AKS UNIVERSITY, SATNA (MP)

Faculty of Basic Science

Department of Mathematics

Syllabus & Credit Scheme

M.Sc. (Mathematics)

Semester-I

Sr.	Subject Code	Subject/ Paper	L	T	Credit
1	78MS101	Advanced Abstract Algebra-I	3	1	4
2	78MS102	Real Analysis-I	3	1	4
3	78MS103	Topology-I	3	1	4
4	78MS104	Complex Analysis-I	3	1	4
Elective-I (Choose any one of these)			3	1	4
5	78MS105-A	Advanced Discrete Mathematics-I			
	78MS105-B	Ordinary Differential Equation			
		Total			**20**

M.Sc. (Mathematics)

Semester-II

Sr.	Subject Code	Subject/ Paper	L	T	Credit
1	78MS201	Advanced Abstract Algebra-II	3	1	4
2	78MS202	Real Analysis-II	3	1	4
3	78MS203	Topology-II	3	1	4
4	78MS204	Complex Analysis-II	3	1	4
Elective-II (Choose any one of these)			3	1	4
5	78MS205-A	Advanced Discrete Mathematics-II			
	78MS205-B	Partial Differential Equation			
		Total			**20**

AKS UNIVERSITY, SATNA (MP)

Faculty of Basic Science

Department of Mathematics

Syllabus & Credit Scheme

M.Sc. (Mathematics)

Semester-III

Sr.	Subject Code	Subject/ Paper	L	T	Credit
1	78MS301	Tensor	3	1	4
2	78MS302	Integral Equation	3	1	4
3	78MS303	Advanced Numerical Techniques	3	1	4
4	78MS304	Special Function-I	3	1	4
Elective-III (Choose any one of these)			3	1	4
5	78MS305-A	Mechanics			
	78MS305-B	Analytic Number Theory			
		Total			**20**

M.Sc. (Mathematics)

Semester-IV

Sr.	Subject Code	Subject/ Paper	L	T	Credit
1	78MS401	Operational Research	3	1	4
2	78MS402	Functional Analysis	3	1	4
3	78MS403	Differential Geometry	3	1	4
Elective-IV (Choose any one of these)			3	1	4
5	78MS405-A	Fluid Mechanics			
	78MS405-B	General Theory of Relativity			
	78MS405-C	Programming in C			
6	78MS451	Project Work			10
		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 elemeny ,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

Canonical Forms : Similarity of linear transformations, Invariant subspace , Reduction to triangular form, Nilpotent transformations.

Texts / References

1. I.N. Herstein, Topics in Algebra,Wiley Eastern,New Delhi.
2. V.Sahai & V. Bisht,Algebra,Narosa Publishing House.
3. P.B. Bhattacharya ,S.K.Jain S.R. Nagpaul,Basic Abstract Algebra, Cambridge University press.
4. N.Jacosan,Basic Algebra,Voi. I,II & VIII, Hindustan Publishing Company.

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, Intigration and differentiation. The fundamental theorem of calculus.

Unit-2

A Relation between the Riemann Integral and Riemann stieltjes Integral. Rearrangements of terms of a series. Riemann's theorem.

Unit-3

Sequence and series of function, pointwise and uniform connergence, Cauchy criterion for uniform connergence. Test for uniform connergence (Weierstrass M-Test, Abel's and Direchlets test) uniform connergence 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 R^n. Chain rule, Interchange of the order of differentiation, Derivatives of higher order. Toylor'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

1. WaterRudin,Principles of Mathematical Analysis,McGraw Hill.
2. T.M. Apostal, Mathematical Analysis,Narosa
3. H.L. Rayden , Real Analysis,Macmillan (Indian edition)

M.Sc. [Mathematics]
Semester – I
Paper –III [Topology – I] (3 + 1)

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, Inferiuor and limit points. Continuous function and homeomorphism.

Unit-3

First & Second countable spaces. Lindelof's theorem, seperable spaces, second countable.

Unit-4

Compactness : Compactness, Basic properties of compactness. Finite Intersection property. Sequntially & countably compact sets. Local compactness.

Unit-5

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

Texts / References

1 . J.R. Munkres, Topology – Afirst course,Prentice-Hall of india.

2. G.F.Simmons,Introduction to Topology and Modern Analysis,McGraw Hill

3.K.D.Joshi : Introduction to Topology,Wiley Eastern.

M.Sc. [Mathematics]
Semester – I
Paper –IV [Complex analysis – I](3 + 1)

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 singularitities, 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.
2. S.Ponnuswamy,Fundamentals of Complex Analysis, Narosa Publishing House.
3. L.V. Ahlfors, Complex Analysis,McGrawHill.

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

Tree: Definition, types of tree and networks, Spanning Tree, cut-sets, Fundamental cut-set. Minimal Spanning tree and Kruskal's Algorithm.

Texts / References

1. J.P.Tremblay & R. Manohar, Discrete Mathematical Structure with Applications to computer science, McGraw-Hill, Book Co. 1997.
2. Seymour Lepschutz,Finite mathematics, McGraw-Hill, Book Co., New York
3. C.L.Liu, Elements of Discrete Mathematics, McGraw-Hill, Book Co.

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

Unit -1

Existence and Uniqueness of Initial Value Problems: Picard's Theorems, Gronwall's inequality, continuation of solutions and maximal interval of existence, continuous dependence.

Unit -2

Higher Order Linear Equations and linear Systems: fundamental solutions, Wronskian, variation of constants, matrix exponential solution.

Unit -3

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

Unit -4

Asymptotic Behavior: stability (linearized stability and Lyapunov methods).

Unit -5

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

Texts / References

1. M.D.Rai Singhania,S. Chand Publications, ODE & PDE.
2. M. Hirsch, S. Smale and R. Deveney, Differential Equations, Dynamical Systems and Introduction to Chaos, Academic Press, 2004
3. L. Perko, Differential Equations and Dynamical Systems, Texts in Applied Mathematics, Vol. 7, 2nd ed., Springer Verlag, New York, 1998.
4. M. Rama Mohana Rao, Ordinary Differential Equations: Theory and Applications. Affiliated East-West Press Pvt. Ltd., New Delhi, 1980.
5. D. A. Sanchez, Ordinary Differential Equations and Stability Theory: An Introduction, Dover Publ. Inc., New York,

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,Jorden-Holder theorem

Unit-2

Galois extension, normal exrension of a Field , Fundamental theorem Galois theory , Solution of pollynomial equation by radicals , Insolvability of the general equation of degree 5 by radicals.

Unit -3

Ideals : Left and right ideals , Maximal ideas,prime ideals,Generator, Basic properties of ideals,Algebra of ideals,Quotient Ring,Ideals in quotent ring.

Unit-4

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

Unit-5

Canonical Forms : Index of Nilpotency. Invariants of Nilpotent transformation. The Primary decomposition Theorem. Jordan blocks and Jordan forms.

Text / References :

5. I.N. Herstein, Topics in Algebra,Wiley Eastern,New Delhi.
6. V.Sahai & V. Bisht,Algebra,Narosa Publishing House.
7. P.B. Bhattacharya ,S.K.Jain S.R. Nagpaul,Basic Abstract Algebra, Cambridge University press.
8. N.Jacosan,Basic Algebra,Voi. I,II & VIII, Hindustan Publishing Company.

M.Sc. [Mathematics]
Semester – II

Paper –II [(Labesque Measure & Integration) – II](3 + 1)

Unit-1

Introduction, Lebesgue outer measure and measurable set. Regularity of a measure. Borel measurability of set. Lebesgue measurability, non- measurability of set.

Unit-2

Measurable function, Introduction, Properties of Lebesgue measurable functions.Integral of Non negative measurable function. Integration of series. Reimann and Lebesgue integral. The general integral.

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

4. WaterRudin,Principles of Mathematical Analysis,McGraw Hill.
5. T.M. Apostal, Mathematical Analysis,Narosa
6. H.L. Rayden , Real Analysis,Macmillan (Indian edition)

M.Sc. [Mathematics]
Semester – II
Paper –III [Topology – II](3 + 1)

Unit-1

Saperation axioms T0, T1, T2, T3, T4.and their characterizations and basic properties. Urysohn's lemma. Tietz extention theorem.

Unit-2

Product Topology :=Difinition and Examples. Product of compact space, connected space, path connectedness and path components. Tychonoft product topology in terms of subspace and its characterization projection map.

Unit-3

Enbedding and metrization. Embedding lemma and Tychonoft embedding. The Urysohn metrization theorem.

Unit-4

Nets and Filters : Topology and convergence of nets Hausdroftness and nets. Compactness and nets Filters and their convergance.

Unit-5

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

Texts / References

1 . J.R. Munkres, Topology – Afirst course,Prentice-Hall of india.

2. G.F.Simmons,Introduction to Topology and Modern Analysis,McGraw Hill

3.K.D.Joshi : Introduction to Topology,Wiley Eastern.

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.
5. S.Ponnuswamy,Fundamentals of Complex Analysis, Narosa Publishing House.
6. L.V. Ahlfors, Complex Analysis,McGrawHill.

M.Sc. [Mathematics]
Semester – II

Paper-V: Optional (i)[Advanced Discrete Mathematics-II](3+1)

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

Boolean Algebra : Boolean Algebras as Lattices.Various Boolean identities. The Switching Algebra examples. SubAlgebra, Direct products and Homomorphism.

Unit-4

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

Unit-5

Introductory Computability Theory : Finite state machines and their transition table diagrams. Equivalence of finite state machines. Reduced Machines. Homomorphism. Finite autometa,Acceptors, Non- deterministic Finite autometa.

Text/References:

4. J.P.Tremblay & R. Manohar, Discrete Mathematical Structure with Applications to computer science, McGraw-Hill, Book Co. 1997.
5. Seymour Lepschutz,Finite mathematics, McGraw-Hill, Book Co., New York
6. C.L.Liu, Elements of Discrete Mathematics, McGraw-Hill, Book Co.

M.Sc. [Mathematics]
Semester – II

Paper-V: Optional (ii)[Partial Differential Equations-II](3+1)

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

Laplace's equation : Fundamental solution, Mean Value Formulas, Properties of Harmonic functions. Green's function. Energy methods.

Unit -4

Heat equation : Fundamental solution,Mean Value Formulas, Properties of solutions, Energy methods.

Unit- 5

Wave Equation : Solution by spherical Means, Non-Homogeneous equations,Energy methods.

Text/References:

L.C. Evans, Partial Differential Equations, 1998.

M.Sc. [Mathematics]
Semester – III
Paper-I[Tensor] (3+1)

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

Bianchi Identities and Einstein tensor. Covarient derivatives. Intrinsic derivatives and geodesic.

References :

1. J.V.Narlikar,General Relativity and Cosmology: The Macmillan Company of India Limited 1978.
2. C.E. Weatherburn,An Introduction to Riemannian Geometry and the tensor calculus,Cambridge university press,1950.

M.Sc. [Mathematics]
Semester – III

Paper II: [Integral equations] (3+1)

Unit-1

Definitions of Integral Equations and their classification. Eigen values and Eigen functions. Fredholm integral equations of kind with separable kernels. Reduction to a system of algebraic equations. An Approximate Method. Method of Successive Approximations. Iterative Scheme for Fredholm Integral equations of the second kind. Conditions of uniform convergence and uniqueness of series solution. Resolvent kernel and its results. Application of iterative Scheme to Volterra integral equations of the Second kind.

Unit-2

Integral Transform Methods. Fourier Transform. Laplace Transform. Convolution integral. Application to Volterra integral equations with convolution-type kernels. Solution of the Cauchy-type singular integral equation. The Hilbert kernel. Solution of the Hilbert-Type singular integral-equation.

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

Integral representation formulas for the solution of the Laplace's and Poisson's equations. Newtonian single-layer and double layer potentials. Integral equation formulation of boundary value problems for Laplace's equation.

References

1. R.P. Kanwal, Linear Integral Equation. Theory and Techniques, Academic Press, New York, 1971.

M.Sc. [Mathematics]
Semester – III

Paper III: [Advanced Numerical Techniques] (3+1)

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

Numerical Integration: integration by interpolation, adaptive quadratures and Gauss methods. Initial Value Problems for Ordinary Differential Equations: Runge-Kutta methods, predictor and corrector scheme, stability and convergence analysis.

Texts / References

1. K.E. Atkinson, An Introduction to Numerical Analysis, Wiley, 1989.
2. S.D. Conte and C. De Boor, Elementary Numerical Analysis %G–%@ An Algorithmic Approach, McGraw-Hill, 1981.
3. K. Eriksson, D. Estep, P. Hansbo and C. Johnson, Computational Differential Equations, Cambridge Univ. Press, Cambridge, 1996.
4. G.H. Golub and J.M. Ortega, Scientific Computing and Differential Equations: An Introduction to Numerical Methods, Academic Press, 1992.
5. J. Stoer and R. Bulirsch, Introduction to Numerical Analysis, 2nd ed., Texts in Applied Mathematics, Vol. 12, Springer Verlag, New York, 1993.

M.Sc. [Mathematics]
Semester – III
Paper IV: [Special Function –I](3+1)

Unit-I Gamma function and Beta function

Definition of gamma function ,Eulerian Definition, Euler's Peoduct, Evaluation of gamma terms.Beta Function : Definition, Gauss's multiplication formula,related functions.

Unit-II

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

Unit-III

Legendre polynomials: Introduction, Recurrence relations, Generating function for Legendre polynomials Rodrigues formula, Hypergeometric forms of Pn (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, Othogonal properties, Expansion of polynomials, more generating functions.

Unit V-

Laguerre Polynomials : I. Simple Laguerre Polynomials: Introduction, The Laguerre Polynomials Ln(X), Generating functions, recurrence relations, Laguerre's differential equation, Rodrigue's formula, Orthogonal properties.
II. Generaliged Laguerre Polynomials: Introduction, Rodrigue's formula, Orthogonal properties. Expansion of polynomials.

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.
4- Lebdev, N.N, Special Functions and Their Applications, Prentice Hall, Englewood Cliffs, New jersey, USA 1995.
5- Whittaker, E.T. and Watson, G.N., A Course of Modern Analysis Cambridge University Press, London, 1963.
2- Srivastava, H.M. Gupta, K.C. and Goyal, S.P.; The H-functions of One and Two Variables with applications, South Asian Publication, New Delhi.

AKS UNIVERSITY
M.Sc. (Mathematics)- Semester- III
Paper V(Optional) (i) [Mechanics](3+1)

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):

1. J.N. Kapoor and J.D. Gupta: A text book of Dynamics. 5th edition, 1999.
2. F. Charlton: Text book of fluid dynamics, C.B.S. Pub. 2004.
3. S.L. Loney: The elements of Statics and dynamics, Cambridge Univ. Press.
4. A.S. Ramsey: A treatise on hydrodynamics, Bell and sons Ltd, London.
5. S K Som and G Biswas: Fluid mechanics and fluid machines
6. F. Gantmacher, Lectures in Analytic Mechanics MIR Publishers.
7. H. Goldstein Classical Mechanics (2nd Edition), Narosa Publishing House, New Delhi
8. M.L. Khanna: Dynamics of a rigid body, Jai Prakash Nath & Co.
9. M.D. Rai Singhania: Fluid dynamics, S. Chand & Co., New Delhi

M.Sc. [Mathematics]
Semester – III

Paper-V: (Optional) (ii)[Analytic Number Theory](3+1)

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:

1. T. M. Apostol,Introduction to Analytic Number Theory,Narosa Pub. House,1989

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

Transportation problem: Initial basic feasible solution, North - West Corner Method Least – Cost Method. Vogel's Approximation method, Optimality test by MODI method, Stepping Stone method, Degeneracy in Transportation Problem.

Unit -5

Network analysis, constraints in Network, Construction of network, Critical Path Method (CPM) PERT, PERT Calculation, Resource Leveling by Network Techniques and advances of network (PERT/CPM) Simulation : Monte - Carlo Simulation.

Texts / References

1- Kanti Swarup, P.K. Gupta and Manmohan, Operations Research, Sultan Chand & Sons, New Delhi.
2- S.D, Sharma, Operation Research,
3- F.S, Hiller and G.J. Lieberman, Industrial Engineering Series, 1995 (This book comes with a CD containing software)
4- G. Hadley , Linear Programming, Narosa Publishing House. 1995.
5- G. Hadley, Linear and Dynamic programming, Addison - Wesley Reading Mass.
6- H.A. Taha, Operations Research - An introduction, Macmillan Publishing co. Inc. New York.
7- Prem Kumar Gupta and D.S. Hira, Operation Research, an Introduction, S. Chand & Company Ltd. New Delhi.

M.Sc. [Mathematics]

Semester – IV

Paper II : [Functional Analysis] (3+1)

Unit-1

Normed linear spaces. Banach spaces and examples. Quotient space of normed linear spaces and its completeness, equivalent norms. Basic properties of finite dimensional Normed linear spaces and compactness. Weak convergence and bounded linear transformations,Riesz Lemma.

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

Hahn-Banach theorem for real linear spaces, complex linear spaces and normed linear spaces. Reflexive spaces. Weak Sequential Compactness. Compact Operators. Solvability of linear equations in Banach spaces. The closed Range Theorem.

Unit-4

Inner product spaces. Hilbert spaces. Orthonormal Sets. Bessel's inequality. Complete orthonormal sets and Parseval's identity. Structure of Hilbert spaces. Projection theorem. Riesz representation theorem.

Unit-5

Adjoint of an operator on a Hilbert space. Reflexivity of Hilbert spaces. Self-adjoint operators, Positive, projection, normal and unitary operators. Application to Sturm-Liouville Problems.

Text/References:

1. H.L. Royden, Real Analysis, Macmillan Publishing Co. Inc., New York, 41h Edition, 1993.
2. S.K. Berberian, Measure and integration, Chelsea Publishing Company, New York, 1965.
3. G. de Barra, Measure Theory and Integration, Wiley Eastern Limited, 1981.
4. P.K. Jain and V.P. Gupta, Lebesgue Measure and Integration, New Age International (P) Limited, New Delhi, 2000.
5. Richard L. Wheeden and Antoni Zygmund, Measure and Integral : An Introduction to Real Analysis, Marcel Dekker Inc. 1977.

M.Sc. [Mathematics]
Semester – IV

Paper III : [Differential Geometry] (3+1)

Unit-1

Graphs and level sets of functions on Euclidean spaces, vector fields, integral curves of vector fields, tangent spaces.

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

1- M. doCarmo, Differential Geometry of Curves and Surfaces, Prentice Hall, 1976.
2- B. O'Neill, Elementary Differential Geo-metry, Academic Press, New York, 1966.
3- J.J. Stoker, Differential Geometry, Wiley-Interscience, 1969.
4- J.A. Thorpe, Elementary Topics in Differential Geometry, Springer (India), 2004.

M.Sc. [Mathematics]
Semester – IV

Paper IV : Optional : (i) [Fluid Mechanics] (3+1)

Unit- 1

Kinematics-Lagrangian and Eulerian methods. Equation of continuity. Boundary surfaces. Stream lines. Path lines and streak lines. Velocity potential. Irrotational and rotational motions. Vortex lines.

.

Unit- 2

Equations of Motion-Lagrange's and Euler's equations of motion. Bernoulli's theorem. Equation of motion by flux method. Equations referred to moving axes. Impulsive actions. Stream function. Irrotational motion in two-dimensions. Complex velocity potential. Sources, sinks, doublets and their images. Conformal mapping. Milne-Thomson circle theorem.

Unit- 3

Two-dimensional irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of liquid. Kinetic energy of liquid. Theorem of Blasius. Motion of a sphere through a liquid at a rest at infinity. Equation of a motion of sphere. Stoke's stream function. Liquid streaming past a fixed aphere. Equation of motion of a sphere. Stoke's stream function.

Unit- 4

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

Unit- 5

Dynamical similarity. Buckingham p-theorem. Reynolds number. Prandt's boundary layer. Boundary layer equations in two-dimensions. Blasius solution. Boundary layer thickness. Displacement thickness. Karman integral conditions. Separation of boundary layer flow.

TEXT BOOKS.

1- A text book of Fluid Mechanics in SI units by R.K, Rajput.
2- An introduction to Fluid Dynamics by R.K. Rathy, Oxford and IBH Published Co.

REFERENCE BOOKS:

1- Fluid Mechanics (Springer) By Joseph H. Spurk.
2- Fluid Mechanics by Irfan A Khan (H.R.W.)
3- An Introduction to Fluid Mechanics by G.K. Batchelor, Foundation Books, New Delhi, 1994.

M.Sc. [Mathematics]
Semester – IV

Paper IV : Optional : (ii) [General Theory of Relativity](3+1)

Unit-1
Review of the special theory of relativity and the Newtonian Theory of gravitation. Principle of equivalence and general covariance, geodesic principle.

Unit-2
Newtonian approximation of relativistic equations of motion. Einstein's field equations and its Newtonian approximation.

Unit-3
Schwarzschild external solution and its isotropic form. Planetary orbits and anologues of Kepler's Laws in general relativity. Advance of perihelion of a planet.

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

Unit-5
Energy-momentum tensor of a perfect fluid. Schwarzschild internal solution. Boundary conditions. Energy-Momentum tensor of an electromagnetic field.

Recommended Books:
[1] S.R.Roy and Raj Bali: Theory of Relativity Jaipur Publishing House,Jaipur, 1987.
[2] S. K. Shrivastva: General Relativity and Cosmology, PHI, NewDelhi.
[3] J.V. Narlikar, General Relativity and Cosmology: The Macmillan
Company of India Limited, 1978.
References:
[1] C.E. Weatherburn, An Introduction to Riemannian Geometry and the tensor Calculus,Cambridge University, Press 1950.
[2] H. Stephani, General Relativity: An Introduction to the theory of the gravitational field,Cambridge University Press 1982.
[3] A.S. Eddington, The Mathematical Theory of Relativity. Cambridge University Press,1965.
[4] R. Adler, M. Bazin, M. Schiffer, Introduction to general relativity, McGraw Hill Inc.1975.

M.Sc. [Mathematics]
Semester – IV

Paper IV : Optional : (iii) [Programming in C] (3+1)

Unit-1

An overview of programming, Programming language, Classification, C essentials-Program Development, Functions, Anatomy of a C function, Variables and Constants, Expressions, Assignments, Formatting sources files, Continuation character, The processor.

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:

1. Samuel P. Harkison and Gly L. Steele Jr., C: A reference manual, 2nd Edition, Prentice Hall, 1984.
2. Brian W. Kernighan and Dennis M. Ritchie, The C Programme Language, 2nd Edition(ANSI features), Prentice Hall, 19849