Classical Mechanics.

OR

MT-106 Computer Programming in Fortran-77.

The flow chart concept, Fortran-77 programming, Integer and real operations, control statements, structured if else-then, if-while statements, Do and Do while loops, Arrays, Input and output operations, Formats, Subroutines and function subprograms,, logic and complex operations, Real operations in double precision, construction of some programs, Additional features of Fortran.

Prescribed Book :

1. SCHAUM SERIE : FORTRAN PROGRAMMING.

Reference Book :

1. V.Rajaramanna : Programming Fortran-77.

MT-201:

MEASURE & INTEGRATION

Cantor set, Cantor-like sets and Lebesgue function, Lebesgue outer measure. Measurable sets, algebra, Regularity of measure, complete measure, Measurable functions, Borel sets and Measurability.

Integration of non-negative functions of real variables. Fatou's lemma. Lebesgue monotone convergence theorem. The general integral lebesgue dominated convergence theorem. Comparison of Riemann and Lebesgue integrals.

Derivatives. Functions of bounded variation, Positive, negative and total variation, Continuity a.e. and differentiability a.e. of a function of B.V. Properties of the function of B.V. Properties of the derivative of the function of B.V. Absolutely continuous functions Vitali covering theorem, Fundamental theorem of integral calculus L_p spaces. Holders and Minkonski's inequalities Completeness of L_p spaces.

Convergence in measure, Convergence in mean of order p , almost uniform convergence, Egoraff's theorem, Implications among these.

PRESCRIBED BOOKS:

1. DeBarra, G. Measure theory and Integration, Wiley Eastern, New Delhi.
2. Rayden, H.L., Real Analysis, 3rd Edition, Maxwell MC Millan international Edition.

Reference Books:

1. Randdph, J.L. : Basic Real and Abstract Analysis, Academic Press.
2. Berbarion, S.K. : Measure theory and Integration, MC Millan.

MT-202:

TOPOLOGY II

1. Topological spaces, Basis for topology. The order topology, Subspace topology. Closed sets and limit points, continuous functions, Homeomorphism. Product topology. The quotient Topology.
2. Connected spaces: Components and Path components, Local connectedness. Compact spaces, Local compactness, News, One point compactification.
3. The countability axioms. The separation axiom Urysohn lemma, Urysohn Metrization theorem.
4. Tychonoff Theorem, Completely Regular spaces.

PRESCRIBED BOOK:

J.R. Munkres: Topology (A first course)
Prentice Hall of India Ltd.

Reference Books-

1. K.D.Joshi : Introduction to General Topology,
(Wiley Eastern)
2. Willard : General Topology (Addison Wesley)
- 3) B.T.Simmon : Fundamentals of Topology
(Mc Millan International Edition)

MT -203: Algebra-II

Review of field Extensions, Transcendental extensions, Separability norms and traces, discriminants, primitive element theorem:

Modules: Sub modules, R-homomorphism, Isomorphism
Direct sum of modules. Free modules, Rank, Projective modules.

Structure Theorem for finitely generated modules over a PID.

Application to group theory. Tensor product of modules.
Localization of rings, Noetherian rings, primary decomposition,
Hilbert Basis Theorem.

Prescribed Books:-

N.S.Gopalkrishnan: University Algebra (Wiley Eastern Ltd.)
Commutative Algebra
(Oxonian Press Pvt.Ltd.)

Reference Books

- 1) I.N.Herstein : Topics in Algebra (IBH)
- 2) S.Lang : Algebra (Addison Wesley)

Topology of C , Open, connected subsets, Components of Open sets, Uniform convergence of sequences and series of functions, Weierstrass M-test, power series, radius of convergence.

Analytic functions, exponential functions, branch of logarithm, Cauchy Riemann equations, harmonic functions Harmonic conjugate.

Path, smooth path, piecewise smooth paths, conformal map, Mobius transformation, Symmetry, principle and orientation principle.

Riemann-Stieltjes Integral and complex integral. Line integral of a continuous function along rectifiable paths, Fundamental theorem of calculus for line integrals.

Power series, expansion of an analytic function, Fundamental theorem of Algebra, Liouville's theorem, Maximum modulus principle, index (winding number) of a curve around a point, Cauchy's theorem and Cauchy's integral formula, Morera's theorem.

Homotopic version of Cauchy's theorem and simple connectivity. Logarithmic derivatives of $f(z)$. The open mapping theorem, the argument principle, Meromorphic functions, Rouché's theorem.

Singularities, classification of singularities, Poles and essential singularities, singular point, Laurent's series development, Casorati-Weierstrass's theorem, Residues and evaluation of integrals, Schwarz's Lemma.

Prescribed books-

1. J.B.CONWAY: Functions of one complex variable (Springer-verlag Graduate text)
2. Walter Rudin: Real and Complex Analysis (McGraw Hill Book Company, New York)

Reference Books-

1. H. Silverman : Complex variables (Houghton Millan & Co.)
2. J.E.Marsden : Basic Complex Analysis (Freeman & Co.)
3. L.V.Allfors : Complex Analysis (McGraw Hill, New York)

MT-205

MATHEMATICAL METHODS-I

1. Linear Boundary Value Problem- Wave Equation, Heat Equation, Laplaces' Equation in Cartesian, Cylindrical and Spherical co-ordinates.
2. Principle of Superposition. Series solutions, separation of variables, Certain types of initial value problems. General solutions of partial differential equations.
3. Orthogonality of functions in the space of piece wise continuous functions on an interval (a,b)

Generalized fourier series. Approximation in the mean Closed and complete orthonormal sets, Sturm-Liouville Problems. Orthogonality of the eigen functions and their uniqueness.
4. Boundary value problems involving
 - (i) the wave equation
 - (ii) heat equation
 - (iii) Dirichlet problems.
5. Temperature in a long cylinder, Heat transfer at the surface of the cylinder, Vibration of circular membrane.
6. Dirichlet problems in spherical regions, Study Temperatures in a hemisphere.

Prescribed Book-

R.V.Churchill & J.W.Brown,

Fourier Series and Boundary value problems.
(Mc Graw Hill International).

Recommended Books-

- (1) Mary L.Bose - Methods of Mathematical Physics
- (2) N.N.Lebedev - Special functions & their applications.
(Frentice Hall)

MT-206 PROGRAMMING AND NUMERICAL METHODS

Characterization of problems that can be solved by computers.

Model of Pascal Machine- Concept of program and data, Input and output introductions.

Types, memory as specialized data storage unit, expressions, their types and properties of arithmetic and logical operators.

Problem reducing through decomposition, sequential decomposition, sequential compositions and conditional composition. Recursion and iteration, Primitive actions: assignment statements, input/output statements.

Programs based on sequential and conditional composition Functional abstraction and procedural abstraction. Among types and iterative programs, character strings, Scalar and Subrange types and case statement, Record types and files.

Organisation of a Computer and its functioning. Role of operating system software. Concept of linking, Paradigms of programming in aid of problem solving.

Introduction to data structures- concept of Stacks, Queues and lists and their implementations, conversion of simple recursive procedures into iterative procedures.

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