AKS UNIVERSITY, SATNA (MP)
Faculty of Basic Science
Department of Mathematics
Syllabus & Credit Scheme
M.Sc. (Mathematics)

Semester-I

<table>
<thead>
<tr>
<th>Sr.</th>
<th>Subject Code</th>
<th>Subject/ Paper</th>
<th>L</th>
<th>T</th>
<th>Credit</th>
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<tbody>
<tr>
<td>1</td>
<td>78MS101</td>
<td>Advanced Abstract Algebra-I</td>
<td>3</td>
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<td>5</td>
<td>78MS105-A</td>
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<td>78MS105-B</td>
<td>Ordinary Differential Equation</td>
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Total 20

Semester-II

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**Total**: 20

### Semester-IV

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<td>General Theory of Relativity</td>
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<td>Programming in C</td>
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<td>78MS451</td>
<td>Project Work</td>
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**Total**: 26
M.Sc. [Mathematics]
Semester – I
Paper –I [Advanced Abstract Algebra – I ] (3 + 1)

Unit-1
Group : Normal and sub normal group, Solvable group, Nilpotent group, commutator sub-group of a group, Cauchy’ theorem.

Unit-2
Field theory: Extension field, Algebraic and Transcendental extensions, Seperable and inseperable extension, finite field perfect field.

Unit –3
Rings : Ring, Unit element, Zero devisors, Nilpotent element, Subring, Integral domain, Polynomial Ring in one and several variables, Ring Homomorphism: Definition and Basic Properties, Fundamental theorem.

Unit-4
Introduction to modules, Examples, Submodules, Quetient modules, Semisimple modules, Algebra of modules.

Unit-5

Texts / References
M.Sc. [Mathematics]  
Semester – I  
Paper – II [Real Analysis – I ] (3 + 1)  

Unit-1  
Introduction of Riemann -stieltjes Integral, some theorem on Riemann-stieltjes Integral, Properties of the Riemann-stieltjes Integral, Integration and differentiation. The fundamental theorem of calculus.

Unit-2  

Unit-3  
Sequence and series of function, pointwise and uniform convergence, Cauchy criterion for uniform convergence. Test for uniform convergence (Weierstrass M-Test, Abel’s and Direchlets test) uniform convergence and continuity. Weierstrass approximation theorem. Power series. Uniqueness theorem for power series.

Unit-4  
Function of several variable. Linear transformation, Derivatives in an open subset of $\mathbb{R}^n$. Chain rule, Interchange of the order of differentiation, Derivatives of higher order. Taylor’s theorem. Inverse function theorem. The implicit function theorem.

Unit-5  
Jacobians, Extremum problem with constraints, Lagrange’s multiplier method, Differentiation of integrals Differential forms, Stoke’s theorem.

Texts / References  
2. T.M. Apostal, Mathematical Analysis, Narosa  
3. H.L. Rayden, Real Analysis, Macmillan (Indian edition)
Unit-1

Countable and uncountable sets. Cardinal numbers and its arithmetic. Schroeder–Bernstein theorem, Cantors theorem and there continuum hypothesis, Zorn’s lemma well ordering theorem.

Unit-2

Definition of topological space, Example of topological spaces. Metric topology, Basis, Subspaces, Neighborhood, Closure, Inferior and limit points. Continuous function and homeomorphism.

Unit-3

First & Second countable spaces. Lindelof’s theorem, separable spaces, second countable.

Unit-4


Unit-5

Connectedness: Separated sets, connected spaces. Connectedness on real line, components, Locally connected spaces.

Texts / References

2. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill
Unit-1
Algebra of complex numbers, Geometric representation of complex numbers Limit, continuity and Differentiability of complex functions, Analytic functions, Complex integration, Cauchy-Goursat theorem, Cauchy integral formula, Higher order derivatives.

Unit-2
Morera’s theorem, Cauchy’s inequality, Liouville’s theorem, Fundamental theorem of algebra, Taylor’s theorem.

Unit – 3
Maximum Modulus principle, Schwartz lemma, Laurent’s series, Isolated singularities, Meromorphic functions, Argument principle, Roche’s theorem, Inverse function Theorem.

Unit-4
Residues, Cauchy residue theorem, Evaluation of Integrals, Branches of many valued functions special reference to arg z, logz and $z^n$.

Unit-5
Bilinear transformation, their properties and classification, Definition and example of conformal mapping, Space of analytic function, Hurwitz theorem, Montel’s theorem, Riemann mapping theorem.

Texts / References
1. J.B. Convey, Functions of one complex variable, Springer-Verlag.
M.Sc. [Mathematics]
Semester – I
Paper – V : Optional (i) [Advanced discrete Mathematics](3 + 1)

Unit - 1
Formal Logic statements, Symbolic representation and Tautologies, Quantifiers, Predicates and validity. Proposition logic.

Unit – 2
Graph Theory: Definition of (undirected) graph, Sub graph, Paths, Circuits & cycles. Simple graph, Weight Graph, Degree of vertices, Connectivity. Planer graph and their properties.

Unit – 3
Euler’s formula for connected planar graphs. Complete and complete Bipartite graphs. Kuratowski’s Theorem (statement only) and its use.

Unit – 4
Matrix representation of Graphs. Adjacency and incidence matrices of a Graph. Isomorphic and Homomorphism Graph.

Unit – 5

Texts / References
M.Sc. [Mathematics]
Semester – I
Paper – V : Optional : (ii) [Ordinary Differential Equations] (3 + 1)

Unit -1


Unit -2


Unit -3

Two Dimensional Autonomous Systems and Phase Space Analysis: critical points, proper and improper nodes, spiral points and saddle points.

Unit -4


Unit -5

Boundary Value Problems for Second Order Equations: Green's function, Sturm comparison theorems and oscillations, eigenvalue problems.

Texts / References

1. M.D. Rai Singhania, S. Chand Publications, ODE & PDE.
M.Sc. [Mathematics]  
Semester – II  
Paper – I  [Advanced Abstract Algebra – II ](3 + 1)

Unit-1  
Cauchy’s theorem, Sylow’s p-sub-group, Sylow’s theorem. Normal and subnormal series, Jordan-Holder theorem

Unit-2  
Galois extension, normal extension of a Field, Fundamental theorem Galois theory, Solution of polynornial equation by radicals, Insolvability of the general equation of degree 5 by radicals.

Unit -3  
Ideals : Left and right ideals, Maximal ideals, prime ideals, Generator, Basic properties of ideals, Algebra of ideals, Quotient Ring, Ideals in quotient ring.

Unit-4  
Modules: Momomorphism, Isomorphism, Finitely generated modules, Uniform modules, Primary Modules, Noether-Laskar theorem, fundamental structure, Theorem of modules.

Unit-5  

Text / References :  
M.Sc. [Mathematics]
Semester – II
Paper –II  [ (Labesque Measure & Integration) – II ](3 + 1)

Unit-1

Unit-2

Unit-3
The four derivatives. Functions of Bounded variation Lebesgue, Differentiation Theorem, Differentiation and Integration.

Unit-4
The L^p-space, convex function, Jensen’s inequality. Holder and Minkowaski inequality.

Unit-5
Convergence in measure, uniform convergence and almost uniform convergence.

Texts / References
5. T.M. Apostal, Mathematical Analysis, Narosa
6. H.L. Rayden , Real Analysis, Macmillan (Indian edition)
Unit-1
Sapereation axioms T0, T1, T2, T3, T4. and their characterizations and basic properties. Urysohn’s lemma. Tietz extension theorem.

Unit-2
Product Topology := Definition and Examples. Product of compact space, connected space, path connectedness and path components. Tychonoff product topology in terms of subspace and its characterization projection map.

Unit-3
Embedding and metrization. Embedding lemma and Tychonoff embedding. The Urysohn metrization theorem.

Unit-4
Nets and Filters: Topology and convergence of nets Hausdorffness and nets. Compactness and nets Filters and their convergence.

Unit-5
Canonical way of converting nets to filters and vice-versa. Ultra filters and compactness.

Texts / References
2. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw Hill
M.Sc. [Mathematics]
Semester – II
Paper –IV [Complex Analysis – II ](3 + 1)

Unit-1

Weierstrass factorization theorem, Gamma function and its properties, Riemann Zeta function, Riemann’s functional equation.

Unit-2

Runge’s theorem Mittag-leffler’s theorem, Analytic Continuation, Uniqueness of direct analytic continuation along a curve, power series method of analytic continuation.

Unit -3

Schwarz Reflection principle, Monodromy theorem and its consequences, Harmonic function on a disk.

Unit-4

Harnax’s Inequality and theorem and Dirichlet problem, Green’s functions Canonical products, Jenson’s formula, poisson Jenson formula.

Unit-5

Convergence, Bloch’s theorem, The little Picard theorem, Schottky’s theorem.

Texts / References

4. J.B. Convey, Functions of one complex variable, Springer-Verlag.
Unit-1

**Lattices**: Lattices as partially ordered set. Their properties. Lattices as algebraic systems. Sublattices, Direct products and Homomorphism.

Unit-2

Some Special Lattices: As, Complete Lattices, Complemented Lattices and Distributive Lattices.

Unit-3


Unit-4

Boolean forms and their equivalence, Minterms Boolean forms, Sum of products canonical forms. Minimization of Boolean functions. Application of Boolean Algebra to Switching Theory (Using AND, OR & NOT gates)

Unit-5


Text/References:

Unit -1
Non-Linear first order : PDE, Complete Integrals, Envelops, Characteristics. Examples of PDE, Classification.

Unit -2
Transport Equation – Initial Value Problem, Non-Homogeneous equations.

Unit -3

Unit -4

Unit -5

Text/References:
Unit- 1
Co-ordinates system, Vector spaces, inner products and norms.
Tensors: Algebra of Tensors, symmetric and skew symmetric Tensors, Types of tensor.

Unit- 2
Products, Rank of tensors. Reimannian metric, christoffel symbols I and II kind.

Unit- 3
Ricci tensor, Riemann christoffel curvature tensor and its symmetry properties. Ricci’s identities.

Unit- 4
Riemann christoffel tensor of the first kind, Projective curvature tensor.

Unit- 5

References:
Unit-1

Unit-2

Unit-3
Symmetric kernels. Orthonormal system of functions. Fundamental properties of eigen values and eigen functions for symmetric kernels. Solutions of, integral equations with symmetric kernels.

Unit-4
Definition of a boundary value problem for an ordinary equation of the second order and its reduction to a Fredholm integral equation of the second kind. Dirac Delta Function. Green's function approach to reduce boundary value problems of a self-adjoint differential equation with homogeneous boundary conditions to integral equation forms.

Unit-5

References
Unit – 1

**Approximation**: uniform approximation by polynomials, data fitting and least squares approximation. Principles of floating point, computations and rounding errors.

Unit – 2

Systems of Linear Equations: factorization methods, pivoting and scaling, residual error correction method.

Unit – 3

**Iterative methods**: Jacobi, Gauss-Seidel methods with convergence analysis, conjugate gradient methods.

Unit – 4

**Eigenvalue problems**: only implementation issues. Interpolation: review of Lagrange interpolation techniques.

Unit – 5


**Texts / References**

Unit-I Gamma function and Beta function
Definition of gamma function, Eulerian Definition, Euler's Product, Evaluation of gamma terms. Beta Function: Definition, Gauss's multiplication formula, related functions.

Unit-II
Bessel function: Definition of J_n (x), Generating function for J_n (x), Alternative forms of generating function, Bessel's differential equation, Recurrence relation for J_n (x), Bessel's Integral.

Unit-III
Legendre polynomials: Introduction, Recurrence relations, Generating function for Legendre polynomials Rodrigues formula, Hypergeometric forms of P_n (X), Some other generating functions, Laplace's first integral form, Legendre's differential equation, Orthogonal properties.

Unit IV-
Hermite polynomials: Introduction, Recurrence relations, Rodrigue’s formula, Generating functions, Bat’sman Generating function, Hermite’s differential equation, Orthogonal properties, Expansion of polynomials, more generating functions.

Unit V-

Text/References:
1- Rainville, E.D.; Special Functions, The Macmillan co., New york 1971,
3- Saran, N., Sharma S.D. and Trivedi - Special Functions with application, Pragati prakashan, 1986.
Unit – 1
Fundamental lemma of calculus of variations Euler’s equation for one dependent function and its generalization to (i) n dependent function (ii) higher order derivatives.

Unit-2
Hydrodynamics: Lagrangian and Eulerian approaches, Equation of continuity, Boundary surface, Streamlines, Velocity potential, Euler’s equation of motion, Steady motion, Bernoulli’s equation.

Unit-3
Catenary: Definitions, Equation of common Catenary, Geometrical properties of the Catenary, Parametric equation of a common Catenary, Approximation to the common Catenary.

Unit-4
Forces in three dimensions, Poinsot’s central axis, Wrenches, Null lines and planes, Motion of particle in three dimensions: Acceleration in terms of different coordinate systems.

Unit-5
Rigid dynamics: Moments and product of inertia, principal axes, D’Alembert’s principal, Motion about fixed axis.

Text / References Books (s):
5. S K Som and G Biswas: Fluid mechanics and fluid machines
Unit-1
Dirichlet Series and Euler Products.

Unit- 2
The Function defined by Series, The half plane of convergence of a Dirichlet Series.

Unit-3
The Integral formula for the coefficients of Dirichlet Series.

Unit- 4
Analytic Properties of Dirichlet Series, Mean value formula for Dirichlet Series.

Unit-5
Properties of Gamma Function , Integral representation of Hurwitz zeta function, Analytic Continuation of Hurwitz zeta function.

Text/References:
M.Sc. [Mathematics]
Semester – IV
Paper I : [Operational Research] (3+1)

Unit -1
General Linear Programming Problem, Formulation of the Linear Programming Problem, Solution by Graphical method, Simplex method.

Unit -2
Solution of a Linear Programming Problem by Big-M method, Two phase method, concept of duality, Fundamental theorem of duality, Dual simplex method.

Unit -3
Assignment problem: Solution of assignment problem, Unbalanced Assignment Problem, Crew Assignment problem, Traveling Salesman problem. Sequencing problem, processing \( n \) jobs on two machines, \( n \) jobs on three machines, \( n \) jobs on \( m \) machines, processing two jobs through \( m \) machines.

Unit-4

Unit -5

Texts / References

2- S.D. Sharma, Operation Research,
5- G. Hadley, Linear and Dynamic programming, Addison - Wesley Reading Mass.
7- Prem Kumar Gupta and D.S. Hira, Operation Research, an Introduction, S. Chand & Company Ltd. New Delhi.
Unit-1

Unit-2
Normed linear spaces of bounded linear transformations, dual spaces with examples. Uniform boundedness theorem and some of its consequences. Open mapping and closed graph theorems.

Unit-3

Unit-4

Unit-5

Text/References:
Unit-1

Unit-5
Surfaces in Euclidean spaces, vector fields on surfaces, orientation, Gauss map.

Unit-3
Geodesics, parallel transport, Weingarten map.

Unit-4
Curvature of plane curves, arc length and line integrals. Curvature of surfaces.

Unit-5
Parametrized surfaces, local equivalence of surfaces. Gauss-Bonnet Theorem, Poincare-Hopf Index Theorem.

Texts / References
Unit- 1

Unit- 2

Unit- 3

Unit- 4
Stress components in a real fluid. Relations between rectangular components of stews. Connection between stresses and gradients of velocity. Navier-stoke’s equations of motion. Plane Poiseuille and Couette flows between two parallel plates

Unit- 5

TEXT BOOKS.
2- An introduction to Fluid Dynamics by R.K. Rathy, Oxford and IBH Published Co.

REFERENCE BOOKS:
2- Fluid Mechanics by Irfan A Khan (H.R.W.)
Unit-1

Unit-2

Unit-3

Unit-4
Bending of light rays in a gravitational field. Gravitational redshift of spectral lines. Radar echo delay.

Unit-5

Recommended Books:

References:
Unit-1


Unit-2

Scalar data types-declarations, Different types of integers, Different kinds of integer constants, Floating-Point types, Initialization, Mixing types, Explicit conversions-Casts, Enumeration types, The void data type, Typedefs.

Unit-3

Operators and Expressions-Precedence and Associativity, Unary plus and minus operators, Binary arithmetic operators, Arithmetic assignment operators, Increment and decrement operators, Rational operators, Logical operators, Bit-Manipulation operators, Bitwise assignment operators, cast operator, Size of operators, Conditional operator, Memory operators.

Unit-4

Control flow-conditional branching, The switch statement, Looping, Nested loops, The break and continue statements, Infinite loops.

Unit-5

Array and pointers: declaring an array, Arrays and Memory, Initializing arrays, Pointer arithmetic, Passing pointers as function arguments, Accessing array elements through pointers, Passing arrays as function arguments, Strings, Multidimensional arrays, Arrays of pointers, Pointers to pointers, Dynamic memory allocation, Structures and unions-structures, Functions passing arguments, Declarations and calls, Pointers to functions.

Text/References: