ANNEXURE –II

M. A. / M. Sc. MATHEMATICS (Previous) 2017-2018

All papers are compulsory

Paper	Paper Name	Max. Marks	Exam. Hours	Teaching Hours
Paper I	**Advanced Abstract Algebra**	100	3 Hrs.	6
Paper II	**Real and complex Analysis**	100	3 Hrs.	6
Paper III	**Differential Equations**	100	3 Hrs.	6
Paper IV	**Geometry**	100	3 Hrs.	6
Paper V	Any one of the following: (a) **Mechanics** (b) Continuum Mechanics	100	3 Hrs.	6

(FINAL) 2017-2018

Paper I	**Topology and Functional Analysis**	100	3 Hrs.	6
Paper II	**Discrete Mathematics**	100	3 Hrs.	6

Optional Papers

Any three of the following paper with the permission of the Head of the Department of Mathematics & Statistics.

Paper III	**Relativity and Cosmology**	100	3 Hrs.	6
Paper IV	**Viscous Fluid Dynamics**	100	3 Hrs.	6
Paper V	Number theory	100	3 Hrs.	6
Paper VI	**Numerical Analysis**	100	3 Hrs.	6
Paper VII	Integral Equations and Internal Transforms	100	3 Hrs.	6
Paper VIII	**Optimization Techniques**	100	3 Hrs.	6
Paper IX	Advanced Topology	100	3 Hrs.	6
Paper X	Computer Programming	Th. 75 Per. 25	3 Hrs. 2 Hrs.	Th. 04 Pre. 02
Paper XI	**Mathematical Theory of Statistics**	100	3 Hrs.	6
Paper XII	Space Dynamics	100	3 Hrs.	6
Paper XIII	Astronomy	100	3 Hrs.	6
Paper XIV	Compressible Fluids and Magneto hydro Dynamics	100	3 Hrs.	6

Note:

1. **Scheme of Examination:**

Question Paper Pattern for Examination: 100 marks

Section A: Total 10 Question will be set from five units i.e. two question from each unit. These questions require very short answer. Each question will be of one (1) mark (Total 10 marks). All the questions in section A are compulsory.

Section B: Total 10 questions will be set from five units i.e. two question from each unit. Students are required to attempt at least one question from each unit. Each question carries 10 marks (Total 50 marks). The answer of each question should be given approximately in 250 words.

Section C: Total 4 descriptive question will be set from five units of the paper, not more than one question from each unit. Each question may also have two sub-division. Students are required to answer two questions in about 500 words. Each question carries 20 marks (Total 40 marks).

2. The right to information act, 2005 is applicable.

M.A. /M.Sc. MATHEMATICS (PREVIOUS)

Note: There will be five papers in all and all papers are compulsory. Each paper will be assigned six hours per week.

PAPER-I
ADVANCED ABSTRACT ALGEBRA

TIME: 3 hours **Max. Marks: 100**

UNIT-I

External and Internal direct product of two and finite number of subgroups; Commutator subgroup ; Cauchy's theorem for finite abelian and non abelian groups, sylow's three theorem and their easy applications, Subnormal and Composition series, Zassenhaus lemma and Jordan Holder theorem.

UNIT-II

Solvable groups and their properties, Nilpotent groups, Fundamental theorem for finite abelian groups, Annihilators of subspace and its dimension in finite dimensional vector space, Invariant, Projection, adjoins, Singular and nonsingular linear transformation, quadratic forms and Diagenalization.

UNIT –III

Prime fields of characteristic zero and of prime number, Polynomial rings, Factorization theory in Integral domain, Prime and irreducible elements, Greatest common divisor and least common multiple, Euclidean domain, Principle ideal domain and Unique Factorization domain and their related theorems, Product of ideals and nilpotent ideals.

UNIT –IV

Definition and examples of Modules, sub module, Factor (Quotient) Module, Sub module generated by a set, Sum and direct sum of two sub modules, Homomorphism and isomorphism, Three isomorphism theorems in modules, simple, and cyclic and Finitely generated module, Fundamental theorem on finitely generated modules over Euclidean rings, Noetherian and artiman modules, Hilbert basis theorem.

UNIT –V

Field extension: finite and infinite, examples, Algebraic and transcendental extensions, Splitting field Separable and inseparable extensions, Normal Extensions, Perfect fields, Finite fields, primitive elements, Automorphisms, Galois theory of field extensions and its fundamental theorem, Solution of polynomial equations by radicals, Abel's theorem.

Books recommended:

1. Surjeet Singh and Quazi Zameeruddin : Modern Algebra
2. I.N.Herstein : Topics in algebra
3. R.S.Agrawal : Algebra
4. N. Jacobson : Basic Algebra Vol. I, II
5. S. Lang : Algebra IIIrd Edition
6. P.B. Bhattacharya S.K. Jain and Etc. : Basic Abstract Algebra (IInd Edition)

PAPER –II
REAL AND COMPLEX ANALYSIS

TIME: 3 hours **Max. Marks: 100**

UNIT-I

COMPLEX ANALYSIS : Complex numbers : The extended plane and its spherical representation, Analytical functions, Cauchy-Riemann equations, Power series including differentiation and integration within the circle of convergence, Conformal transformation, Linear, Bilinear, Exponential, Trigonometric and Joukowski's transformations. Riemann definition of integration, index of a point with respect to a closed curve and general form of Cauchy's integral formula.

UNIT-II

Simple connectivity, Cauchy's fundamental theorem, Cauchy's integral formula, Liouville's theorem; Morera's theorem, Taylor's theorem, Laurent's theorem; Poisson's integral formula, Maximum Modulus theorem, Rouche's theorem. Singularities, residues, Cauchy's theorem of residues and Evaluation of definite integrals.

UNIT – III

Metric spaces: Examples and properties of a metric space, Open sphere (ball or neighborhood) Open sets, closed sets and the related results, Continuous mappings Cauchy sequence and convergence, complete metric space, Compact spaces and compact sets, Baire's category theorem.

UNIT-1V

Measure Theory: Outer measure of a subset of R'Lebesgue outer measure of a subset of R ,Existence, non-negativity and monotonicity of Lebesgue outer measure, Relation between Lebesgue outer measure and length of an interval, Countable subadditivity of Lebesgue outer measure, translation invariance, Lebesgue outer measure-, (Lebesgue) measurable sets (Lebesgue) measure, Complement, union, intersection and difference of measurable sets, denumerable union and intersection of measurable sets, countable additivity of measure, the class of measurable sets as a algebra, the measure of the intersection of a decreasing sequence of measurable sets, some special classes of measurable sets, intervals, open sets, closed sets, Borel sets, F_6 and G_6 sets.
Measurable functions; Different equivalent definition of a measurable function; Scalar multiple, sum,difference and product of measurable functions of measurable function. Measurability of a continuous function and measurability of a continuous image of measurable function.

UNIT-V

Supremum, infimum, limit superior, limit inferior and limit of a sequence of measurable functions. Convergence pointwise and convergence in measures of a sequence of measurable functions. Lebesgue Integral; Characteristic function of a set; simple function; Lebesgue integral of a simple function; Lebesgue integral of a bounded measurable function; Lebesgue integral and Riemann integral of a bounded function defined on a closed interval; Lebesgue integral of a non-negative function; Lebesgue integral of a measurable function; Properties of Lebesgue integral. Convergence Theorems and Lebesgue integral; the bounded convergence theorem; Fatou's Lemma: Monotone convergence theorem; Lebesgue convergence theorem.

Books Recommended:

1. George F-Simmons : Introduction to Topology and Modem Analysis, McGraw Hill Book Co.
2. S.I.Hu : Elements of Real Analysis
3. H.L.Royden : Real Analysis.
4. G.N.Purohit : Lebesgue Measure and Integration.
5. E.G.Phillips : Functions of a complex variable.
6. E.T.Copson : An introduction to the Theory of functions of a Complex variable.

PAPER –III

DIFFERENTIAL EQUATIONS

TIME: 3 hours **Max. Marks: 100**

UNIT – I

Partial differential equation: Existence and uniqueness of solutions, second order partial differential equations, boundary value problems, Green function and Cauchy problem.

UNIT – II

Calculus of variations: Linear functionals, Minimal functional theorem, General variation of a function, Euler – Lagrange's equation, Variational methods of boundary value problems in ordinary and partial differential equations. Variation problems in parametric forms.

UNIT –III

Series solutions of a second order liner differential equations near a singular, point (for benius method). Hyper geometric functions: Definitions of hyper geometric series and function; elementary properties of hyper geometric function; Integral formula for hyper geometric series, Linear transformations, contegeneous function relation, Linear relation between the solutions of hyper geometric differential equation Kumar's confluent hyper geometric function and its simple and basic properties

UNIT –IV

Legendre's polynomial Functions: Legendre's differential equation and associated Legendre's differential equations, Simple properties of Legendre's functions of first and second kind and the associated Legendre's function of integral order.

UNIT-V

Bessel functions, Generating function, Integral formulae, Recurrence relations; Addition formula and other properties of Bessel functions. Classical Orthogonal Polynomials, Generating functions and other properties, associated with the Jacobi, Laguerre, Legendre and Hermite Polynomials.

Books recommended:

1. Rainville, E.D. : Special Functions.
2. Sneddon, I.N. : Special Functions.
3. Sneddon, I.N. : Element of Practical differential equation.
4. Forsyth, A.R. : A Treatise of Differential equations
5. Gupta, A.S. : Calculus of variations with Applications
6. Bansal, J.L. : Differential equations Vol. II
7. Gelfand, I.M. and Fomin, S.V. : Calculus of variations.

PAPER – IV
GEOMETRY

TIME: 3 hours **Max. Marks: 100**

UNIT-I

The Axes of Plane Sections: Circular sections, Axes of central sections of a central conicoid, Axes of any section of a central conicoid, Axes of section of a paraboloid, Circular sections, Umblics.

UNIT-II

Generating Lines, The section of a surface by a tangent plane, Systems of generators of a central hyperboloid, Locus of the points of intersection of perpendicular, generators, The projection of generators, Generators' of the hyperbolic paraboloid.

Confocal Conicoids: The three confocals through a point,- Elliptic coordinates, confocal touching a given plane, confocal touching a given line, The parameter of the confocals through a point on a central conicoid, The normals. The self polar tetrahedron, The axes of an enveloping cone, The equation to the conicoid.

UNIT-III

Tensors; Transformation of coordinates, Contravariant and covariant vectors, second order tensors, Higher order tensors. Addition, subtraction and multiplication of tensors, Contraction, Quotient Law, symmetric and skew symmetric tensors: Conjugate symmetric tensors of the second order, Fundamental tensor, Associated tensors, Christoffel symbols, Transformation law of Christoffel symbols, Covariant differentiation of vectors and tensors.

UNIT-IV

Conoids; Equation to a conoid, surface in general, The degree of a surface, tangents and tangent planes, The inflexional tangents; the equations $\zeta=f(\xi,\eta)$. The indicatrix and representation by parameters. Curves in space, Equation to a curve, The tangent and its direction cosines, The normal plane-, contact of a curve and surface, Oscilating plane, Principal normal and binormal curvature, torsion, spherical indicatrices, frenet's formulae, signs of the curvature and torsion, formula for direction cosines of the principal normal and binormal , radius of torsion the relation $\sigma = + \eta \tan \alpha$ Circle of curvature, The osculating sphere and coordinates in terms of the arc.

UNIT-V

Envelopes: Envelopes of a system of surfaces with one parameter and its relation with characteristic, The edge of regression and its relation with characteristic, Envelope of a system of surfaces with two parameters and its relation with characteristic, skew and developable surface, Tangent plane to a ruled surface, Generators of developable surface, envelope of a plane with one parameter: criterion for $\zeta = f(\xi,\eta)$ to represent a developable surface and properties of a generator of a skew surface.

Curvature of surfaces, Curvature of normal sections through elliptic and hyperbolic points, Umblics, Curvature of an oblique section, radius of curvature of a given section through any point of a surface, Principal radii at a point of an ellipsoid: Lines of curvature of an ellipsoid, Lines of curvature on a developable surface, Normals to a surface at points of a line of a curvature, Lines of curvature on a surface of revolution, Principal radii and lines of curvature through a point of the surface,determination of umblics, Curvature at points of a generator of a skew surface, The measure of curvature at a point and expressions for the measure of curvature, Curvilinear coordinates, Linear element principal radii and lines of curvature.

Books recommended:

1. L. Robert, J-T.Bell : Coordinate Geometry of the three dimensions.
2. Bansal &Sharma : Differential Geometry.
3. B.Spain : Tensor Calculus.
4. J.L.Bansal : Tensor Analysis.

PAPER –V (A)

MECHANICS

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Hydrodynamics: Lagrange's and Euler's, Methods; Acceleration, Equation of Continuity, Boundary surface, Stream lines, velocity potential. Euler's dynamical Equations, Bernoulli's Theorem, Lagrange's Equations under conservative forces, the motion once irrotational is always irrotational.

UNIT- II

Central Orbit, Kapler's Law of Planetary motion. Rigid Dynamics: Moments and products of inertia, Principal axes theorem, Parallel axes, Momental ellipsoid, D'Alembert's principle and the equation of motion.

UNIT-III

Motion in two dimensions under finite forces including sliding and rolling friction, Impulsive motion in two dimensions.

UNIT-IV

Principle of momentum and energy, Lagrange's equations in generalized coordinates.

UNIT-V

Michelson-Morley experiment, Lorentz-Fitgerald contraction, postulates of special theory of Relativity, Lorentz transformations, Mass - Energy formula, transformation formulas for momentum and energy. Minkowski's 4-dimensional continuum space, Space like and time like intervals, Relativistic Hamiltonian and Lagrangian.

Books Recommended:

1. S.L. Loney : Dynamics
2. A.S. Ramsay : Dynamics
3. A.S. Ramsay : A Text book of Hydrodynamics
4. M. Ray : Hydrodynamics
5. Gaur, Mathur & Goyal : Hydrodynamics
6. Bansal, Sharma & Goyal : Dynamics of a Rigid Body
7. Ray & Sharma : A Text Book of dynamics of a Rigid Body
8. M. Ray : Dynamics of a particle
9. Roy & Bali : Theory of Relativity

PAPER-V (B)

CONTINUUM MECHANICS

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Cartesian tensors, index notation and transformation, law of Cartesian tensors, addition, subtraction and multiplication of Cartesian tensor, gradient of a scalar function, divergence of a vector function and curl of a vector function using the index notation. The identity, Stocks Gauss and Green's theorem. The continuum approach classification of continuous media. Body forces and surface forces, components of stress tensor, force and moment equation of equilibrium.

UNIT-II

The stress quadric, principal stresses and Principal axes, stress invariants and the stress deviator tensor, Maximum shearing stress. Lagrangian and Eulerian description of deformation of flow. The commoving derivative. Velocity and acceleration. The continuity equation.

UNIT-III

Strain tensors, the linear rotation tensor and rotation vector. Analysis of rotation displacement, Geometrical meaning of the components of the linear strain tensor, Principal axis theory for the linear strain tensor, Properties of linear strain tensors. The linear cubical dilation. Compatibility equations for the linear strain components. The rate of strain tensor and the vorticity tensor. The rate of rotation vector and vorticity. Properties of the rate of strain tensor.

UNIT-IV

Law of conservation of mass and Eulerain continuity equation. The momentum integral theorem and the equation of motion, Kinetic equation of state. The first and second laws of thermodynamics and the dissipation functions.

Application: (linear elasticity): Assumptions and basic, equations, generalising Hook's law for an isotropic Homogeneous solid. capatibility equations. classification of types of problems in linear elasticity. The principle of super position.

UNIT-V

The strain energy function, the uniqueness theorem P-L relationship and the work kinetic energy equation. Irrotational flow and the velocity potential, Kinetic equations of state and the first law of thermodynamics.

The equation of continuity. The equation of motion, vorticity-stream surfaces for inviscid flow, Bernoullis equations, Irrotational flow and the velocity potential, similarity parameters and fluid flow.

Books for References:

1. Q. Fredenic & T.S. Chang : Continuum mechanics: Allyn and Bacon, Inc, Boston.
2. Mase G.E. : Continuum Mechanics (Schaum series).
3. Sommer Field A : Mechanics of Deformable bodies.
4. Mortone E. Gurtin : An Introduction to Continuum Mechanics (Academic Press).

M.A./ M.Sc. MATHEMATICS (FINAL)
2011-2012

Note- There will be five papers in all. Paper-I: Topology and Functional Analysis and Paper-II: Discrete Mathematics will be compulsory. Each paper will be assigned six hours per week.

PAPER-I
TOPOLOGY & FUNCTIONAL ANALYSIS

TIME: 3 hours **Max. Marks: 100**

UNIT-I Topological spaces: open sets, closed sets, Closure of a set, Limit point of a set, Derived set, Boundary of a set. Kuratowaskis theorem, Open bases, Open subbases, second countable space, separable space, Lindel of theorem, continuous functions in topological spaces, continuity in Metric spaces.

UNIT-II

Compact Topological spaces: Continuity and compactness, compactness and base, Compactness and subbase, Product of compact spaces, Tychonoff theorem compactness, sequentially compactness and Bolzano-Weirstrass Property and their equivalences in Metric spaces.

Seperation Axioms: T_o - space, T_1 - space, Hausdroff space, Regular and completely regular and normal spaces separation Axioms and compactness.

UNIT-III

Connectedness: Connectedness and continuity, Product .of connected topological spaces, Components, connectedness in metric spaces.

Approximation: Weirstrass approximation theorem, function algebra, C(X, R) and C (X, C) the real Stone-Weirstrass theorem, Complex Stone-Weirstrass theorem.

UNIT-1V

Normed linear spaces; Banach spaces; Continuous linear transformations, Hahn-Banach theorem; the natural embedding of a normed linear space into its second conjugate, the open mapping theorem; the closed graph theorem, the uniform boundedness theorem.

UNIT-V

Hillbert spaces; Schwartz's inequality: orthogonal complements, Orthonormal sets, conjugate space, Riesz representation theorem, Adjoint of an operator, self adjoint operator, Normal operator, Matrix representation of a linear operator.

Books recommended:

1. George F.Simmons : Introduction to Topology and modern analysis, McGraw Hill Book Co.
2. S.I.Hu : Elements of Real Analysis.
3. H.L.Royden : Real analysis.
4. W.J.Thron : Topological structure.
5. J.Kelley : General Topology.

PAPER-II
DISCRETE MATHEMATICS

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Formal logic– Statement, Symbolic Representation and Tautologies, Quantifiers, Predicate validity, Propositional logic.

Semi groups and monoids, Relations and ordering. Functions definitions and examples of semi groups and monoids (including those pertaining to concatenation operation). Homomorphism of semi groups and monoids. Quotient subgroups, sub semigroups and sub monoids. Direct products. Basic Homomorphism theorem.

UNIT-II

Lattices: - Lattices as partially ordered sets. Their properties. Lattices as Algebraic systems. Sub lattices, direct products and Homomorphism complete, Complemented and distribution lattices.

Boolean Algebras:- Boolean Algebras as lattices. Various Boolean identities. The switching Algebras examples. Sub Algebras. Direct products and Homeomorphisms, Join- irreducible elements, Atoms and miterms, Boolean forms and their equivalence. Minterms Boolean forms. Minimization of Boolean functions. Application of Boolean Algebras to switching theory (usj and, OR and not gates).The karnaugh map method.

UNIT-III

Graph theory: Definition of (Undirected) graphs, Paths, Circuits, Cycles and Sub graphs. Indeed subgroups... Degree of vertex. Connectivity. Planner graphs and their properties.

Trees. Euler's formula for connected planar graphs complete and complete Bipartite graphs. Non Planer graph Kuratoueskis theorem (Statematonly). Spanning trees. Cut sets, Fundamental cut–sets, and Cycles. Minimal spanning trees and kruskal's Algerian. Euler's theorem on the existence of eulerian paths and circuits. Directed graphs. In degree and out degree of a vertex. Weighted undirected graphs, Dijkstra's Algorithm. Strong connectivity and marshal's Algorithm. Directed trees. Surch trees. Tree traversals.

UNIT-IV

Introductory computability Theory – Finite state machines and their Transition Table Diagrams. Equivalence of finite state machines. Reduced machines. Homomorphism. Finite Automata. Acceptors. Non- deterministic Finite Automata and equival ends of it are power to that of Deterministic Finite Automata.

UNIT-V

Phrase structure Grammar. Rewriting Rules. Derivations, Sentential forms. Language generated by a Grammar. Regular context – free, and context sensitivity Grammars and Languages. Regular sets, Regular expressions and pumping Lemna Kleene's Theorem stamens.

Books recommended:

1. J.P. Tremblay & R. Manohar : Discrete Mathematical structure with applications to computer science.
2. J.L. Gerstling : Mathematical Structures for Computer Science, (3rd edition).
3. N. Arsing Deo : Graph theory with applications to Engineering and Computer Science.
4. K.D. Joshi : Foundation of Discrete Mathematics
5. S. Wiitala : Discrete mathematics – A Unified Approach
6. C. L. Liu : Elements of Discrete Mathematics.

OPTIONAL PAPERS

Any three of the following papers with the permission of the Head of the Department of mathematics & statistics.

PAPER-III
RELATIVITY AND COSMOLOGY

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Geodesics, Null Geodesics, Geodesics Coordinates, Equation of Geodesics for the given metric. Riemann christoffel tensors and its significance, Curvature tensor, Ricci-tensor, Bianchi Identity.

UNIT-II

Energy momentum tensor and its expression for perfect fluid. Principle of covariance, principle of equivalence, condition for flat space time, Newtonian approximation of relativistic equation of motion. Einstein field equations and its Newtonian approximation. Schwarzschild exterior and interior relations for gravitational field.

UNIT-III

Planetary orbit, three crucial tests, Advance of perihelion, Gravitational. Deflection of light, shift in spectral lines, Weyl postulates, Franhaufer lines, Radar echo delay. Hubble law. Mach principle.

UNIT-IV

Static cosmological models of Einstein and De-Sitter, their derivation, properties and comparison with the actual universe, derivation of Robertson-Walker Metric. Hubble and Deceleration parameters. Red shift.

UNIT-V

Maxwell's equations in empty space, Energy momentum tensor for electromagnetic field, Einstein-Maxwell equation in General Relativity, Reissner Nordstrom solution.

Books Recommended:

1. P.G.Bergman : Introduction to Theory of Relativity
2. J.L.Synge : Relativity, The special Theory
3. J.L.Synge : Relativity, the General Theory
4. B.Spain : Tensor Calculus
5. J.L.Bansal : Tensor Analysis
6. J.V.Narlikar : Lecture on general Relativity.
7. Ray & Bali : Theory of Relativity
8. B.F.Shutz : A first course in General Relativity.

PAPER –IV
VISCOUS FLUID DYNAMICS

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Viscosity, Analysis of stress, Relation between stress and rate of strain, Navier-stokes equations and equation of energy in cartesian system of coordinates, vorticity and circulation. Reynolds law of similarity, Physical importance of non-dimentional parameters, Reynolds number Froude numbers, Mach number, Prandtl number, Eckert number.

UNIT-II

Some exact solutions of Navier-stokes equations-steady, motion between parallel plates, Hagen poiseuille flow a circular pipe, flow between coaxial circular pipes, flow between two concentric rotating cylinders, Pulsatile flow between parallel surfaces, flow in convergent and divergent channels (Jaffery-Hamel flow),flow in the vicinity of stagnation point, unsteady motion of a plate.

UNIT-III

Theory of very slow motion of a sphere in viscous fluid Osceen's improvement of stoke's theory. Boundary layer Theory: Boundary layer equations for two dimensional flows over a plane wall. Boundary layer on a flat plate (Blasius. Topper solution). Characteristic boundary layer parameters. similar solutions of the boundary layer equations.Exact solutions of the steady state boundary layer equation in two dimensional motion, Boundary layer along a flat plate.

UNIT-IV

Flow past a wedge, Flow past a convergent channel. Boundary layer separation. Blasius series solution, Gortler,new series method. Prandtl-mises transformation, Axial symmetrical and three dimensional boundary layer: - Boundary layer on a Yawed cylinder. Approximate methods for the solution of the boundary layer equations Karman momentum integral equation, Karman-Pohlhousen method. Energy integral equations. Walz-Thwaites method based on energy integral equation.

UNIT-V

Thermal Boundary Layer in Two Dimension Flow.

Thermal boundary layer equation for a plane wall. Forced convection in a laminar boundary layer on a flat plate (i) Crocco's first integral (ii) Reynolds’s analogy (iii) Crocco's second integral for Pr =1. Free convection from a heated vertical plate: Thermal energy integral equation.Approximate solution of the Pohlhousen's problem of free convection from a heated vertical plate

Book& Recommended:

1. G.Schfichting : Boundary Layer Theory.
2. S.I.Pai : Viscous Flow Theory, Vol.I, Laminar flow.
3. J.L.Bansal : Viscous Fluid Dynamics.
4. M. D. Raisinghania : Fluid Dynamics.
5. Shanti Swarup : Fluid Dynamics.

PAPER-V

NUMBER THEORY

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Divisibility: Gcd and Lcm of two or more integers, Euclidean, algorithm, the linear diophantine equation ax + by = c. Prime Numbers, composite numbers, infinitude of primes, fundamental theorem of arithmetic.

Congruences: Basic properties, divisibility tests, linear congruences. Application of Congruences: Fermat's little theorem, Euler's generalization, Wilsons's theorem Chinese remainder theorem.

UNIT-II

Number Theoretic functions: T.J, and, Multiplicative functions, Mobius inversion formula, the greatest integer function. Primitive Roots and Indices, Primitive roots, characterization of natural numbers having primitive roots, theory of indices, solution of certain congruence, through indices. Quadratic Residues: Quadratic residues and quadratic non residues of an integer in general and of a prime in particular, Gauss Lemma and its applications, the quadratic reciprocity law.

UNIT-III

Special Numbers: Fibonacci numbers, Fermat's numbers, Perfect numbers. Diophantine Equations: Representation of integers as sums of 2,3 and 4 squares.

Continued Fractions: Finite and infinite continued fraction convergent of a given continued fraction and their properties, Uniqueness of a continued fraction Periodic continued fraction, Pell's equation in general, characterization of solutions of x-dy = 1 in terms of its smallest positive solution.

UNIT-IV

Algebraic number fields and their rings of integers, Calculations for quadratic and cubic cases. Localization , Glois extension.

UNIT- V

Dedikind rings, discrete valuation rings completion, unramified and ramified extensions, different discriminates, cyclotomie fields, roots of unity.

Books Recommended:

1. Donald M.Burton : Elementary Number Theory, Allyn and Bacon Inc.
2. Niven & H.S. Zuckerman : An Introduction to the Theory of Numbers. Willey eastern India Ltd.
3. Lang, S. : Algebraic Number theory, GTM Vol. 110, Springer-Verlag 194.

PAPER-VI

NUMERICAL ANALYSIS

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Iterative methods: Simple iteration, theory of iteration, Acceleration a convergence, method for multiple and complex roots, Newton Rapson method for simultaneous equations, Convergence of iteration process in the case of several unknowns.

UNIT -II

Solution of polynomial equations: Polynomial evaluation, real and complex roots, Synthetic division, The Birge – vita, Bairstow and Graeffe's root squaring method.

System of Simultaneous equations(Linear): Direct method of determinant, Gauss – Elimination, Gauss- Jordan Cholesky, Partition method of Successive approximation, Conjugate Gradient , Gaurs or Jacobi iteration, Gauss- Seidel and Relaxation methods.

UNIT- III

Eigen value problems: Basic properties of Eigen values and Eigen vector power methods, Method for finding all Eigen pairs of a matrix, Complex Eigen values.

Curve fitting and Function Approximations: Linear square error criterion, Linear regression, Polynomial fitting and other curve fittings, Approximation of functions by Taylor series and Chebyshev Polynomials.

UNIT – IV

Numerical Solutions of ordinary differential equations: Taylor series method, Euler's and modified Euler's methods, Runge Kutta method up to fourth order, multi step method(Predictor Corrector strategies), Stability Analysis Single and Multi step methods.

UNIT- V

Difference method for BVP's ordinary Differential equations: Boundary value problems (BVP's), Shooting methods, Finite Difference method, Difference scheme for non-linear boundary value problem of the type $y' = f(x, y)$, $y'' = (x, y, y')$ and $y^{iii} = f(x, y, y', y'')$

Books Recommended:

1. Jain, Iyenger and Jain : Numerical Analysis
2. Jain, M. K. : Numerical solutions of differential equation

PAPER-VII

INTEGRAL EQUATIONS AND INTEGRAL TRANSFORMS

TIME: 3 hours **Max. Marks: 100**

UNIT – I

Linear Integral equations: Definition and classification, Conversion of initial and boundary value problem to an integral equation, Eigen values and Eigen functions, Solution of fredholm integral equations of second kind with seperable kernels. Reduction to a system of Algebraic equations.

Solution of Fredholm and Voltera integral equations of second kind by method successive substitution and successive approximations . Resolvenlt Kernal and its applications.

UNIT- II

Condition of uniform convergence and uniqueness of series solutions.
Integral Equation with symmetric kernels: Complex Hilbert space,Orthogonal system of functions. Fundamental Properties of Eigen values and Eigen functions for symmetric Kernels, Expansion in Eigen- functions and Bilinear form. Hilbert – Schmidt theorem, Solution of Fredholm integral equations of second kind with symmetric Kernels. Classical– Fredholm theory. Fredholm theorems, Solution of volterra integral equations with convolution type Kernels and Abel equations by Laplace tranform.

UNIT –III

Laplace transform: Definition and its properties. Rules of manipulations, Laplace theorms of derivatives and integrals , Properties of inverse laplace transtorms, Convolution theorm, Complex inversion formuls , applications to the solutions of ordinary differential equations with constant and variable coefficients and simple boundary value problems.

UNIT –IV

Fourier Transform: Definition and properties of fourier sine and cosine and complex transforms, Convolution theorm, Inversion theorms and Fouries transform of derivations. Applications to the solution by the partial differintial equations.

UNIT - V

Millin Transform: Definition and elementary properties, Mellin transforms of derivations and integrals Inversion theorm and convolution theorem.

Infinite Hankel transform: Definition and Elementary Properties, Hankel transform of derivations, Inversion theorem and parseval theorem. Application to the Solution of simple boundary value problems.

Books Recommended:

1. Ranville, E.D. : Laplace and Fourier Transforms.
2. Sneddon, I.N. : The use of Integral Transforms.
3. Ze manian, A.H. : Generalized Integral transforms.
4. Lowit, : Linear Integral equations.

PAPER-VIII
OPTIMIZATION TECHNIQUES

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Dual simplex algorithm, Bounded value algorithm, Parametric linear Programming, sensitivity analysis, changes in the coefficients of the objective function, changes in the components of vector b, variation in the components (aid) of the matrix A. Addition of the new variable, deletion of a variable, Addition of a new constraint. Deletion of constraint.

UNIT-II

Integer programming problem. All integer and mixed integer programming problems, Gamory's cutting plane methods(Fractional cut and λ-cut),Branch and bound method; Traveling salesman problem.

UNIT-III

Project scheduling through PERT and CPM, cost time, trade off, Resource leveling.

UNIT-IV

Quadratic forms, convex functions, Global and relative optimum of a function f(x), unconstrained extreme of differentiable functions, method of Lagrange multipliers for constrained extreme with equality constraints, convex programming problem. Lagrangian function and saddle point, Kuhn-Tucker theorem, Kuhn-Tucker conditions, Quadratic programming problem Wolfe's algorithms, and Beale's algorithm.

UNIT-V

Dynamic Programming: Bellman's principle of optimality, multiple stage decision problems, characteristics of DPP. Solution of finite number of stages problems by Dynamic programming. Network flow problems. Maximal flow, minimal cut theorems, shortest route problem.

Books Recommended:

1. Operation Research : Kanti swaroop, Mak-Mohan, P.K.Gupta.
2. Operation Research : Hamdy A Taha
3. Operation Research : S.D.Sharrna
4. Linear-Programming : S.I.Gass
5. Optimization Methods in Operations Research and systems analysis : K.V.Mittal

PAPER-IX
ADVANCED TOPOLOGY

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Nets and filters: directed set, Net, Limit and cluster point of a net subnet, Filter, Base and sub-base of a filter limit and cluster point of filter, sub filter. Characterization of open sets; continuous functions, Hausdroff spaces and compact spaces in terms of nets and filters. The limited equivalence of nets and filters.

UNIT-II

Ultra filter, the various sets of necessary and sufficient conditions for a filter to be an ultra filter, important results on ultra-filter. Embedding and metrization, Evaluation map. Meaning of embedding, embedding lemma, Embedding theorem, meaning of metrization, Urysohn's Metrization theorem, Nagata-Smirnow Metrization theorem Compactification, Meaning of compactification. Alexandroff one point compactification, Stone-coach compactification.

UNIT-III

Paracompactness: Refinement, Locally and discrete Classes of subjects, locally finite and discrete classes, Properties of these systems. Definition of a paracompact space, properties of paracompact space, the various definitions of paracompactness for a regular topological space and their equivalence, deductions from these of some simple sufficient conditions for paracompactness; behaviour of paracompact spaces with respect to products.

UNIT-IV

Uniform spaces: Uniformity, uniforms spaces, Uniform topology and properties of uniformities. Uniformiability of a topological space, equivalence of uniformiability and Complete regularity. Uniform continuity, relation between uniform continuity and continuity. Product uniformity and topology induced by it, Cauchy filters in a uniform space and their properties, complete uniform spaces, relations between the completeness and the closedness of a sub-space of a uniform space, equivalence of the compactness of uniform space with Its compactness and totally boundedness.

UNIT-V

Function space: Meanings of a function space, topology of point wise convergence or point open topology, topology of compact convergence or compact open topology, topology of uniform convergence on compact spaces, relation between these three properties of Y which a space of functions from a set X to a top space Y possesses.

Books recommended:

1. Thron, W.J. : Topological Structure.
2. Pervin, V.J. : Foundations of General Topology.
3. Kelley; J. : General Topology

PAPER-X
COMPUTER PROGRAMMING

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Information and Data concepts: Definition of information, and data categories, Features and levels of information, Number system in computers, classification of computers, elementary idea about components, devices in a computer system, specification of a modern computer system.
Concept of Software, System and application of software, computer interpreters and assembler, Operating system, overview of DOG commands Overview of GUI and concept of windows, computer network and its uses, concepts of Internet, www, htp, Telnet, e-mail.

UNIT-II

Programming languages, classification of programming languages, Generation of languages, steps in programme development, Problem identification, algorithms, flow charting, Program coding, testing & debugging. Fundamentals of C Programming: Overview of G, data types, contents and variables, operations and expressions, control constituents; If then-for and while. Type modifiers, Type casting.

UNIT-III

Arrays, functions, Basic I/O, Do-while, switch, Break and continue, exit( ) functions, Program design examples: Summation of set of numbers, generation of positive prime numbers, Generation of fibonacci sequences, finding kith smallest element, sorting by insertion of alphabets & numeric information.

Scope rules, functions: Parameters, Passing, call by value and reference functions with arrays, Recursion, Pointers, in G. file handling in C, C standard and header files.

UNIT-IV

Computer Arithmetic: Floating point representation of numbers, arithmetic operations with normalized floating point numbers, consequences of normalized floating point representation, computing pitfalls, errors in numbers, Binary representation of numbers.

Iterative Methods: The method of successive bisection, false position, Newton-Rapson iterative method, secant method, successive approximation, comparison of iterative methods, solution of polynomial equations, solution of simultaneous non linear equations.

UNIT-V

Solution of simultaneous algebraic equations: Gauss elimination method, Pivoting, Ill-conditioned equations, Gauss-Seidel iterative method and Algorithm, comparison of direct and iterative methods. Differentiation & Integration: formulae for numerical differentiation, Numerical integration Simpson's rule, errors in integration formulae algorithms for integration of tabulated function, algorithms for integrating knowm function, Gaussian quadrature formulae.

Numerical Solutions of differential equations: Eulers method. Taylor's series method, Runge Kutta method, Runge Kutta fourth order formulae, Higher order differential equations, Predictor-corrector method and its comparison with Runge Kutta methods.

Books Recommended:

1. Introduction Information Technology-Satish jain, BPB Publication, Cannought Place, New Delhi.
2. Fundamentals of computers-V.Rajaraman PHI Ltd.

3. The c-Programming Language B.W.Kernyharn & D.M. Ritche- PHI Ltd.
4. Computer Programming inc.-Kanetekar-B.P.B. Publication, New Delhi.
5. Computer oriented Numerical Methods-V. Rajraman PHI Ltd.

Note:

1. Candidates who have offered Computer Programming/ Computer Science/ Computer Applications in B.A. /B.Sc. /M.C.A courses will not be allowed to offer this subject/paper in their M.A./ M.Sc. examination.
2. Only ten students will be allowed to offer this course on the basis of merit of M.A./M.Sc. Previous Mathematics examination.
3. Four hours will be given to theory and two hours will be given for practical per week. Practical will be based on theory paper.
4. Questions from Unit IV and V will be based on programming.
5. Ten marks will be allotted for file work and oral examination.
6. This course will run only after the necessary infrastructure facilities have been provided to the department.

PAPER-XI
MATHEMATICAL THEORY OF STATISTICS

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Elements of theory of probability; sample space, various definitions of probability, addition and multiplication laws of probability, conditional probability and statistical independence of events. Baye's theorem and its applications. Mathematical expectations, conditional expectations, Moments and cumulates. Moments generating and characteristic functions.

UNIT-II

Binomial, Negative -binomial, Poisson and Hyper geometric distributions Rectangular, Normal, Cauchy, Gamma and Beta distributions Elementary idea of Exponential and Lap lace distributions.

UNIT-III

Inversion theorem. Chebyshev's inequality, control limit theorem for i.e. random variables. Curve fitting and principle of least squares, Scatter diagram, linear regression and correlation.

UNIT-IV

Chi-square, t and F sampling distributions with derivations, properties and applications, large sample theory.

UNIT-V

Elements of theory of estimation: Point estimation, criterion of good estimators for one arameter; Consistency, Efficiency, sufficiency and unbiasedness. Method of maximum likelihood estimation properties of maximum likelihood estimators (without proof). M.L.E. for Binomial, Poisson and Normal populations.

Interval estimation for mean and variance in cage of Normal population.

Elements of testing of hypothesis: Two kinds of error in testing of hypothesis. Critical region, Neyman-Pearson Lemma and determination of BCR in Neyman sense for testing simple v/s simple hypothesis in uniform and normal populations.

Note: Candidates who have offered Mathematical Statistics / Statistics / Applied Statistics as an optional subject / paper in their B.A. /B.Sc. examination will not be permitted to offer this course.

Books recommended:

1. Gupta and Kapoor : Fundamentals of Mathematical Statistics.
2. Kapoor and Saxena : Mathematical Statistics.
3. Goon and Others : Outline of Statistical Theory, Vol. I, II.

PAPER-XII
SPACE DYNAMICS

TIME: 3 hours **Max. Marks: 100**

UNIT- I

Basic formula of a spherical triangle –The two body problem: the motion of the center of mass, the relative motion, Kepler's equation, Solution by Hamilton Jacobi theory.

The Determination of Orbits- Laplace Gauss method.

UNIT- II

The three body Problem- General three Body problem, Restricted three Body problems, Jacobi integral Curves of zero velocity, Stationary Solutions and their Stability. The n- Body problem The Motion of the center of mass, Classical integrals.

UNIT- III

Perturbation - Osculating orbit, Perturbing forces, Secular and Periodic perturbations, Legrange's Planetory equations in terms of pertaining forces and in terms of a perturbed Hamiltonian. Motion of the moon- The perturbing forces, perturbation of Keplerian elements of the Moon by the Sun.

UNIT- IV

Flight Mechanics : Rocket performance in a vacuum, Vertically ascending path, Gravity twin trajectories Multistage rocket in a vacuum, Definitions pertinent to single stage rocket.

Performance limitations of single stage rockets, Definitions Pertinent of Multistage rockets, Analysis of Multi stage Rockets neglecting Gravity. Analysis of Multi stage rockets including Gravity

UNIT- V

Rocket Performance with Aerodynamic forces short range non- lifting missiles: Ascent of a sounding rocket. Some approximate performance of a rocket- Powered air craft.

Books recommended:

1. J.M.A. Danby : Fundamentals of celestial Mechanics.
2. E.Finlay, Freundlich : Celestial Mechanics.
3. Arigelo Miele : Flight Mechanics- Vol. I –Theory of flight paths.

PAPER-XIII
ASTRONOMY

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Spherical Trigonometry- Great and small circular spherical triangles and their properties, various spherical trigonometrically formula-Cosine, sine, supplemental cosine, sine cosine, contingent, half of an angle and side Napier's analogies, Delambe's analogies, their identities formulae for, right angled triangles and their solutions.

Celestial sphere, diurnal motion, Hour angle rising and setting of stars motion of sun, Zenith distance and Azimuth, Twilight.

UNIT-II

Refraction: Laws, effect of refraction on sun rise and sun set, Simpson's Hypothesis, effect of refraction in right ascension and declination etc.

Time: Equation of time, seasons and their lengths, precession and Nutation and their effects on right ascension and declination, planetary precession double stars.

UNIT-III

Aberration and its effect of longitude, latitude, right ascension and declination, position of apex, diurnal aberration and its effect in declination, right ascension and hour angle.

Parallax: shape of each, geocentric parallax, distance of Moon, Parallax in declination and Hour angle and geocentric parallax in zenith dist. azimuth, right ascension and declination annual parallax in longitude, and latitude, Parallactic angle and stellar parallax in right ascension and declination.

UNIT-IV

The meridian circle: the three errors, Besell's formula, correction for level and collimation error, total correction to the observed time of transit Kepler's Laws and planetary motion: Various definitions and laws, relation in elliptic motion, anomaly V in terms of eccentric anomaly, true anomaly V in terms of mean anomaly M, Euler's theorem.

UNIT-V

Planetary phenomena: Sydereal period and synodic period and their relation, elongation phases of moon, brightness, maximum brightness. Eclipses: Eclipses of moon angular radius of earth's shadow, duration of eclipses, the ecliptic limits, eclipses of sun and their Limits, frequency of eclipse, the metonic cycle. Proper motions of stars and their relation, tangential velocity and parallax, radial velocity at different epochs, the solar motion and parallactic motion, determination of solar apex form proper motions.

Books Recommended:

1. Astronomy by Gorakh Prasad.
2. Astronomy by Smart.

PAPER-XIV

COMPRESSIBLE FLUIDS AND MAGNETO HYDRODYNAMICS

TIME: 3 hours **Max. Marks: 100**

UNIT-I

Thermodynamic concepts, ideal gases, polytrophic gases, Differential equations of motion, Conservation of energy Isentropic flow, Subsonic and supersonic flow, circulation, Bernoulli's law, Limi speed and critical speed.

UNIT-II

Steady and non-steady flows, Steady isentropic channel flow, solution of the equation of steady flow methods of small perturbation linearised flows, Prandtl-Glauert motion, hodograph method, limiting line.

UNIT-III

Basic equations of electrodynamics of continuous media-Maxwell's equations, Constitutive equations, Ohm’s law for moving media. Electromagnetic body force, Coupled equations of electrodynamics and hydrodynamics, Conservation of mass momentum and energy.

Boundary condition, MHD approximation Magnetic pressure, similarity parameters and their significance, Frosen in fields, Magneto Hydrostatics and force free fields.

UNIT-IV

Steady MHD channel-flow problems-General equations and boundary conditions, Harlmann’s and Poisseiulle flows, simple heat transfer problems, MHD waves Effect of Compressibility, Viscosity and finite conductivity, MHD shockwaves Stability problems-Stuart’s and Lock’s conditions, Chandrashekhar's contributions.

UNIT-V

Motion of charged particles in electromagnetic fields, Adiabatic invariants, Magnetic mirror and battle, Pinches and their stability problems, applications of MHD to flowmetry, Power generation, MHD theories of sunspots and solar cycle, dynamo theories, elementary ideas of MHD boundary layers and turbulence.

Books recommended:

1. Millue Themson : Aero Dynamic
2. Sheroliff : Magneto hydrodynamics
3. Sutton and Sherman : Engineering MHD
4. Cowling : Magneto-Hydrodynamics.
5. Ferraro and Plumpton : Magnet of Fluid mechanics.
6. Chandrasekhar : Hydrodynamics and Hydromagnetics stability.