BHAGWANT UNIVERSITY
Sikar Road, Ajmer
Rajasthan

Syllabus

Institute of social sciences & Applied Sciences

M Sc (Mathematics)

M.SC. (PREVIOUS) (MATHEMATICS
M.Sc. MATHEMATICS

Subject Code	Name of Subject	Teaching Period			Max.Marks 100		
		L	T	P	External	Internal	
						Mid Term 15	Assignment 15
01MSC13 101	Advanced Abstract Algebra	3	1	0	70	30	
01MSC13 102	Real & Complex Analysis	3	1	0	70	30	
01MSC13 103	Topology	3	1	0	70	30	
01MSC13 104	Differential Geometry & Tensors	3	1	0	70	30	
01MSC13 105	Special Functions & Transform Calculus	3	1	0	70	30	
	TOTAL	15	5	0	70	30	

M.SC. (FINAL) MATHEMATICS

Subject Code	Name of Subject	Teaching Period			Max.Marks 100		
		L	T	P	External	Internal	
						Mid Term 15	Assignment 15
Compulsory Papers							
02AMM101	Functional Analysis & Integration Theory	3	1	0	70	30	
02AMM102	Advanced Differential and Integral Equation	3	1	0	70	30	
Optional Papers(Select any Three)							
02 AMM 103	Advanced Numerical Methods	3	1	0	70	30	
02 AMM 104	Relativity & Cosmology	3	1	0	70	30	
02 AMM 105	Advanced Mathematical Statistics	3	1	0	70	30	
02 AMM 106	Operations Research	3	1	0	70	30	
	Total	18	6	0			

M.Sc. (Previous) Examination

Advanced Abstract Algebra

Paper Code: 01MSC13 101
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. Cauchy's theorem for finite abelian groups. Cauchy's theorem for finite groups, Solvable Groups , Jordan-Holder Theorm, Nilpotent groups, Euclidean rings . Polynominal 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. Galois extensions, Fundamental theorem of Galois theory.

Unit II

Euclidean rings. Modules, Submodules, Quotient modules Direct sums and Module Homomorphisms. Generation of modules, Cyclic modules. 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. Eigen values and Eigen vectors of a linear transformation.

Unit III

Diagonalisation, Bilinear, Quardric and Hermitian forms, Inner product spacesCauchySchwarz inequality, Orthogonal vectors. Orthogonal complements, Orthonormal sets and bases. Bessel's inequality for finite dimensional spaces, Gram-Schmidt orthogonalization process. Normal and self adjoint matrices and transformation, Unitary matrices and transformations, Principal axis theorem.

References:

1. Algebra : Maclane and Birkhoff Macmillan Company.
2. Topics in Algebra : I.N.Herstein Wiley Eastern Ltd.
3 Linear Algebra : S.Lang Addision Wesley.
4 Linear Algebra : Hofmann and Kunz Prentice Hall.

REAL AND COMPLEX ANALYSIS

Paper Code: 01MSC13 102
Maximum Marks: 100
External Marks: 70
Internal Marks: 30

Unit I (Measure Theory)

Countable and non-countable sets. The Lebesgue measure of sets of real number, Measurable functions, Structure of Measurable functions, Weierstras's Theorem on the approximation of continuous functions by

polynominal s, Lebesgue Integral of Measurable functions. Summable functions,The space of square summable functions.Functions of finite varition.

UNIT II

Complex integration, Cauchy's Goursat Theorem, Cauchy's integral formula, Higher order derivatives, Morera's theorem, Cauchy's inequality and Liouville's theorem. The fundamental theorem of algebra, Taylor's theorem, Maximum modulus principle, Schwarz lemma, Laurent's series, Isolated singularties, 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 za. Spaces of analytic functions, Hurwitz's theorem. Montel's theorem Riemann mapping theorem. Weierstrass' factorization theorem, 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

References:

1. Lebesgue Measure and Integration : P.K.Jain&V.P.Gupta
2. Methods of Real Analysis : Goldberg
3. Real Analysis : H.L.Royden
4 Complex Analysis : B.S.Tyagi

TOPOLOGY

Paper Code: 01MSC13 103
Maximum Marks: 100
External Marks: 70
Internal Marks: 30

Unit I (Metric Spaces)

Metric spaces, Bounded and bounded metric spaces, Open and closed sets in a metric space, Cantor's ternary set, Closure Bases, Product spaces, Topological spaces, Sequence and subsequence in metric space,
Cauchy sequence, Complete metric spaces, Completion of a metric space.

Unit II (Topology)

Topological spaces, Subspaces, Open sets, Closed sets, Neighbourhood system,Continous mapping and Homeomorphism bases, and sub basis, Cauchy's sequences, Nets, Filters,Complete metric spaces, Product
spaces, Quotient spaces.

Unit III

Compact and locally compact spaces, Tychonoff's one point compactifications.Separation axioms, Normal spaces, connected and locally connected spaces, Continuity and connectedness and compactness, Hausdra spaces, Regular spaces.

References :

1. Topological Spaces. : Kowalsky
2. General Topology. : Kelly
3. Introduction to Topology : G.F. Simmons
and Mordern Analysis
4. Introduction to General Topology : K.D. Joshi

5. General Topology. : Gautam and Santi Naryan

DIFFERENTIAL GEOMETRY AND TENSORS

Paper Code: 01MSC13 104
Maximum Marks: 100
External Marks: 70
Internal Marks: 30

Unit I

Curves in space (3 *R*):Space curves, Path ,arc length, tangent line, contact of a curve and surface. Inflexional 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. Concept of surface and fundamental forms : Definition of surface, Regular point and singularites on a surface, Tangent plane and normal,

Unit II

Curves on a surface : Curvature of normal section, Meusnier theorem, Principal directions and Principal curvatures , Mean curvature, first curvature and total curvature, , Envelope, Edge of regression , Ruled surfaces , Developable surface,. Transformation of Co-ordinates, Covariant, Contravariant and Mixed tensors, Invariants, Addition, Subtraction and Multiplication of Tensors, contraction of tensors, 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. Covariant derivative, Riemann Christoffel tensor, Curvature tensor, Ricci tensor, Bianchi identities, Riemann curvature. Flat space, Space of constant curvature.

References:

1. Differential Geometry : C.E.Weatherburn
2. Differential Geometry : H.C.Sinha
3. Tensor Analysis : J.L.Bansal
4. Tensor Calculus : Berry Spain
5. Cartesian Tensor : A.M.Goodbody

SPECIAL FUNCTIONS AND TRANSFORM CALCULUS

Paper Code: 01MSC13 105
Maximum Marks: 100
External Marks: 70
Internal Marks: 30

Unit I

Hyper-Geometric Functions, Legendre’s Polynomial, Associated Legendre’s functions, Bessel’s functions, Recurrence relations, Orthogonal Properties,

Hermite and Laguerre Polynominals their generating functions and general integral properties.

Unit II

Laplace Transform: Definition and properties, Rules of manipulation : Laplace transform of dervatives : Inverse Laplace transform , Complex inversion formula, Theorems of Laplace transform. Fourier Transform: Fourier sine and cosine transform. Convolution theorems. Fourier transform of derivative. Hankel Transform: Definition and elementary properties : Inversion theorem, Hankel transform of derivatives, Parseval Theorem.

Unit III

Application to the solution of ordinary differential equations with constant coefficients and with variable coefficient, Simultaneous ordinary differential equations. Partial differential equations, Integral and difference equations,

References:

1. The use of integral Transforms Mcgraw Hill : Sneddon.I.N
2. Theory and problems of Laplace transform : Spegal M.R
3. Integral Transforms : Sharma and Vasishtha

M.SC.(FINAL) – EXAMINATION

COMPULSORY PAPERS

FUNCTIONAL ANALYSIS AND INTEGRATION THEORY

Paper Code: 02MSC13 101
Maximum Marks: 100
External Marks: 70
Internal Marks: 30

Unit I (Functional Analysis)

Normed linear spaces, Banach Spaces and their examples, Continuous linear transformations. The open mapping theorem, Closed graph theorem, Uniform boundedness theorem, Continuous linear functionals, Hahn- Banach theorem.

Unit II

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 III (Integration Theory)

Signed measure. Hahn decomposition theorem, mutually singular measures. Radon-Nikodym theorem. Labesgue decomposition. 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: Hindustan Publishing
Company (1974).

3. Introduction to Functional Analysis : A.E. Taylor, John wiley and sons. (1958)
4. Functional of Modern Analysis : J.Dieudonne (1969). Academic Press.

ADVANCED DIFFERENTIAL AND INTEGRAL EQUATIONS

Paper Code: 02MSC13 102
Maximum Marks: 100
External Marks: 70
Internal Marks: 30

Unit I (Differential Equations)
Existence and Uniquencess of solution dy/dx = f(x,y). Green's function. Sturm-Liouville Boundary value problem. Cauchy problem and characteristics, Classification of Second order P .D.E. Separation of variables for heat equation. Wave equation and Laplace Equation.

Unit II (Calculus of Variations)
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 III (Integral Equations)
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. 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)

ADVANCED NUMERICAL METHODS

Paper Code: 02MSC13 103
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. Eigen value Problems: Basic properties of Eigen values and Eigen Vector , Power method, Method for finding all Eigen pairs of a Matrix. Complex
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 III

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.

RELATIVITY AND COSMOLOGY

Paper Code: 02MSC13 104
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. 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 III

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 electric
and magnetic intensities, Lorentz invariance of Maxwell's equations in tensor form. Energy–momentum tensor of electromagnetic field. Electromagnetism in general relativity . Reissner –Nordstrom solution.
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.

ADVANCED MATHEMATICAL STATISTICS

Paper Code: 02MSC13 105
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 . 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. 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 III

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) 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: 02MSC13 106
Maximum Marks: 100
External Marks: 70
Internal Marks: 30

UNIT- I

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

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 II

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.

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

Unit III

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.