Syllabus
Mathematics - II for Electrical and Electronics Engineering Stream

Module-1: Vector Calculus
Introduction to Vector Calculus in EC & EE engineering applications. Vector Differentiation: Scalar and vector fields. Gradient, directional derivative, curl and divergence - physical interpretation, solenoidal and irrotational vector fields. Problems. Vector Integration: Line integrals, Surface integrals. Applications to work done by a force and flux. Statement of Green's theorem and Stoke's theorem. Problems.

Self-Study: Volume integral and Gauss divergence theorem.
Applications: Conservation of laws, Electrostatics, Analysis of streamlines and electric potentials.

Module-2: Vector Space and Linear Transformations
Importance of Vector Space and Linear Transformations in the field of EC & EE engineering applications. Vector spaces: Definition and examples, subspace, linear span, Linearly independent and dependent sets, Basis and dimension. Linear transformations: Definition and examples, Algebra of transformations, Matrix of a linear transformation. Change of coordinates, Rank and nullity of a linear operator, Rank-Nullity theorem. Inner product spaces and orthogonality.

Self-study: Angles and Projections.Rotation, reflection, contraction and expansion.
Applications: Image processing, AI & ML, Graphs and networks, Computer graphics.

Module-3: Laplace Transform
Importance of Laplace Transform for EC & EE engineering applications. Existence and Uniqueness of Laplace transform (LT), transform of elementary functions, region of convergence. Properties–Linearity, Scaling, t-shift property, s-domain shift, differentiation in the s-domain, division by t, differentiation and integration in the time domain. LT of special functions periodic functions (square wave, saw-tooth wave, triangular wave, full & half wave rectifier), Heaviside Unit step function, Unit impulse function. Inverse Laplace Transforms: Definition, properties, evaluation using different methods, convolution theorem (without proof), problems, and applications to solve ordinary differential equations.

Self-Study: Verification of convolution theorem.
Applications: Signals and systems, Control systems, LR, CR & LCR circuits

Module-4: Numerical Methods -1
Importance of numerical methods for discrete data in the field of EC & EE engineering applications. Solution of algebraic and transcendental equations: Regula-Falsi method and Newton-Raphson method (only formulae). Problems. Finite differences, Interpolation using Newton's forward and backward difference formula, Newton's divided difference formula and Lagrange's interpolation formula (All formulae without proof). Problems. Numerical

integration: Trapezoidal, Simpson's (1/3)rd and (3/8)th rules(without proof). Problems.

Self-Study: Bisection method, Lagrange's inverse Interpolation, Weddle's rule.
Applications: Estimating the approximate roots, extremum values, area, volume, and surface area.

Module-5:Numerical Methods -2
Introduction to various numerical techniques for handling EC & EE applications. Numerical Solution of Ordinary Differential Equations (ODEs): Numerical solution of ordinary differential equations of first order and first degree - Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor corrector formula (No derivations of formulae). Problems.

Self-Study: Adam-Bashforth method.
Applications: Estimating the approximate solutions of ODE for electric circuits.

Laboratory experiments
Suggested software's: Mathematica/MatLab/Python/Scilab

1. Finding gradient, divergent, curl and their geometrical interpretation and Verification of Green's theorem
2. Computation of basis and dimension for a vector space and Graphical representation of linear transformation
3. Visualization in time and frequency domain of standard functions
4. Computing inverse Laplace transform of standard functions
5. Laplace transform of convolution of two functions
6. Solution of algebraic and transcendental equations by Regula-Falsi and Newton-Raphson method
7. Interpolation/Extrapolation using Newton's forward and backward difference formula
8. Computation of area under the curve using Trapezoidal, Simpson's (1/3)rd and (3/8)th rule
9. Solution of ODE of first order and first degree by Taylor's series and Modified Euler's method
10. Solution of ODE of first order and first degree by Runge-Kutta 4th order and Milne's predictor-corrector method