SUBJECT : MATHEMATICS

1. **Linear Algebra**: Vector space, Linear dependence and independence, Subspace, bases, dimension, Finite dimensional vector spaces.

   Matrices: Cayley- Hamilton theorem, eigenvalues and Eigen vectors, matrix of transformation, row and colum reduction, echelon form, rank, equivalence, congruence and similarity. Reduction to canonical forms. Orthogonal and unitary reduction of quadratic and hermitian forms, positive definite quadratic forms.

2. **Calculus** : Real numbers, bounded sets, open and closed sets, real, sequences, limits, continuity, differenticibility, mean value theorems, Taylor's theorem with remainders, indeterminate form, maxima and minima, asymptotes, functions of several variables, continuity, differentiability, partial deriavatives, maxima and minima, Lagranges methods of multipliers, jacobian, Raimann's definition of definite integrals. Indefinite integrals, infinite & improper integrals, beta & beta gamma functions, double and tripe integrals (evaluation techniques only), areas, surface and volumes, centre of gravity.

3. **Analytic geometry**: Cartesian and polar co-ordinates in two and three dimensions, second degree equations in two and three dimensions, reduction to canonical forms, straight lines, shortest distance between two skew lines plane, sphere, cone, cylinder, paraboloid, ellipsoid, hyperboloid of one and two sheets and their properties.

4. **Ordinary differential equations**: Formulation of differential equation, order and degree, equations of first order and first degree, integrating factors, equations of first order but not of first degree, calariaut's equation, singular solution.

Higher order linear equations with constant coefficients, complementary functions and particular integrals, general solution, Euler-Cauchy equation.

Second order linear equations with variable coefficients, determination of complete solution when one solution is known, method of variation of parameters.

5. **Dynamics, Statics and Hydrostatics**: Degree of freedom and constraints, rectilinear motion, simple harmonic motion, motion in a plane projectile, constrained motion, work and energy, conservation of energy, motion under impulsive forces, kepler's law, orbit under central forces, motion of varying mass, motion under resistance.

   Equilibrium of a system of particles, work and potential energy, friction, common catenary, principle of virtual work, stability of equilibrium, equilibrium of forces in three dimensions.

   Pressure of heavy fluids, equilibrium of fluids under a given system of forces, Bernoulli's equation, center of pressure, thrust on curved surfaces, equilibrium of floating bodies, stability of equilibrium, metacenter, pressure of gases.

6. **Vector analysis**: Scalar and vector fields, triple products, differentiation of vector function of scalar variable, gradient, divergence and curl in Cartesian, cylindrical and spherical co-ordinates and their physical interpretation. Higher order derivatives, vector identities and vector equations.

   Application to geometry: Curves in spaces, curvature and torsion, Serret-Frenet formulae Gauss and Stoke's theorem, Green's identities.

7. **Algebra**: Groups, Sub groups, normal subgroups, homomorphism of groups, quotient groups basic isomorphism theorem, Sylow's theorem, permutation groups, Cayley theorem. Rings and ideals, principal ideal Domains, Unique Factorisation Domains and Euclidean Domains, and Euclidean Domains, field extensions, finite fields.

8. **Complex Analysis**: Analytic function, Cauchy-Riemann equations, Cauchy's theorem Cauchy's integral formula, power series, taylor's series, Laurent's series, Singularities, Cauchy Rasidue theorem, Contour integration, Conformal mapping, Bilinear transformation.

9. **Operations Research**: Linear programming problems, basic solution, basic feasible solution and optimal solution. Graphical method and simplex method of solution, Duality, Transportation and assignment problems.

   Analysis of steady state and transient solution for queueing system with poisson arrivals and exponential service time.

   Deterministic replacement models, sequencing problem with two machines and n jobs, 3 machines and n jobs (special case).

10. **Mathematical Modeling**

   (a) Difference and differential equation growth models: Single species population models, Population growth an age structure model. The spread of technological innovation.

   (b) Higher order linear models - A Model for the detection of diabetes.

(c) Nonlinear population growth models: prey- predator models, Epidemic growth models.

(d) An Application in environment: Urban wastes water management planning models.

(e) Models from political science: Proportional representation (cumulative and comparison voting) models.

11. **Partial differential equations**: Curves and surfaces in three dimensions, formulation of partial differential equations, solutions of equations, solutions of equation of type dx/P=dy/Q=dz/R; orthogonal trajectories, pfaffian differential equations, partial differential equations of the first order, solution by Cauchy's method of characteristics, charpit's method of solution, linear partial differential equations of the second order with constant coefficients, equations of vibrating string, heat equation, Laplace equations.

12. **Probability**: Notion of probability: Random experiment, Sample space, axioms of probability, Elementary properties of probability, equally likely outcome problems.

Random variables: Concept, cumulative distribution function, discrete and continuous random variables, expectations, mean, variance, moment generating function.

Discrete distribution: Binomial, geometric, poisson.

Continuous distribution: Uniform, Exonential, Normal, Conditional probability, and conditional expectation, Bayes theorem, independence, computing expectation by conditioning.

Bivariate random variables: Joint distribution, Joint and Conditional distributions.

Functions of random variables: Sum of random variables, the law of large number and central limit theorem, approximation of distributions.

13. **Mechanics and fluid dynamics**: Generalised co- ordinates, holonomic and non-holonomic systems D'Alembert's principle and Langrage's equation, Hamilton equations, moment of inertia, motion of rigid bodies in two dimensions.

Equation of continuity, Euler's equations of motion for inviscid flow, stream-lines, path of a particle, potential flow. Two dimensional and axisymytric motion, sources and sinks, votex motion, flow past a cylinder and a sphere, method of images, Navier- Stocke's equation, for a viscous fluid.

14. **Discrete Mathematics**: Introduction to graph theory: graphs and degree sum theorem, connected graph, bi-partite graphs, trees, Eulerian and Hammiltonian graph, plane graph and Euler's theorem, planar graphs, 5-color theorem, marriage theorem.

15. **Logic** : Logical connectives negation, quantifiers, compound statement, Truth table, Tautologies, Boolean algebra- Lattices, geometrical lattices and algebraic structures, duality, distributive and complemented lattices, boolean lattices and boolean algebras, boolean functions and expressions, design and implementation of digital networks, switching circuits.