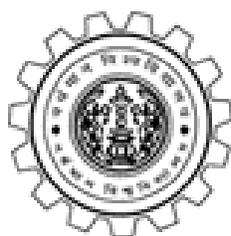


SYLLABUS FOR PH.D. COURSE WORK



DEPARTMENT OF MATHEMATICS
THE UNIVERSITY OF BURDWAN
BURDWAN

Paper-I (Research Methodology) : 100 Marks

Group-A: (Research Methods): 40 Marks

Pedagogical research, Ethics of research, Classification and indexing; (6L)

Writing a research proposal, research paper, Ph.D. thesis; Review process. (12L)

Short communication, poster presentation, fast track communication of a research paper, Plenary talks, Invited talks of a conference/ workshop. (3L)

Group-B: (Mathematical Methods applied to Sciences): 40 Marks

Convention, Symbols, Axiom, Proposition, Lemma, Abstraction, Theorem, Generalization, Extension, Proofs. (3L)

A historical introduction of Euclidean to Riemannian geometry in connection with general theory of relativity and cosmology, Mathematical modeling. (3L)

Mathematical methods-I

Applications of Group theory in number theory, Spectral theory, Generalization of integration theory, Applications of differential geometry in Mechanics, Applications of conformal transformation. (9L)

Mathematical methods-II

Strum-Liouville problems, Generalized function, Dirac-Delta function, Riemann-Zeta function, Integral equations, Basic concept of Nonlinear Ordinary Differential Equations with applications to physical problem (9L)

Group-C: (Computer Fundamentals) : 20 Marks

Introduction to computer – Basic concept of computer hardware, software, operating systems, Algorithm and Flowchart, programming languages, representation of numbers in computers; Scientific text processing packages; Statistical packages; Curves, surface drawing packages; Basic concepts of programming with Mathematica and MATLAB.

(15L)

References:

- [1] I. Stakgold; Green's functions and boundary value problems
- [2] G. C. Layek, A. Samad and S. Pramanik; Computer Fundamentals, Fortran 77, C and Numerical Programs, Levant Books (Sarat Book House).
- [3] D. W. Jordan and P. Smith; Nonlinear ordinary differential equations.

- [4] G. Bachman and L. Narici; Functional Analysis, Academic Press.
- [5] E. Kreyszig; Introductory Functional Analysis with Applications, Wiley Eastern, 1989.
- [6] I. N. Sneddon; Furier Transforms (McGraw Hill).
- [7] F. G. Tricomi; Integral Equation, Interscience Publishers.
- [8] I. Niven, H. S. Zuckerman and H. L. Montgomery; An Introduction to the Theory of Numbers, John Wiley & Sons, Inc., 1991.
- [9] C. R. Kothari; Research Methodology (Methods and Techniques), New age international (P) Ltd. publishers.
- [10] H. L. Royden; Real Analysis, Macmillan, New York.
- [11] I. S. Sokolnikoff, Riemannian Geometry.

Paper-II (Optional Paper, Pure group) : 100 Marks

Abstract Algebra: 25 Marks

Group Theory : Free groups, Free products, Amalgamated free product. (5L)

Ring Theory: Polynomial ring, Noetherian ring and Artinian ring, radical of ring, Jacobson radical, prime radical, prime ideal and m-system, prime ring, semi-prime ideal and n-system, semi-prime ring, direct product and subdirect product of rings. (10L)

Measure and Integration: 25 Marks

Measures: outer measures, extension of measures, Lebesgue measure, measurable spaces, measurable functions, limits of measurable functions, simple functions, integration, simple functions, integrable functions. Integration over locally compact spaces: continuous functions with compact support, G_δ -sets, F_σ -sets, Baire sets, Borel sets, regularity of Baire and Borel measures, content, Integration of continuous functions with compact support.

(15L)

Introduction to Smooth Manifolds: 25 Marks

Definition of differentiability of a function $f: \mathbb{R}^n \rightarrow \mathbb{R}^n$, definition of smooth manifolds with simple examples (\mathbb{R}^n , circle S^1 , sphere S^2). Definition of differentiability of a function from a manifold to another manifold, Tangent vectors, Vector fields, Lie bracket.

(7L)

Affine connection on a manifold and its curvature and torsion, Riemannian manifold (definition and example), Fundamental theorem of Riemannian geometry (statement only), Computations of Riemannian curvature, Ricci curvature and scalar curvature from a given Riemannian metric.

(8L)

Advanced Functional Analysis: 25 Marks

Locally convex topological vector spaces, Spectral Theory of Operators, Banach Algebra, Approximation Theory on normed linear space, Fixed point theory, Geometry of Banach spaces and its application to fixed point theory. (15L)

References

- [1] T. W. Hungerford; Algebra, Springer-Verlag, New York Inc,1973.
- [2] C. Musili; Introduction to Rings and Modules (Second Revised Edition), Narosa Publishing House Pvt. Ltd., New Delhi, 1994.
- [3] N. H. McCoy; The Theory of Rings, Chelsea Publishing Company, Bronx, New York, 1973.
- [4] D. M. Burton; A First Course in Rings and Ideals, Addison-Wesley Publishing Company, London, 1970.
- [5] Sterling K. Berberian, Measure and integration, Chelsea Publishing Company, Bronx, New York.
- [6] P. R. Halmos, Measure theory, Van Nostrand, New York.
- [7] U. C. De and A. A. Shaikh, Differential geometry of manifolds, Narosa Publishing House Pvt. Ltd., 2007.
- [8] Kobayashi and Nomizu, Foundations of differential geometry, Vol I and Vol II Wiley Interscience, 1996.
- [9] J. Diestel, Geometry of Banach spaces, Springer-Verlag, Berlin, Heidelberg, New York, 1975.
- [10] Narici & Beckerstein, Topological vector spaces, Marcel Decker Inc. , N.Y, 1963.
- [11] Lusternik & Sobolev, Functional Analysis, Hindustan Pub. Corp., Delhi, 1961.
- [12] W.A. Kirk & K. Goebel, Topics in Metric Fixed Point Theory, Cambridge University Press, 1990.
- [13] Joshi & Bose, Some Topics in Non Linear Functional Analysis, Wiley Eastern Ltd, 1984.
- [14] Granas & Dugundgi, Fixed Point Theory, Springer, 2003.

Paper – II (Optional Paper, Applied group) : 100 Marks

Solid Mechanics : 25 Marks

Analysis of stress and strain, Stress equation of motion, Necessity of constitutive equations, Constitutive equation (stress-strain relations) for isotropic elastic solid, Compatibility equations for stresses, Fundamental boundary value problems of elasticity, Saint-Venant's principle.

(15L)

Fluid Mechanics : 25 Marks

Governing equations of viscous flows, concept of Boundary Layer Theory, Some exact solutions of viscous flows, Application of similarity variable in fluid flow problems, Derivation of self-similar equations for some specific boundary layer flow problems, Concept of flow separation and its control mechanism, Thermal boundary layers in laminar flow: forced and natural convection.

(15L)

Quantum Mechanics : 25 Marks

Basic concepts and potential scattering – Types of collisions, channels, thresholds, cross sections, general features of potential scattering, the method of partial waves, the integral equation of potential scattering, the Coulomb potential, scattering of two identical particles, approximation methods, variational principles.

e^-/e^+ -atom collisions - general features, elastic and inelastic scattering, rearrangement processes, e^- -impact ionization.

(15L)

Operation Research : 25 Marks

Convex functions and their properties, local and global optima, Constrained optimization: Method of constrained variation and Lagrange multiplier, Kuhn-Tucker conditions;

Real coded Genetic Algorithms and applications.

(15L)

References

- [1] C. Truesdell, Continuum Mechanics.
- [2] T. J. Chang, Continuum Mechanics (Prentice-Hall).
- [3] H. Schlichting, Boundary Layer Theory, Mc Graw-Hill Book Company, 2002.
- [4] S. W. Yuan, Foundations of Fluid Mechanics, PHI, 1969.
- [5] J. L. Bansal; Viscous Fluid Dynamics, 2003.

- [6] C. J. Joachirs and B. H. Boansder; Physics of atoms and molecules.
- [7] C. J. Joachain and B. H. Branden; Quantum Mechanics.
- [8] Bazaraa, M. S., Sherali, H. D. and Shetty, C. M., Nonlinear Programming, John Wiley & Sons. Ine., 2004.
- [9] Michalawicz, Z., Genetic Algorithms + Data Structure = Evaluation Programs, Berlin: Springer Verlag, 1996.
- [10] Rao, S. S., Optimization theory and Applications, Wiley Eastern Ltd., New Delhi.

Optional Paper – III (Term Paper, Optional) : 100 Marks

[Term paper based on review of previous research works / literature survey]

Marks distribution:

Submission (type written) : 60 Marks

Presentation : 25 Marks

Viva-voce : 15 Marks