BHAGWANT UNIVERSITY

Sikar Road, Ajmer

Rajasthan

Syllabus

Department of Mathematics

M. A / M Sc

M.A./ M.SC. (MATHEMATICS)

FIRST SEMESTER

Subject Code	Subject Name	Teaching hours			Distribution of marks					
					Theory Papers			Practicals		
		L	T	P	Internal	External	Total	internal	External	total
	Abstract Algebra	3	1	-	30	70	100	-	-	-
	Complex Analysis	3	1	-	30	70	100	-	-	-
	Tensor	3	1	-	30	70	100	-	-	-
	Metric Space	3	1	-	30	70	100	-	-	-
	Special Functions	3	1	-	30	70	100	-	-	-
Total		15	5	-	150	350	500	-	-	-

SECOND SEMESTER

Subject Code	Subject Name	Teaching hours			Distribution of marks					
					Theory Papers			Practicals		
		L	T	P	Internal	External	Total	internal	External	total
	Linear Algebra	3	1	-	30	70	100	-	-	-
	Measure Theory	3	1	-	30	70	100	-	-	-
	Differential Geometry	3	1	-	30	70	100	-	-	-
	Topology	3	1	-	30	70	100	-	-	-
	Integral Transform	3	1	-	30	70	100	-	-	-
Total		15	5	-	150	350	500	-	-	-

THIRD SEMESTER

Subject Code	Subject Name	Teaching hours			Distribution of marks					
					Theory Papers			Practicals		
		L	T	P	Internal	External	Total	internal	External	total
	Functional Analysis & Integration Theory	3	1	-	30	70	100	-	-	-
	Calculas of Variations & Integral Equations	3	1	-	30	70	100	-	-	-
Optional Papers any three										
	Numerical Analysis	3	1		30	70	100	-	-	-
	Mathematical Statistics	3	1		30	70	100	-	-	-
	Operations Research	3	1	-	30	70	100	-	-	-
	Graph Theory	3	1	-	30	70	100	-	-	-
	Relativity & Cosmology	3	1	-	30	70	100	-	-	-
Total		15	5	-	150	350	500	-	-	-

FOURTH SEMESTER

Subject Code	Subject Name	Teaching hours			Distribution of marks					
					Theory Papers			Practicals		
		L	T	P	Internal	External	Total	internal	External	total
	Ordinary Differential Equtations	3	1	-	30	70	100	-	-	-
	Mechanics	3	1	-	30	70	100	-	-	-
Optional Papers any three										
	Discrete Mathematics	3	1		30	70	100	-	-	-
	Partial Differential Equtations	3	1		30	70	100	-	-	-
	Mathematical Programming	3	1	-	30	70	100	-	-	-
	Fluid Dynamics	3	1	-	30	70	100	-	-	-
	Fuzzy Mathematics	3	1	-	30	70	100	-	-	-
Total		15	5	-	150	350	500	-	-	-

M.A./ M.SC. (MATHEMATICS)

FIRST SEMESTER

ABSTRACT ALGEBRA

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I

Groups: Normal and subnormal series, composition series, theorems on isomorphism of groups, class equation for finite group, Burnside theorem.

UNIT-II

abelian groups, C -groups, solvable groups , Jordan-
Holder theorem, nilpotent groups.

UNIT-III

Euclidean rings: Polynomial rings, field theory-extension fields, algebraic and transcendental extensions, separable and inseparable extensions, normal extensions, perfect fields, finite fields, primitive elements, algebraically closed fields, automorphisms of extensions.

UNIT-IV

Galois extensions, fundamental theorem of Galois theory, solution of polynomial equations by radicals, insolvability of the general equation of degree 5 by radicals. Euclidean and polynomial rings, polynomials over rational fields, the Einstin criterion, polynomial rings over commutative ring, unique factorization domain, chain conditions on rings.

UNIT-V

Modules, sub modules, quotient modules, cyclic modules, simple module, semi simple modules, s emma, free Modules.

Reference Books:

(1)Algebra Maclane and Birkhoff Macmillan Company.
(2)Topics in Algebra I.N.Herstein Wiley Eastern Ltd.
(3) Abstract Algebra D.Chatterji PHI
(4) Modern Algebra A.R.Vasistha KPM

COMPLEX ANALYSIS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I
Complex integration, Cauchy's Goursat theorem, Cauchy's integral formula, higher order derivatives, Morera's theorem, Cauchy's inequality and Liouville's theorem.
UNIT-II
the fundamental theorem of algebra, Taylor's theorem, maximum modulus principle, Schwarz lemma, Laurent's series, Isolated singularities, meromorphic functions, the argument principle, Rouche's theorem, inverse function theorem.
UNIT-III
Residues, Cauchy's residue theorem, evaluation of integrals, branches of many valued functions with special reference to arg z, log z and z_n.
UNIT-IV
Spaces of analytic functions, Hurwitz's theorem. Montel's theorem , Riemann mapping theorem, Weierstrass factorization theorem.
UNIT-V
Gamma function and its properties, Riemann-
Zeta function. Riemann's functional equation, Runge's theorem, Mittag-Leffler's theorem, analytic continuation, uniqueness of direct analytic continuation.
Reference Books:
(1)Complex Analysis R. V. Churchil
(2) The Elements of Compex Analysis B. Choudhry
(3)Functions of One Complex Variable John B. Conway

TENSORS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I
Transformation of co-ordinates, covariant, contravariant and mixed tensors, invariants, addition, subtraction and multiplication of tensors, contraction of tensors.
UNIT-II
quotient law of tensors, fundamental tensors, length of curve , associated tensors.
UNIT-III
Christoffel symbols, covariant differentiation of tensors , law of covariant differentiation. geodesics, null geodesics, geodesics co-ordinates, parallelism.
UNIT-IV
Covariant derivative, Riemann-Christoffel tensor, curvature tensor, Ricci tensor.
UNIT-V
Bianchi identities, Riemann curvature, flat space, space of constant curvature.
Reference Books:
(1) Tensor Calculus B. Spain
(2) Advanced Tensor Analysis Raj Bali

(3) Cartesin Tensor A.M.Goodbody

METRIC SPACE

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I
Metric Spaces: Definition, Euclidean spaces, inequalities, bounded and unbounded metric spaces.
UNIT-II
Basic concepts of spheres, open sets, equivalent metrics, closed sets, neighborhoods, accumulation points, adherent points, closure interior exterior, frontier and boundary of a set, bases, subspaces of a metric spaces, product spaces.
UNIT-III
Complete Metric Spaces: Sequence and subsequences in metric spaces Cauchy sequences, complete metric space, Baire category theorem, completeness and contracting mappings, complete metric spaces, completion of a metric space.
UNIT-IV
Connectedness: Separated sets, connected and disconnected sets, connectedness on the real line, components, totally disconnected spaces, locally connected spaces.
UNIT-V
Compactness: Hausdroff axiom, compact spaces, Lindelof spaces, locally compact spaces, product of two compact spaces.
Continuity and homeomorphism: Preliminary limits and continuity, homomorphism, continuity and connectedness, continuity and compactness projection mappings, connectedness of the product of two spaces uniform continuity, extension theorems.
Book Recommended:
1. Metric spaces : Q.H. Ansari
2. First course in Metric spaces: B.K. Tyagi Cambridge
3. Metric spaces: Micheal Springer
4. Real Variables with Basic Metric space topology: R.B.Ash Dover
5. Metric Spaces: J.N. Sharma Krishna Prakashan Mandir

SPECIAL FUNCTIONS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I
Hypergoemetric functions: Series solution of Gauss hypergeometric equation, Gauss hypergeometric function and its properties, integral representation, linear and quadratic transformation formulas, contiguous function relations, differentiation formulae, linear relation between the solutions of Gauss hypergeometric function and its properties, I transformation.
UNIT-II
Bessel function and Legendre polynomial: Generating function for $J_n(x)$, alternative

forms of generating functions, trigonometric expansions involving Bessel functions, modified Bessel function, orthogonality of Bessel functions, some integral involving Bessel functions, polynomial, a generating function.

UNIT-III

Rodrigues formula, hypergeometric form, Laplace first and second integral of $P_n(x)$ and related properties, expansion involving Legender polynomial, Legender function of second kind and its properties.

UNIT-IV

Hermite polynomial : Definition of Hermite polynomials $H_n(x)$, pure recurrence relations, differential recurrence relations, Rodrigue's formula, other generating functions, orthogonality, expansion of polynomials, more generating functions, hypergeometric representations, integral representation of Hermite polynomial, differential equation and its solution.

UNIT-V

Laguerre Polynomials: The Laguerre Polynomials $L_n(X)$, generalized Laguerre polynomial, generating functions, pure recurrence relations, differential recurrence relation, Rodrigue's formula, orthogonal, expansion of polynomials, special properties, other generating functions integral relations..

Reference Books:

1.Special Functions: Earl D. Rainville, Chelsea Pub Co.
2.Special Functions with application: Saran, Sharma and Trivedi, Pragati rakashan
3.Special Functions: R. Askey and R. Roy, Cambridge
4.Special Functions & Their Applications: N. N. Lebdev,Prentice Hall, Englewood Cliffs, NJ.

M.A./ M.SC. (MATHEMATICS)

SECOND SEMESTER

LINEAR ALGEBRA

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I

Vector Spaces: Bases and co-ordinates, dimensions, Sylvester law of nullity, linear transformations and their representation as matrices, change of basis, dual space, dually paired vector spaces.

UNIT-II

Eigen values and Eigen vectors of a linear transformation, diagonalisation, bilinear,quardric and Hermitian forms.

UNIT-III

Inner product spaces: Cauchy-Schwarz inequality, orthogonal vectors, orthogonal Complements.

UNIT-IV

orthonormal sets and bases.
for finite dimensional spaces, Gram-Schmidt orthogonalization process.

UNIT-V
normal and self adjoint matrices and transformation, unitary matrices and transformations, Principal axis theorem.

Reference Books:

(1) Linear Algebra S.Lang Addision Wesley
(2) Linear Algebra Hofmann and Kunz Prentice Hall
(3) Linear Algebra Friedberg,Insel and Spence
(4) Linear Algebra A.G.Hamilton Cambridge

MEASURE THEORY

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I
Countable and non-countable sets, the Lebesgue measure of sets of real number,

UNIT-II
Measurable functions, structure of measurable functions, Weirestrass theorem on the approximation of continuous functions by polynomials.

UNIT-III
Lebesgue integral of measurable functions, properties of Lebesgue integrals.

UNIT-IV
Summable functions, the space of square summable functions, functions of finite Variation.

UNIT-V
the Stieltjes integral, the indefinite Lebesgue integral.

Reference Books:

(1) Lebesgue Measure and Integration P.KJain&V.P.Gupta
(2)Theory of functions of Real Variable Vol. 1 I. P. Natanson
(3) Measure Theory K.P.Gupta KPM
(4) An Introduction to Measure and Integration I.K.Rana Narosa

DIFFERENTIAL GEOMETRY

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I
Curves in space (ft_1): Space curves, path ,arc length, tangent line, contact of a curve and surface, inflexinal tangent, the osculating plane, tangent at any point of a surface $f(x,y,z)=0$, normal plane, principal normal and binormal, curvature, torsion and skew curvature, Serret-Frenet formulae, Helices, fundamental theorems for space curves, circle of curvature, osculating sphere.

UNIT-II

Concept of surface and fundamental forms: Definition of surface, regular point and singularities on a surface, tangent plane and normal.

UNIT-III

first fundamental form, relation between E,F,Q and H, second fundamental form, Weingarton equations, angle between
parametric curves, direction coefficients.

UNIT-IV

Curves on a surface: Curvature of normal section, Meusnier theorem, principal directions and principal curvatures, mean curvature, first curvature and total curvature,

UNIT-V

minimal surface, navel point, lines of curvature, envelope, edge of regression, ruled surfaces, developable surface, asymptotic lines.

Reference Books:

(1)Differential Geometry C.E.Weatherbum
(2)Differential Geometry H.C.Sinha
(3) Coordinate Geometry of the three dimensions Robert, L., Bell J. T.

TOPOLOGY

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I

Topological spaces: Topology, T-open sets, weaker and stronger topology, Indiscrete and discrete topology, co-finite topology, usual topology, open sets, closed sets, neighborhood, closure, interior, limit point, relative topology, upper limit topology, intersection of topological spaces, Kuratowski-Space, theorems on metric spaces, equivalent metrics.

UNIT-II

Bases, sub-bases and countability: Base, sub-base, local base, first countable, second countable, theorems, hereditary property, theorems related to metric space, sequence in a topological space.

UNIT-III

Continuous functions: Continuity, sequentially continuous, homeomorphism, topological property, open and closed maps, uniform continuity, product invariant, theorems.

Separation axioms: T_0, T_1, T_2, spaces, normal spaces, Hausdorff space, regular spaces, T_3, T_4-spaces, completely regular spaces, Tychnoff space, completely normal, T_0-Space.

UNIT-IV

Compactness: Cover, open cover, finite sub-cover reducible, compact sets, finite intersection property, Heine-Borel, Lindeloff space, locally compact, Bolzano Weirerstrass property, sequentially compact, Lebesgue number, totally bounded set.

Connectedness: Separated sets, disconnectedness, totally disconnected , maximal connected set, component, path , arc wise connected, locally connected, theorems on connectedness.

UNIT-V

Product spaces: Product topology, projection maps, problems related to product invariant, topology for the cartesian product of arbitrary collection, Tychonoff topology.

Nets and convergence: Binary relation, directed set, residual subset, cofinite subset, net, sequence convergence of a set, cluster point, subnet, isotones map.

Filters and ultra filters: Filter, cofinite filter, Nbd filter, filter base, ultrafilters.

Books Recommended:

1. Point set Topology Munkres Pearson

2. Basic topology : M.A. Armstrong Sringer
3. Topology of Metric spaces (second edition) : S.Kumaresan Narosa

INTEGRAL TRANSFORM

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I
Laplace Transform: Definition and its properties, rules of manipulation, Laplace transform of derivatives and integrals, inverse Laplace transform, complex inversion formula, theorems of Laplace transform, convolution theorem for Laplace transforms,
UNIT-II
application of Laplace transform to solution of differential equations, solving boundary value problem using Laplace transforms.
UNIT-III
Fourier transform: Definition and properties of Fourier sine, cosine and complex transforms, convolution theorem, inversion theorems, Fourier transform of derivatives, sine and cosine Fourier transforms, solving differential equations and interal equations using Fourier transform.
UNIT-IV
Hankel Transform: Definition and elementary properties , inversion theorem, Hankel transform of derivatives, parseval theorem.
UNIT-V
Mellin Transforms : Definition, properties and evaluation of transforms, convolution theorem for Mellin transforms.
Reference Books:
1. Use of Integral Transforms: I. N. Sneddon, McGraw-Hill Inc.
2. Integral Transforms and Their Applications: Davies**,** Brian, Springer-Verlag.
3. Integral Transforms Sharma & Vasistha
4. Theory and problems of Laplace Transformation:M.R.Spegal

M.A./ M.SC. (MATHEMATICS)

THIRD SEMESTER

FUNCTIONAL ANALYSIS AND INTEGRATION THEORY

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

Unit I

Normed linear spaces, Banach Spaces and their examples, Continuous linear transformations.

Unit II

The open mapping theorem, Closed graph theorem, Uniform boundedness theorem, Continuous linear functionals, Hahn- Banach theorem.

Unit III

Inner product spaces, Hilbert spaces and their examples, Cauchy Schwarz's inequality, Parallelogram law, Orthogonal complements, Orthonormal sets, Bessel's inequality, Gram-Schmidt orthogonalization process, Riesz representation theorem, Operators and projections.

Unit IV

Signed measure. Hahn decomposition theorem, mutually singular measures. Radon-Nikodym theorem. Labesgue decomposition.

Unit V

Riesz representation theorem. Extension theorem (Caratheodory), Lebesgue-Stieltjes integral, product measures, Fubini's theorem, Differentiation and Integration.

References:

1. Introduction to Topology : G.G Simmons: McGraw Hill and Modern Analysis Book company Chapters 2,9, and 10(1963).

2. Elements of Functional Analysis : L. A. Luesternik and L.J Sobolev:

CALCULAS OF VARIATIONS AND

INTEGRAL EQUATIONS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

Unit I Existence and Uniquencess of solution dy/dx = f(x,y). Green's function. Sturm-Liouville Boundary value problem. Cauchy problem and characteristics.

Unit II

Classification of Second order P .D.E. Separation of variables for heat equation. Wave equation and Laplace Equation.

Unit III

Linear functional, Minimal functional theorem, General variation of a function Euler-Lagrange's equation, Variational Methods for Boundary value problems in ordinary and partial differential equations.

Unit IV

Linear Integral equation of the first and second kind of Fredholm and Volterra types, Solution by successive substitutions and successive approximations, Solution equation with separable kernels.

Unit V

The Fredholm alternative Hilbert Schimdt theory for symmetric kernels.

References :

1. Integral Equations, : Lovitte W.V Dover Publications.

2. Linear Integral Equations, : Kanwal R.P Academic PressNew York.

OPTIONAL PAPERS (ANY THREE OF THE FOLLOWING)

NUMERICAL ANALYSIS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

Unit I

Iterative Methods: Simple iteration theory of iteration, Accleration of convergence. Methods for multiple and complex roots. Newton-Raphson Method for simultaneous equations ,Convergence of iteration process in the case of several unknown. Solution of Polynomial Equations: Polynominal Evaluation, Real and complex roots. Synthetic division. The Birge –Vieta. Bairstow and Graffe's root squareing methods.

Unit II

System of simultaneous equation (linear): Direct methods-Methods of determination. Gauss – elimination, Gauss-Jordan , Cholesky, Partition Methods of Sucecessive , Appproximate- Conjugate Gradient, Gauss and Jacobi iteration, Gauss seidel iteration and relaxation methods.

Unit III

Eigen value Problems: Basic properties of Eigen values and Eigen Vector , Power method, Method for finding all Eigen pairs of a Matrix. Complex

Unit IV

Eigen values. Curve fitting and Function Approximation : Least square error criterion Linear regression, Polynominal fitting and other curve fitting . approximation of functions by Taylor series and Chebyshev Polynominals.

Unit V

Numerical solution of Ordinary Differential Equations: Taylor Series method. Euler,s and modified Euler's methods. Runge-kutta method upto fourth order. Multistep method (Predictor –corrector strategies). Stability Analysis –Single and multistep methods. Difference methods for BVPs ordinary Differential Equations Boundary value problems (BVP's) Shooting methods. Finite difference method.

References:

1. Numerical Analysis : Jain, Iyenger and Jain

2. Numerical Method : S.S. Sastry

3. Numerical Solution of Differential equations : Jain M.K.

MATHEMATICAL STATISTICS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

Unit I

Sample spaces, Combination of events. Statistical independence, Conditional probability,Bays theorem, Repeated trials. Random Variable,Distribution function .

Unit II

Probability, Probability function, Density function , Mathematical expectation, Generating function (mfg and pgf) continuous probability distribution, characteristic function , Fourier's Inversion, Cheby-Shev, Normal, Hypergeometric , Rectangular ,Negative, Binominal ,Beta ,Gama and Cauchy's distribution.

Unit II

Association of attributes. Index number, Introduction, Price–relatives, Quantity relatives, Value relatives ,Link and Chain relatives ,Aggregate methods, Fisher,s Ideal Index.

Unit III

Elementary sampling theory, Distribution of means of sampling from Binomial,Cauchy, Rectangular and normal distribution Distribution of second order moments in sampling from normal population. Exact distribution of 2 X,t,z and F ,Statistics in samples from a normal population, Their simple properties and applications.

Unit IV

Test of significance of difference between two means and two standard deviations for large samples with modification for small samples and taken from normal population. Analysis of variance, simple cases(one criteria and two criteria of classification)

Unit V

Elementary statistical Theory of estimation. Fisher's criteria for the best estimator. Consistent, Efficient and sufficient estimator. Method of Maximum likelihood estimators and other methods of estimation . Method of least square.

References :

1. Mathematical Theory of Statistics : Kapur and Saxena

2. A first course in Mathematical Statistics : Wealtherburn

3. The Advanced Theory of Statistics : M.G. Kendall

4. Introduction of Mathematical Probability : Uspensky

OPERATIONS RESEARCH

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT- I

Linear Programming-Simplex Method. Theory of the Simplex Method. Duality and Sensitivity Analysis.

UNIT- II

Other Algorithms for Linear Programming Dual simplex method, Parametric Linear Programming, Upper Bound Technique, Interior Point Algorithm, Linear Goal Programming. Transportation and Assignment Problems.

Unit III

Network Analysis - Shortest Path Problem, Minimum Spanning Tree Problem, Maximum Flow Problem, Minimum cost folu problem, Network simplex method, Project planning and control with PERT-CPM.

Unit IV

Game theory - Two person, Zero-sum games, Games with mixed strategies, Graphical Solution, Solution by Linear Programming. Integer Programming - Branch and Bound Technique.

Unit V

Dynamic programming, Principle of optimality due to Bellman, Solution of an LPP by dynamic programming.Nonlinear Programming - One and Multi variable unconstrained optimization. Kuhn-Tucker conditions for constrained optimization, Quadraticprogramming. Separable programming, Convex programming, Non-convex programming.

References :

1. F.S. Hiller and G.J. Lieberman, Introduction to Operation Research (Sixth

edition), McGraw Hill International edition, Industrial engineering Series,

1995.

2. G. Hadley, Linear Programming, Narosa Publishing House, 1995.

3. G. Hadley, Nonlinear and Dynamic Programming, Addison-Wesley, Reading

Mass.

4. Kanti Swarup, P.K. Gupta and Man Mohan, Operations Research, Sultan

Chand & Sons, New Delhi.

GRAPH THEORY

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I Graphs and simple graphs - Graph Isomorphism - The Incidence and Adjacency Matrices - Subgraphs - Vertex Degrees - Paths and Connection - Cycles - Trees - Cut Edges and Bonds - Cut Vertices.

UNIT-II :

Connectivity - Blocks - Euler tours - Hamilton Cycles.

UNIT-III

Matchings - Matchings and Coverings in Bipartite Graphs - Edge Chromatic Number - Vizing's Theorem.

UNIT-IV

Independent sets - Ramsey's Theorem - Chromatic Number - Brooks' Theorem - Chromatic Polynomials.

UNIT-V

Plane and planar Graphs - Dual graphs - Euler's Formula - The Five-Colour Theorem and the Four-Colour Conjecture.

Reference Books

1. J.Clark and D.A.Holton , *A First look at Graph Theory,* Allied Publishers, New Delhi, 1995.
2. R. Gould. *Graph Theory*, Benjamin/Cummings, Menlo Park, 1989.
3. A.Gibbons, *Algorithmic Graph Theory*, Cambridge University Press, Cambridge, 1989.

4. R.J.Wilson and J.J.Watkins, *Graphs : An Introductory Approach*, John Wiley and Sons, New York, 1989.
5. R.J. Wilson, *Introduction to Graph Theory*, Pearson Education, 4th Edition, 2004, Indian Print.
6. S.A.Choudum, *A First Course in Graph Theory*, MacMillan India Ltd

RELATIVITY AND COSMOLOGY

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

Unit I

Bianchi identities and Einstein tensor, conformal curvature tensor, Algebraic clsssification of conformal curvature tensor, condition for flat spacetime, Lorentz transformation. Mass-Energy formula. Minkowski's n dimensional continuum, space-like and time-like intervals.

Unit II

Principal of equivalence and Principle of general co-variance, Newtonain approximation of relativistic equations of motion . Einsten's field equations and its Newtonian approximation. Schwarzschild exterior solution and its isotropic form.

Unit III

Planetary orbits and analogues of Kepler`s Laws in general relativity. Advance of perihelion of Mercury. Bending of light rays in a gravitational field. Gravitational red shift of spectral lines , Energy- Momentum tensor of perfect fluid.

Unit IV

Conservation of electric charge. Transformation formula for electric charge and electric current densities, Maxwell's equations in vacuo. Propagation of electric and magnetic intensities. Transformation of electricand magnetic intensities, Lorentz invariance of Maxwell's equations in tensor form. Energy–momentum tensor of electromagnetic field. Electromagnetism in general relativity . Reissner –Nordstrom solution.

Unit V

Static cosmological models. Einstein universe. De-sitter universe. Properties of these universe.Comparison with actual universe.

References:

1. Weatherbworn C.E : An introduction of riemannian Geometry and

tensor calculus

: Cambridge Univ. Press

2. Eddington A.S. : The mathematical Theory of Relativity :

Cambridge Univ, Press

3. Narlikar J.V : General Relativity and cosmology : The Mac

Millan &Co. Ind.Ltd.

4. Alder R.Bazim M. : Introduction to general relativity : McGraw hill

Inc. Schiffer M.

M.A./ M.SC. (MATHEMATICS)

FOURTH SEMESTER

ORDINARY DIFFERENTIAL EQUATIONS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I
Second order homogeneous equations-Initial value problems-Linear dependence and independence - Wronskian and a formula for Wronskian -Non-homogeneous equation of order two.
UNIT-II
Homogeneous and non-homogeneous equation of order n - Initial value problems- Annihilator method to solve non-homogeneous equation - Algebra of constant coefficient operators.
UNIT-III :
Initial value problems - Existence and uniqueness theorems - Solutions to solve a non-homogeneous equation - Wronskian and linear dependence - reduction of the order of a homogeneous equation - homogeneous equation with analytic coefficients -The Legendre equation.
UNIT-IV
Euler equation - Second order equations with regular singular points -Exceptional cases - Bessel Function.
UNIT-V
Equation with variable separated - Exact equation - method of successive approximations - the Lipschitz condition - convergence of the successive approximations and the existence theorem.

Reference Books
1. Williams E. Boyce and Richard C. DI Prima, Elementary differential equations and boundary value problems, John Wiley and sons, New York, 1967.

2. George F Simmons, Differential equations with applications and historical notes, Tata McGraw Hill, New Delhi, 1974.

3. N.N. Lebedev, Special functions and their applications, Prentice Hall of India, New Delhi, 1965.

4. W.T. Reid. Ordinary Differential Equations, John Wiley and Sons, New York, 1971

5. M.D.Raisinghania, Advanced Differential Equations, S.Chand & Company Ltd. New Delhi 2001

6. B.Rai, D.P.Choudary and H.I. Freedman, A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi, 2002.

MECHANICS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I :
The Mechanical system - Generalised coordinates - Constraints - Virtual work - Energy and Momentum
UNIT-II
Derivation of Lagrange's equations- Examples - Integrals of motion.
UNIT-III
Hamilton's Principle - Hamilton's Equation - Other variational principle.
UNIT-IV
Hamilton Principle function - Hamilton-Jacobi Equation - Separability
UNIT-V
Differential forms and generating functions - Special Transformations - Lagrange and Poisson brackets.

Reference Books
1. H. Goldstein, *Classical Mechanics,* (2nd Edition) Narosa Publishing House, New Delhi.

2. N.C.Rane and P.S.C.Joag, *Classical Mechanics*, Tata McGraw Hill, 1991.

DISCRETE MATHEMATICS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT - I
Properties and examples of Lattices - Distributive lattices - Boolean algebras - Boolean polynomials - Minimal Forms of Boolean Polynomials.
UNIT - II
Switching Circuits - Applications of Switching Circuits
UNIT - III
Finite fields
.
UNIT - IV
Irreducible Polynomials over Finite fields - Factorization of Polynomials over Finite fields.
UNIT - V
Introduction to Coding - Linear Codes.
Reference Books
1. A.Gill, *Applied Algebra for Computer Science*, Prentice Hall Inc., New Jersey.

2. J.L.Gersting, *Mathematical Structures for Computer Science*(3rd Edn.), Computer Science Press, New York.

3. S.Wiitala, *Discrete Mathematics- A Unified Approach,* McGraw Hill Book Co

PARTIAL DIFFERENTIAL EQUATIONS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT - I
Formation and solution of PDE- Integral surfaces - Cauchy Problem order equation - Orthogonal surfaces - First order non-linear - Characteristics - Compatible system - Charpits method.
UNIT - II
Intrduction-Classification of Second order PDE-Canonical forms-Adjoint operators-Riemans method.
Introduction – Classification of Second Order PDE - Canonical forms – Adjoint Operators _ Riemann's method.

UNIT - III
Derivation of Laplace and Poisson equation - BVP - Separation of Variables - Dirichlet's Problem and Newmann Problem for a rectangle - Solution of Laplace equation in Cylindrical and spherical coordinates - Examples.
UNIT - IV
Formation and solution of Diffusion equation - Dirac-Delta function - Separation of variables method - Solution of Diffusion Equation in Cylindrical and spherical coordinates - Examples.
UNIT - V
Formation and solution of one-dimensional wave equation - canocical reduction - IVP- d'Alembert's solution - IVP and BVP for two-dimensional wave equation - Periodic solution of one-dimensional wave equation in cylindrical and spherical coordinate systems - Uniqueness of the solution for the wave equation - Duhamel's Principle - Examples.
Reference Books
1. R.C.McOwen, *Partial Differential Equations*, 2nd Edn. Pearson Eduction, New Delhi, 2005.

2. I.N.Sneddon, *Elements of Partial Differential Equations,* McGraw Hill, New Delhi, 1983.

3. R. Dennemeyer, *Introduction to Partial Differential Equations and Boundary Value Problems,* McGraw Hill, New York, 1968.

4. M.D.Raisinghania, *Advanced Differential Equations,* S.Chand & Company Ltd., New Delhi, 2001.

MATHEMATICAL PROGRAMMING

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I
INTEGER LINEAR PROGRAMMING : Types of Integer Linear Programming Problems - Concept of Cutting Plane - Gomory's All Integer Cutting Plane Method - Gomory's mixed Integer Cutting Plane method - Branch and Bound Method.
UNIT-II
CLASSICAL OPTIMIZATION METHODS : Unconstrained Optimization - Constrained Multi-variable Optimization with Equality Constraints - Constrained Multi-variable Optimization with inequality Constraints.
NON-LINEAR PROGRAMMING METHODS: Examples of NLPP - General NLPP - Graphical solution - Quadratic Programming - Wolfe's modified Simplex Methods.
UNIT-III
Canonical and Standard form of LP - Slack and Surplus Variables - Reduction of any Feasible solution to a Basic Feasible solution - Alternative Optimal solution - Unbounded solution - Optimality conditions - Some complications and their resolutions - Degeneracy and its resolution

UNIT-IV
REVISED SIMPLEX METHOD : Standard forms for Revised simplex Method - Computational procedure for Standard form I - comparison of simplex method and Revised simplex Method.

BOUNDED VARIABLES LP PROBLEM: The simplex algorithm.

UNIT-V

PARAMETRIC LINEAR PROGRAMMING : Variation in the coefficients cj , Variations in the Right hand side, bi .

GOAL PROGRAMMING : Difference between LP and GP approach - Concept of Goal Programming - Goal Programming Model formulation - Graphical Solution Method of Goal Programming - Modified Simplex method of Goal Programming.

Reference Books

1. Hamdy A. Taha, *Operations Research,* (seventh edition) Prentice - Hall of India Private Limited, New Delhi, 1997.

2. F.S. Hillier & J.Lieberman *Introduction to Operation Research* (7th Edition) Tata- McGraw Hill ompany, New Delhi, 2001.

3. Beightler. C, D.Phillips, B. Wilde ,*Foundations of Optimization* (2nd Edition) Prentice Hall Pvt Ltd., New York, 1979

FLUID DYNAMICS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT-I

Kinematics of Fluids in motion. Real fluids and Ideal fluids - Velocity of a fluid at a point, Stream lines , path lines , steady and unsteady flows- Velocity potential - The vorticity vector- Local and particle rates of changes - Equations of continuity - Worked examples - Acceleration of a fluid - Conditions at a rigid boundary.

UNIT-II

Pressure at a point in a fluid at rest. - Pressure at a point in a moving fluid - Conditions at a boundary of two inviscid immiscible fluids- Euler's equation of motion - Discussion of the case of steady motion under conservative body forces.

UNIT-III

Some three dimensional flows. Introduction- Sources, sinks and doublets - Images in a rigid infinite plane - Axis symmetric flows - stokes stream function

UNIT-IV

Meaning of two dimensional flow - Use of Cylindrical polar coordinate - The stream function - The complex potential for two dimensional, irrotational incompressible flow - Complex velocity potentials for standard two dimensional flows - Some worked examples - Two dimensional Image systems - The Milne Thompson circle Theorem.*Chapter 5. Sections 5.1 to 5.8*

UNIT-V

Stress components in a real fluid. - Relations between Cartesian components of stress- Translational motion of fluid elements - The rate of strain quadric and principal stresses - Some further properties of the rate of strain quadric - Stress analysis in fluid motion - Relation between stress and rate of strain - The coefficient of viscosity and Laminar flow - The Navier - Stokes equations of motion of a Viscous fluid.

Reference Books

1. R.W.Fox and A.T.McDonald. *Introduction to Fluid Mechanics*, Wiley, 1985.

2. E.Krause, *Fluid Mechanics with Problems and Solutions*, Springer, 2005.

3. B.S.Massey, J.W.Smith and A.J.W.Smith, *Mechanics of Fluids,* Taylor and Francis, New York, 2005

4. P.Orlandi, *Fluid Flow Phenomena,* Kluwer, New Yor, 2002.

5. T.Petrila, *Basics of Fluid Mechanics and Introduction to Computational Fluid Dynamics,* Springer, berlin, 2004.

FUZZY MATHEMATCS

Paper Code:

Maximum Marks: 100

External Marks: 70

Internal Marks: 30

UNIT - I : FUZZY SETS
Fuzzy sets – Basic Types – Basic concepts – Characteristics – Significance of the paradigm shift – Additional properties of α – cuts.

UNIT - II : FUZZY SETS VERSUS CRISP SETS
Representation of Fuzzy sets – Extension principle of Fuzzy sets – Operation on Fuzzy sets – Types of operation – Fuzzy complements.

UNIT - III : OPERATIONS ON FUZZY SETS
Fuzzy intersection – t-norms – Fuzzy unions – t-conorms – Combinations of operations- Aggregation operations.

UNIT - IV : FUZZY ARITHMETIC
Fuzzy number – Linguistic variables – Arithmetic operation on intervals – Lattice of Fuzzy numbers.

UNIT - V : CONSTRUCTING FUZZY SETS
Methods of construction : An overview – Direct methods with one expert – Direct method with multiple experts – Indirect method with multiple experts and one expert – Construction from sample data.

Reference Books

1. H. J. Zimmerman, *Fuzzy Set Theory and its Applications*, Allied Publishers, 1996.

2. A. Kaufman, Introduction to the theory of Fuzzy Subsets, Academic Press, 1975.