PANDIT DEENDAYAL UPADHYAYA SHEKHAWATI UNIVERSITY, SIKAR

SYLLABUS

M.A./M.Sc Mathematics

(ANNUAL SCHEME)
SESSION 2022-23

PREVIOUS EXAMINATION-2023

Paper-I Advanced Abstract Algebra
Paper-II: Real Analysis and Topology
Paper-III: Differential Equations and Special Functions
Paper-IV: Differential Geometry and Tensor Analysis
Paper-V: Mechanics

Dy. Registrar
Pandit Deendayal Upadhyaya
Shekhawati University,
Sikar(Rajasthan)

PANDIT DEENDAYAL UPADHYAYA SHEKHAWATI UNIVERSITY, SIKAR

M.A./M.Sc. (Previous) Mathematics Examination – 2023

Scheme of Examination : Annual Scheme
Note: Papers I to V are compulsory

Paper – I: Advanced Abstract Algebra

Teaching : 6 Hours per Week
Examination: Common for Regular/Non-collegiate Candidates

3 Hrs. duration **Theory Paper** **Max. Marks 100**

Note : This paper is divided into FIVE Units. TWO questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE Question from each Unit. All questions carry equal marks.

Unit 1

Direct product of groups (External and Internal). Isomorphism theorems – Diamond isomorphism theorem, Butterfly Lemma, Conjugate classes (Excluding p-groups), Commutators, Derived subgroups, Normal series and Solvable groups, Composition series, Refinement theorem and Jordan-Holder theorem for infinite groups.

Unit 2

Sylow's theorems (without proof), Cauchy's theorem for finite abelian groups. Euclidean rings. Polynomial rings and irreducibility criteria. Linear transformation of vector spaces, Dual spaces, Dual basis and their properties, Dual maps, Annihilator.

Unit 3

Field theory – Extension fields, Algebraic and Transcendental extensions, Separable and inseparable extensions, Normal extensions. Splitting fields.

Galosis theory – the elements of Galois theory, Automorphism of extensions, Fundamental theorem of Galois theory, Solutions of polynomial equations by radicals and Insolvability of general equation of degree five by radicals.

Unit 4

Matrices of a linear maps, Matrices of composition maps, Matrices of dual map, Eigen values, Eigen vectors, Rank and Nullity of linear maps and matrices, Invertible matrices, Similar matrices, Determinants of matrices and its computations, Characteristic polynomial, minimal polynomial and eigen values.

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Unit 5

Real inner product space, Schwartzs inequality, Orthogonality, Bessel's inequality, Adjoint, Self adjoint linear transformations and matrices, Orthogonal linear transformation and matrices, Principal Axis Theorem.

Reference Books :

1. Deepak Chatterjee, Abstract Algebra, Prentice – Hall of India (PHI), New Delhi, 2004
2. N.S.Gopalkrishnan, University Algebra, New Age International, 1986.
3. Qazi Zameeruddin and Surjeet Singh, Modern Algebra, Vikas Publishing, 2006
4. G.C.Sharma, Modern Algebra, Shivlal Agrawal & Co., Agra, 1998.
5. Joseph A. Gallian, Contemporary Abstract Algebra (4^{th} Ed.), Narosa Publishing House, 1999.
6. David S. Dummit and Richard M. Foote, Abstract Algebra (3^{rd} Edition), John Wiley and Sons (Asia) Pvt. Ltd, Singapore, 2004.
7. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra (4^{th} Edition), Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
8. I.N. Herstein, Topics in Algebra (2^{nd} edition), John Wiley & Sons, 2006.
9. Michael Artin, Algebra (2^{nd} edition), Pearson Prentice Hall, 2011.

Paper – II : Real Analysis and Topology

Teaching : 6 Hours per Week

Examination : Common for Regular/Non-collegiate Candidates

3 Hrs. duration **Theory Paper** **Max. Marks 100**

Note : This paper is divided into FIVE Units. TWO questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

Unit 1

Algebra and algebras of sets, Algebras generated by a class of subsets, Borel sets, Lebesgue measure of sets of real numbers. Measurability and Measure of a set, Existence of Non-measurable sets, Measurable functions, Realization of non-negative measurable function as limit of an increasing sequence of simple functions, Structure of measurable functions, Convergence in measure, Egoroff's theorem.

Unit 2

Weierstrass's theorem on the approximation of continuous function by polynomials, Lebesgue integral of bounded measurable functions, Lebesgue theorem on the passage to the limit under the integral sign for bounded measurable functions. Summable functions, Space of square summable funetions. Fourier series and coefficients, Parseval's identity, Riesz-Fisher Theorem.

Unit 3

Lebesgue integration on R^2. L^p –spaces, Holder-Minkowski inequalities. Completeness of L^p-spaces, Topological spaces, Subspaces, Open sets, Closed sets, Neighbourhood system, Bases and sub-bases.

Unit 4

Continuous mapping and Homeomorphism, Nets, Filters, Separation axioms (To, T_1, T_2, T_3, T_4). Product and Quotient spaces.

Unit 5

Compact and locally compact spaces. One point compactification theorem. Connected and Locally connected spaces, Continuity and Connectedness and Compactness.

Reference Books :

1. Shanti Narayan, A Course of Mathematical Analysis, S. Chand & Co., N.D., 1995.
2. S.C.Malik and Savita Arora, Mathematical Analysis, New Age International, 1992.
3. T.M.Apostol, Mathematical Anslysis, Narosa Publishing House, New Delhi, 1985.
4. R.R.Goldberg, Real Analysis, Oxford & IBH Publishing Co., New Delhi, 1970.
5. S.Lang, Undergraduate Analysis, Springer-Verlag, New York, 1983.
6. James R.Munkres, Topology, 2nd Edition, Pearson International, 2000.
7. J. Dugundji, Topology, Prentice-Hall of India, 1975.
8. George F. Simmons, Introduction to Topology and Modern Analysis, MeGraw-Hill, 1963.
9. Walter Rudin, Real and Complex Analysis, Tata MeGraw-Hill Pub. Co. Ltd., 1986.
10. I.N. Natansen, Theory of Functions of a Real Variable, Fredrik Pub. Co., 1964.

Paper – III : Differential Equations and Special Functions

Teaching : 6 Hours per Week

Examination : Common for Regular/Non-collegiate Candidates

3 Hrs. duration **Theory Paper** **Max. Marks 100**

Note : This paper is divided into FIVE Units. TWO questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

Unit 1

Non-linear ordinary differential equations of particular forms. Riccati's equation- General solution and the solution when one, two or three particular solutions are known. Total Differential equations. Partial differential equations of second order with variable co-efficients- Monge's method.

Unit 2

Classification of linear partial differential equation of second order, Canonical forms. Cauchy's problem for first order partial differential equations, Method of separation of variables, Laplace, Wave and diffusion equations, Linear homogeneous boundary value problems. Eigen values and eigen functions. Strum-Liouville boundary value problems. Orthogonality of eigen functions. Reality of eigen values.

Unit 3

Calculus of variation – Functionals, Variation of a functional and its properties, Variational problems with fixed boundaries, Euler's equation, Extremals, Functional dependent on several unknown functions and their first order derivatives, Functionals dependent on higher order derivatives, Functionals dependent on the function of more than one independent variable. Variational problems in parametric form, Series solution of a second order linear differential equation near a regular singular point (Method of Frobenius) for different cases.

Unit 4

Gauss hypergeometric function and its properties, Integral representation, Linear transformation formulas, Contiguous function relations, Differentiation formulae, Linear relation between the solutions of Gauss hypergeometric equation, Kummer's confluent hypergeometric function and its properties, Integral representation, Kummer's first transformation. Legendre polynomials and functions $P_n(x)$ and $Q_n(x)$.

Unit 5

Bessel functions $J_n(x)$, Hermite polynomials $H_n(x)$, Laguerre and Associated Laguerre polynomials.

Reference Books :

1. J.L. Bansal and H.S. Dhami, Differential Equations Vol-II, JPH, 2004.
2. M.D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Co., 2003.
3. L.C. Evans. Partial Differential Equations, Graduate Studies in Mathematics, Vol. 19, AMS, 1999.
4. I.N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill, 1988.
5. E.A. Codington, An Introduction to Ordinary Differential Equations, Prentice Hall of India, 1961.
6. Frank Ayres, Theory and Problems of Differential equations, TMH, 1990.
7. D.A. Murary, Introductory Course on Differential Equations, Orient Longman, 1902.
8. A.R.Forsyth, A Treatise on Differential Equations, Macmillan & Co. Ltd., London, 1956.

Paper- IV : Differential Geometry and Tensor Analysis

Teaching : 6 Hours per Week
Examination : Common for Regular/Non-collegiate Candidates

3 Hrs. duration **Theory Paper** **Max.Marks 100**

Note : This paper is divided into FIVE Units. TWO questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

Unit 1

Space curves, Tangenet, Contact of curve and surface, Osculating plane, Principal normal and Binormal, Curvature, Torsion, Serret-Frenet's formulae, Osculating circle and Osculating sphere, Existence and Uniqueness theorems, Bertrand curves, Involute, Evolutes.

Unit 2

Ruled surface, Developable surface, Tangent plane to a ruled surface. Necessary and sufficient condition that a surface $\zeta = (\xi,\eta)$ should represent a developable surface. Conoids, Inflexional tangents, Singular points, Indicatrix. Metric of a surface, First, second and third fundamental forms, Weingarten equations. Fundamental magnitudes of some important surfaces, Orthogonal trajectories.

Unit 3

Normal curvature, Meunier's theorem. Principal directions and Principal curvatures, First curvature, Mean curvature, Gaussian curvature, Umbilics. Radius of curvature of any normal section at an umbilic on $z = f(x,y)$. Radius of curvature of a given section through any point on $z = f(x,y)$. Lines of curvature, Principal radii, Relation between fundamental forms. Asymptotic lines, Differential equation of an asymptotic line, Curvature and Torsion of an asymptotic line. Gauss's formulae, Gauss's characteristic equation, Mainardi-Codazzi equations. Fundamental existence theorem for surfaces, Parallel surfaces, Gaussian and mean curvature for a parallel surface, Bonnet's theorem on parallel surfaces.

Unit 4

Geodesics, Differential equation of a geodesic, Single differential equation of a geodesic, Geodesic on a surface of revolution, Geodesic curvature and Torsion, Normal angle, Gauss-Bonnet Theorem.

Tensor Analysis-Kronecker delta. Contravariant and Contravariant and Covariant tensors, Symmetric tensors, Quotient law of tensors, Relative tensor. Riemannian space. Metric tensor, Indicator, Permutation symbols and Permutation tensors.

Unit 5

Christoffel symbols and their properties, Covariant differentiation of tensors. Ricci's theorem, Intrinsic derivative, Geodesics, Differential equation of geodesic, Geodesic coordinates, Field of parallel vectors, Reimann-Christoffel tensor and its properties. Covariant curvature tessor, Einstein space. Bianchi's identity Einstein tensor, Flate space, Isotropic point, Schur's theorem.

Reference Books :

1. R.J.T. Bell, Elementary Treatise on Co-ordinate geometry of three dimensions, Macmillan India Ltd., 1994.
2. Mittal and Agarwwal, Differential Geometry, Krishna publication, 2014.
3. Barry Spain, Tensor Calculus, Radha Publ. House Calcutta, 1988.
4. J.A. Thorpe, Introduction to Differential Geometry, Springer-Verlog, 2013.
5. T.J. Willmore – An Introduction to Differential Geometry. Oxford University Press. 1972.
6. Weatherbum, Reimanian Geometry and Tensor Clculus, Cambridge Univ. Press, 2008.
7. Thorpe, Elementary Topics in Differential Geometry, Springer Verlag, N.Y. (1985).
8. R.S. Millman and G.D. Parker, Elements of Differential Geometry, Prentice Hall, 1977.

Paper – V : Mechanics

Teaching : 6 Hours per Week

Examination : Common for Regular/Non-collegiate Candidates

3 Hrs. duration **Theory Paper** **Max. Marks 100**

Note : This paper is divided into FIVE Units. TWO questions will be set from each Unit. Candidates are required to attempt FIVE questions in all taking ONE question from each Unit. All questions carry equal marks.

Unit 1

D'Alembert's Principle. General equations of motion of a rigid body. Motion of the centre of inertia and motion relative to the centre of inertia. Motion about a fixed axis. The compound pendulum, Centre of percussion. Conservation of momentum (linear and angular) and energy for finite as well as impulsive forces.

Unit 2

Motion in three dimensions with reference to Euler's dynamical and geometrical equations. Motion under no forces, Motion under impulsive forces. Motion of a Top.

Unit 3

Lagrange's equations for holonomous dynamical system, Energy equation for conservative field, Small oscillations, Motion under impulsive forces. Hamilton's equations of motin, conservation of energy, Hamilton's Principle and Principle of Least Action.

Unit 4

Kinematics of ideal fluids. Lagrange's and Euler's methods. Equation of continuity in Cartesian, cylindrical and spherical polar coordinates. Boundary surface. Stream-lines, path-lines, velocity potential, rotational and irrotational motion.

Unit 5

Euler's hydrodynamical equations. Bernoulli's theorem. Helmholtz equations. Cauchy's integrals, Motion due to impulsive forces. Motion in two-dimensions: Stream function, Complex potential. Source, Sinks, Doublets, Images in two-dimensions.

Reference Books :

1. N.C. Rana and P.S. Joag, Classical Mechanics, Tata McGraw-Hill, 1991.
2. M. Ray and H.S. Sharma, A Text Book of Dynamics of a Rigid Body, Students' Friends & Co., Agra, 1984.
3. M.D. Raisinghania, Hydrodynamics, S. Chand & Co. Ltd., N.D. 1995.
4. M. Ray and G.C. Chadda, A Text Book on Hydrodynamics, Students' Friends & Co., Agra, 1985.
5. H. Goldstein, Classical Mechanics, Narosa, 1990.
6. J.L. Synge and B. A. Griffith, Principles of Mechanics, McGraw-Hill, 1991.
7. L.N. Hand and J.D. Finch, Analytical Mechanics, Cambridge University Press, 1998.