

ALGEBRA - I

Scheme of examination:

MM: 70

*Note: In all five questions are to be answered .First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will carry equal marks.*

**Unit-1**

Direct product of groups (External and Internal). Isomorphism theorems – Diamond isomorphism theorem, Butterfly Lemma, Conjugate classes (Excluding p-groups).

**Unit - 2**

Commutators, Derived subgroups, Normal series and Solvable groups, Composition series, Refinement theorem and Jordan-Holder theorem for infinite groups.

**Unit - 3**

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

**Unit -4**

Galois 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.

20  
R  
D  
shank  
J

**REAL ANALYSIS**

Scheme of examination:

MM: 70

*Note: In all five questions are to be answered .First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will 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.

**Unit - 2**

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 – 3** 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.

**Unit - 4**

Summable functions, Space of square summable functions. Fourier series and coefficients, Parseval's identity, Riesz-Fisher Theorem.

20  
PC  
Dygi  
Jestaru

**DIFFERENTIAL EQUATIONS - I**

Scheme of examination:

MM: 70

*Note: In all five questions are to be answered. First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will 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.

**Unit - 2**

Total Differential equations. Forms and solutions, necessary and sufficient condition, Geometrical Meaning Equation containing three and four variables, total differential equations of second degree.

**Unit - 3**

Series Solution: Radius of convergence, method of differentiation, Cauchy-Euler equation, Solution near a regular singular point (Method of Forbenius) for different cases, Particular integral and the point at infinity.

**Unit - 4**

Partial differential equations of second order with variable co-efficients- Monge's method.

2020  
R. M. Duggal  
4/11/20  
20/11/20

**DIFFERENTIAL GEOMETRY**

Scheme of examination:

MM: 70

*Note: In all five questions are to be answered .First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will carry equal marks.*

**Unit - 1**

Space curves, Tangent, 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 and Evolutes.

**Unit – 2** Conoids, Inflexional tangents, Singular points, Indicatrix. Ruled surface, Developable surface, Tangent plane to a ruled surface. Necessary and sufficient condition that a surface  $\zeta = f(\xi, \eta)$  should represent a developable surface. Metric of a surface, First, Second and Third fundamental forms. Fundamental magnitudes of some important surfaces, Orthogonal trajectories.

**Unit - 3**

Normal curvature. Principal directions and Principal curvatures, First curvature, Mean curvature, Gaussian curvature, Radius of curvature of a given section through any point on  $z = f(x,y)$ . Lines of curvature, Principal radii, Relation between fundamental forms.

**Unit - 4**

Asymptotic lines, Differential equation of an asymptotic line, Curvature and Torsion of an asymptotic line. Gauss's formulae, Gauss's

*Handwritten signatures and initials in blue ink.*

*Handwritten initials in blue ink.*

*Handwritten signature in blue ink.*



characteristic equation, Weingarten equations, Mainardi-Codazzi equations. Fundamental existence theorem for surfaces, Parallel surfaces, Gaussian and mean curvature for a parallel surface.

20  
mu  
omega  
M  
Jury  
1/2015  
JEB914

**DYNAMICS OF RIGID BODIES**

Scheme of examination:

MM: 70

*Note: In all five questions are to be answered .First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will carry equal marks.*

**Unit - 1**

D'Alembert's principle. The general equations of motion of a rigid body. Motion of centre of inertia and motion relative to centre of inertia. Motion about a fixed axis.

**Unit - 2**

The compound pendulum, Centre of percussion. Motion of a rigid body in two dimensions under finite and impulsive forces.

**Unit - 3**

Motion in three dimensions with reference to Euler's dynamical and geometrical equations. Motion under no forces, Motion under impulsive forces. Conservation of momentum (linear and angular).

**Unit - 4**

Lagrange's equations for holonomous dynamical system, Energy equation for conservative field, Small oscillations, Motion of a top, Hemilton's equations of motion, Hamilton's principle and principle of least action.

29 RAV  h/ot 2109145

**CALCULUS OF VARIATION AND SPECIAL FUNCTION - I**

Scheme of examination:

MM: 70

*Note: In all five questions are to be answered. First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will carry equal marks.*

**Unit - 1**

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.

**Unit - 2**

Functionals dependent on higher order derivatives, Functionals dependent on the function of more than one independent variable. Variational problems in parametric form.

**Unit - 3**

Gauss hypergeometric function and its properties, Series solution of Gauss hypergeometric equation. Integral representation, Linear and quadratic 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 and series solution of Legendre's equation.

**Unit - 4**

Legendre polynomials and functions  $P_n(x)$  and  $Q_n(x)$ .

*Handwritten signatures and initials in blue ink, including 'Suresh' and '20'.*

ALGEBRA – II

Scheme of examination:

MM: 70

*Note: In all five questions are to be answered. First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will carry equal marks.*

**Unit - 1**

Linear transformation of vector spaces, Dual spaces, Dual basis and their properties, Dual maps, Annihilator.

**Unit - 2**

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.

**Unit - 3**

Determinants of matrices and its computations, Characteristic polynomial and eigen values. Real inner product space, Schwartzs inequality.

**Unit – 4**

Orthogonality, Bessel's inequality, Adjoint, Self adjoint linear transformations and matrices, Othogonal linear transformation and matrices, Principal Axis Theorem.

29  
RM  
Dey  
21/05/16



TOPOLOGY

Scheme of examination:

MM: 70

*Note: In all five questions are to be answered. First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will carry equal marks.*

**Unit - 1**

Topological spaces, Subspaces, Open sets, Closed sets, Neighbourhood system, Bases and sub-bases.

**Unit - 2**

Continuous mapping and Homeomorphism, Nets, Filters.

**Unit - 3**

Separation axioms ( $T_0, T_1, T_2, T_3, T_4$ ). Compact and locally compact spaces. Continuity and Compactness.

**Unit - 4**

Product and Quotient spaces. Tychonoff's one point compactification. Connected and Locally connected spaces, Continuity and Connectedness.

Handwritten signatures and initials at the bottom of the page, including "20", "R", "S", "D", "S", and "21/09/19".

**DIFFERENTIAL EQUATION - II**

Scheme of examination:

MM: 70

*Note: In all five questions are to be answered .First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will carry equal marks.*

**Unit - 1**

Classification of linear partial differential equation of second order, Canonical forms, Cauchy's problem of first and second order partial differential equation.

**Unit - 2**

Linear homogeneous boundary value problem, Eigen values and eigen functions, Sturm-Liouville boundary value problems, orthogonality of eigen functions, Lagrange's identity, properties of Eigen functions, important theorems of sturm Liouville system, Periodic functions.

**Unit - 3**

Non-homogeneous boundary value problems, Non-homogeneous Sturm-Liouville boundary value problems (method of eigen function expansion). Method of separation of variables, Laplace, wave and diffusion equations.

**Unit - 4**

Green's Functions: Non-homogeneous Sturm-Liouville boundary value problem (method of Green's function), Procedure of constructing the Green's function and solution of boundary value problem, properties of Green's function, Inhomogeneous boundary conditions, Dirac delta

*Handwritten signatures and marks in blue ink at the bottom of the page.*

function, Bilinear formula for Green's function, Modified Green's function.

20  
R  
C  
h  
D  
T  
S

**RIEMANNIAN GEOMETRY AND TENSOR ANALYSIS**

Scheme of examination: MM: 70

*Note: In all five questions are to be answered .First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will carry equal marks.*

**Unit - 1**

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

**Unit - 2**

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

**Unit - 3**

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.

**Unit - 4**

Reimann-Christoffel tensor and its properties. Covariant curvature tensor, Einstein space. Bianchi's identity. Einstein tensor, Flat space, Isotropic point, Schur's theorem.

*Handwritten signatures and initials in blue ink at the bottom of the page.*



**HYDRODYNAMICS**

Scheme of examination:

MM: 70

*Note: In all five questions are to be answered. First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will carry equal marks.*

**Unit - 1**

Kinematics of ideal fluid. Lagrange's and Euler's methods. Equation of continuity in Cartesian, cylindrical and spherical polar coordinates.

Boundary surface.

**Unit - 2**

Stream-lines, path-lines and streak lines, velocity potential, irrotational motion.

**Unit - 3** Euler's hydrodynamic equations. Bernoulli's theorem.

Helmholtz equations. Cauchy's integral.

**Unit - 4**

Motion due to impulsive forces. Motion in two-dimensions, Stream function, Complex potential. Sources, Sinks, Doublets, Images in two-dimensions.

*2020* *Ru* *2020* *2020* *2020* *2020* *2020*

**SPECIAL FUNCTIONS - II**

Scheme of examination:

MM: 70

*Note: In all five questions are to be answered .First question will be short answer type, compulsory and will cover the entire syllabus. There shall be two questions from each unit. A student has to answer at least one question from each unit. All questions will carry equal marks.*

**Unit - 1**

Bessel functions  $J_n(x)$ .

**Unit - 2**

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

**Unit - 3**

Jacobi Polynomial: Definition and its special cases, Bateman's generating function, Rodrigue's formula, orthogonality, recurrence relations, expansion in series of polynomials.

**Unit - 4**

Chebyshev polynomials  $T_n(x)$  and  $U_n(x)$ : Definition, Solutions of Chebyshev's equation, expansions, Generating functions, Recurrence relations, Orthogonality.

*Handwritten signatures and initials in blue ink at the bottom of the page.*