Revised Structure and syllabi of

B.A. /B.Sc. (Semester V & VI)
Mathematics
(Applicable from July 2020)

Structure	
B.A. /B.Sc. Semester V	B.A./B.Sc. Semester VI
Paper I : **Numerical Analysis** Paper II: **Linear & Abstract Algebra** Paper III: **Linear Programming**	Paper I : **Analysis** Paper II: **Differential Geometry & Tensor Analysis** Paper III: **Discrete Mathematics**

Each paper carries 100 Marks (4 Credits)

Syllabus B.A. /B.Sc. (Semester V)

Paper I: Numerical Analysis

Unit I

Solution of equations: bisection, Secant, Regular Falsi, Newton Raphson's method, Newton's method for multiple roots, Interpolation, Lagrange and Hermite interpolation, Difference schemes, Divided differences, Interpolation formula using differences.

Unit II

Numerical differentiation, Numerical Quadrature: Newton Cotes Formulas, Gaussian Quadrature Formulas, System of Linear equations: Direct method for solving systems of linear equations (Gauss elimination, LU Decomposition, Cholesky Decomposition), Iterative methods (Jacobi, Gauss Seidel, Relaxation methods). The Algebraic Eigen value problem: Jacobi's method, Givens method, Power method.

Unit III

Numerical solution of Ordinary differential equations: Euler method, single step methods, Runge-Kutta method, Multi-step methods: Milne-Simpson method, Types of approximation: Last Square polynomial approximation, Uniform approximation, Chebyshev polynomial approximation.

Unit IV

Difference Equations and their solutions, Shooting method and Difference equation method for solving Linear second order differential equation with boundary conditions of first, second and third type.

Reference Books:

1. Numerical Methods for Engineering and scientific computation by M. K. Jain, S.R.K. Iyengar & R.K. Jain.
2. Introductory methods of Numerical Analysis by S. S. Sastry

Paper II: Linear & Abstract Algebra

Unit I
Automorphism, inner automorphism, automorphism groups and their computations, Conjugacy relations, Normaliser, Counting principle and the class equation of a finite group, Center of group of prime power order. Sylow's theorems.
Unit II
Prime and maximal ideals, Euclidean Rings, Principal ideal rings, Polynomial Rings, Polynomial over the Rational Field, The Eisenstein Criterion, Polynomial Rings over Commutative Rings, unique factorization domain.
Unit III
Vector spaces, Subspaces, Linear independence and dependence of vectors, Basis and Dimension, Quotient space, Linear transformations, The Algebra of linear transformations, rank nullity theorem, their representation as matrices.
Unit IV
Linear functionals, Dual space, Characteristic values, Cayley Hamilton Theorem, Inner product spaces, Cauchy-Schwarz inequality, Orthogonal vectors, Orthonormal sets and bases, Bessel's inequality for finite dimensional spaces, Gram-Schmidt orthogonalization process, Bilinear and Quadratic forms.

Reference book
1. Topics in Algebra by I. N. Herstein.
2. Linear Algebra by K. Hoffman and R. Kunze.

Paper III: Linear Programming

Unit I
Linear programming problems, Slack and surplus variables, Standard and matrix forms of linear programming problem, Basic feasible solution.
Unit II
Convex sets, Fundamental theorem of linear programming, Simplex method.
Unit III
Artificial variables, Big-M method, Two phase method, Revised simplex method.
Unit IV
Duality in linear programming problems, Dual simplex method, Primal-dual method integer programming.

Reference book:
1. Linear Programming by G. Hadley

Syllabus B.A. /B.Sc. (Semester VI)

Mathematics

(Applicable from January 2021)

Paper I : Analysis

Unit I

Definition and examples of metric spaces, Neighborhoods, Interior points, Limit Points, Open and closed sets, Convergent and Cauchy sequences, Completeness, Cantor's intersection theorem. Uniform convergence of sequences and series of functions, Uniform convergence and continuity, Uniform convergence and integration, Uniform convergence and differentiation, Power series.

Unit II

Stereographic projection, Continuity and Differentiability of complex functions, Analytic functions, Cauchy Riemann equations, Harmonic functions.

Unit III

Complex integration, Cauchy-Goursat theorem, Cauchy's Integral formula, Formulae for first, second and nth derivatives, Cauchy's Inequality, Maximum Modulus Theorem, Liouville's Theorem, Elementary functions, Mapping by elementary functions, conformal mapping.

Unit IV

Taylor and Laurent Series, Absolute and uniform convergence of Power series, Residues and Poles, Residue theorem, Zeros and poles of order m, Evaluation of improper real integrals, Definite integrals involving sines and cosines.

Reference book:

1. Mathematical Analysis by Shanti Narain.
2. Complex variable and applications by Brown & Churchill.

Paper II: Differential Geometry & Tensor Analysis

Unit I

Local theory of curves-Space curves, Examples, Plane Curves, tangent and normal and binormal, Osculating Plane, normal plane and rectifying plane, Helices, Serret-Frenet apparatus, contact between curve and surfaces, tangent surfaces, involutes and evolutes of curves, Bertrand curves, Intrinsic equations, fundamental existence theorem for space curves.

Unit II

Metric-first fundamental form and arc length, Direction coefficients, families of curves, intrinsic properties, geodesics, canonical geodesic equations, normal properties of geodesics, geodesics curvature, Gauss-Bonnet theorem, Gaussian curvature, normal curvature, Meusneir's theorem, mean curvature, Gaussian curvature, umbilic points, lines of curvature, Rodrigue's formula, Euler's theorem.

Unit III

Tensor algebra: Vector spaces, the dual spaces, tensor product of vector spaces, transformation formulae, contraction, special tensor, inner product, associated tensor.

Tensor Analysis: Contravariant and covariant vectors and tensors, Mixed tensors, Symmetric and skew-symmetric tensors, Algebra of tensors, Contraction and inner product, Quotient theorem, Reciprocal tensors, Christoffel's symbols, Covariant differentiation.

Unit IV

Gradient of scalars, Divergence of a contra-variant vector, covariant vector and conservative vectors, Laplacian of an invariant, curl of a covariant vector, irrotational vector, Riemannian space, Riemannian curvatures and their properties, Ricci tensor, and scalar curvature, Einstein space and Einstein tensor, Geodesics.

Reference book:

1. An introduction to Differential Geometry by T. J. Willmore

Paper III: Discrete Mathematics

Unit I

Propositional Logic- Proposition logic, basic logic, logical connectives, truth tables, tautologies, contradiction, normal forms (conjunctive and disjunctive), modus ponens and modus tollens, validity, predicate logic, universal and existential quantification, proof by implication, converse, inverse contrapositive, contradiction, direct proof by using truth table.

Relation- Definition, types of relation, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation.

Unit II

Boolean Algebra- Basic definitions, Sum of products and products of sums, Logic gates and Karnaugh maps.

Graphs- Simple graph, multi graph, graph terminology, representation of graphs, Bipartite, regular, planar and connected graphs, connected components in a graph, Euler graphs, Hamiltonian path and circuits, Graph colouring, chromatics number, isomorphism and homomorphism of graphs.

Unit III

Combinatories- Inclusion- exclusion, recurrence relations (nth order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relations), generating function (closed form expression, properties of G.F., solution of recurrence relations using G.F. solution of combinatorial problem using G.F.)

Unit IV

Finite Automata- Basic concepts of automation theory, Deterninistic Finite Automation (DFA), transition function, transition table, Non Deterministic Finite Automata (NDFA), Mealy and Moore machine, Minimization of finite automation.

Reference book:

1. Discrete Mathematics by C. L.Liu.
2. Discrete Mathematics with computer application by Trembley and Manohar.