DEPARTMENT OF MATHEMATICS

PATNA UNIVERSITY, PATNA - 800005

Subject : **Mathematics** Faculty : **Science**

For Pre-Ph.D. Coursework in Mathematics

The pattern of questions in paper II (Mathematics)

Full Marks :**100** Time : **3 hours**

Group A : Compulsory

To answer 10 questions of 3 marks each

(At least 2 questions from each unit be given)

10 × 3 = 30 Marks

Group B : To answer 5 questions of 6 marks each

(At least 1 question from each unit be given)

5 × 6 = 30 Marks

Group C : To answer 4 questions of 10 marks each

(At least 1 question from each unit be given)

4 × 10 = 40 Marks

Total = 100 Marks

17.5.13

(R.N. Pandey)
Professor & Head
Deptt. of Mathematics, P.U

Professor & Head
Department of Mathematics
Patna University, Patna-800005

17/5/13

Certified

18/02/2024

Professor & Head
Department of Mathematics
Patna University, Patna-800005

160

11

SYLLABUS

B) Paper II (Mathematics) Code : **MAT-R-101**

Unit I : (Algebra)

(i) Homomorphism of Groups, Composition series of a Group Nil potent and solvable Groups.

(ii) Theory of Rings and its ideals, Decomposition of ideals, polynomial Rings, Noetheriam Rings, Extension Fields, Galois Group, Application of Galois Theory, Solvability by radicals.

(iii) Linear Transformation on vector spaces, their matrix representation, Reduction to various canonical forms, structure of Bilinear, Quadratic and Hermitian forms, and their applications.

Unit 2 (Analysis)

(i) Riemann-Stieltje's integration and its applications; Function of several variables, Jacobian, partial derivatives and differentiability, Extremal problems, theory of uniform convergence of sequence of real/ complex functions.

(ii) Applications of complex Integration, Theory of Residues, Study of Conformal mapping and Bilinear Transformation, power series, Application of Entire, meromorphic and Univalent functions Methods of analytic continuation.

Unit 3 (Any one)

(a) For pure Mathematics (Measure theory and Topology)

(i) Lebseque theory of measure and integration; outer measure and Borel measure, measurable functions, convergence theorems, lebseque differentiation and integration, L^p-spaces and its completeness, signed measure, Decomposition theorems, Baire

17.5.17
Professor & Head
Department of Mathematics
Patna University, Patna-800005

18/02/2021
Professor & Head
Department of Mathematics
Patna University, Patna-800005

measure and Product measure, Lebseque-Stieltje's; integration and its applications.

(ii) Continuity and homeomorphism in topological spaces, relative topology on subspaces, separation axions, countability, Lindeloff spaces and B.W.P., Connected and Disconnected spaces, Compact and locally compact spaces; Product spaces and Quotient spaces, Meteriziability.

(iii) Nets and Filters; study of convergence, continuity and Hausdorffness in Nets and Filters.

Or

(b) For Applied Mathematics (Vector calculus, Tensors and Calculus of Variation)

(i) Scalar and vector fields, study of grad, div, curl and Laplacian, Notion of Flux, volume integral and surface integral, applications of Green's theorem, Gauss Divergence theorem and Stoke's theorem.

(ii) Transformation of coordinates, Tensors, Algebra of tensors, symmetric and Shew-symmetric tensors, tensor of type (r,s), Quotient law, Contraction of tensors, Reciprocal tensor, Riemannian metric, Christoffel symbols covariant derivative, geodesics, Riemann-Christoffel curvature tensor, Bianchi's identity, Einstein tensor and its properties.

(iii) Method of Calculus of Variations, Euler-Lagrange's equations, solving extremal problems; shortest distance, path of quickest decent, etc.

Unit 4 (Differential and Integral equations)

(i) Initial value problem (I.V.P) of differential and equivalent integral equation, Existence and uniqueness of solution of I.V.P,

15/02/2021

Professor & Head
Department of Mathematics
Patna University, Patna-800005

Professor & Head
epartment of Mathematics

convergence theorem, Ascoli-Arzela theorem, Peano's existence theorem.

(ii) Study of Fourier series, Fourier transform and Laplace transform; properties of Harmonic functions and those of Green's functions.

(iii) Use of Integral transform method for solving I.V.P of differential equation; use of variable separable method and Integral transform method for solving boundary value problem (B.V.P) of partial differential equations (Ex. wave, heat and Laplace).

(iv) Eigen values and eigen functions of integral equations, symmetric and separable Kernels, use of method of successive approximations, Integral transform and Green's function for solving Fredholm and Volterra integral equation of first and second kind.

Units 5 (Any one)

(a) (Functional Analysis and theory of operators)

(i) Theory of Normed linear spaces, Banch spaces and Hilbert spaces, Finite dimensional spaces and compactness, Spaces of continuous linear transformations, Hahn-Banch theorem and its applications, Reflexive spaces.

(ii) Theory of operators in Hilbert spaces, Study of Topological vector spaces, Locally convex spaces, Frechet spaces and Nuclear spaces. Study of special operators like closed, compact, Fredholm and Riesz operators; Operator algebra and fixed point theorems.

Or

(b) (Operations Research)

Linear and non-linear programming, Optimization techniques, Game theory, Queuing theory, simulation, Monto-Carlo method, Network

18/02/2024

Professor & Head
Department of Mathematics
Patna University, Patna-800005

Professor & Head
Department of Mathematics

analysis in project-planning (PRT and CPM), sequencing–N jobs and M machines, where M = 2, 3, and P.

Or

(c) (Fluid Mechanics)

(i) Equation of continuity, Boundary surfaces, stream lines, velocity potential, rotational and irrotational motion, Lagrange's and Euler's equations of motion, Bernoulli's theorem, Impulsive motion.

(ii) Motion in two-dimensions, Notion of source, sink, doublets and their images; Circle theorem; Two dimensional irrotational motion produced by motion of circular, co-axial and elliptic cylinders in an infinite mass of fluid, Blasius theorem; Motion of a sphere/ cylinder through liquid at rest at infinity under some constraints; liquid streaming past a fixed sphere/ cylinder; Stoke's stream function.

(iii) Vortex motion and its properties, Motion due to circular and rectilinear vortices; Navier-stoke's equation for solving hydrodynamical problems.

(iv) Bio-mathematical models, study of diseased human joints, flow of blood in arteries, stability of replacement models.

Or

(d) (Theory of Relativity)

(i) Special theory of relativity, Inertial frame, Gallilean and Lorentz transformation and their properties; Relativistic formula for composition of velocities and accelerations; Aberration, Doppler's effect; Equivalence of mass and energy.

(ii) General theory of relatively, Principle of equivalence and general covariance, Einstein field equation, Schwart-Schild external/ internal

17.5.17
Professor & Head
Department of Mathematics
Patna University, Patna-800005

18/02/2021
Professor & Head
Department of Mathematics
Patna University, Patna-800005