



GOKARAJU RANGARAJU
INSTITUTE OF ENGINEERING AND TECHNOLOGY

LINEAR ALGEBRA AND SINGLE VARIABLE CALCULUS

Course Code: GR15A1001
I Year I Semester

L:2 T:1 P:0 C:3

Prerequisites: Vector algebra, Matrix algebra and Pre-calculus

Course Objectives

- To introduce the ideas of linearity and linear systems, which lie at the core level of many engineering concepts.
- To explore the extensions of differential calculus, which form the stepping stones to a broader subject called “approximation theory”.
- To learn the skill of seeing a mathematical equation in many commonly occurring natural phenomena and acquire preliminary skills to predict their behavior.

Course Outcomes: At the end of the course, the student will be able to

- Apply the concepts of matrix rank to analyze linear algebraic systems
- Compute eigen values and vectors for engineering applications
- Understand, model and solve linear dynamical systems

Unit-I

Linear Algebra and Matrix eigen value problem: Rank of a matrix, Consistency of a system of linear equations-Pseudo inverse of a matrix-Condition number of a matrix-Approximate solution of an over determined system of linear equations using the pseudo inverse-Solution of a system of homogeneous linear equations.

Vector norms, Linear dependence of vectors, Gram-Schmidt orthogonalization of vectors, Matrix norms.Determination of eigen values and eigen vectors of a square matrix-Properties of eigen values and eigen vectors of real and complex matrices.

Unit-II

Matrix factorizations and Quadratic Forms: Diagonalization of a matrix-Orthogonal diagonalization of symmetric matrices-Computation of matrix powers- Computation of Singular value decomposition - QR factorization.

Quadratic forms-Definiteness of a quadratic form-Rank, index and signature of a quadratic form- Reduction of a quadratic form into a canonical form by Lagrange's method and by an orthogonal transformation.



Unit-III

Differential Calculus of functions of a single variable: Mean value theorems (Rolles', Lagrange's, Cauchy's, Taylor's and Maclaurin's theorems Geometrical Interpretation without proof) - Approximation of functions by Taylor's and Maclaurin's theorems-Series expansion of functions.

Unit-IV

Linear differential equations of the first order and their applications: Formation of ODE-Methods to solve first order LDE (exact, reducible to exact, linear and Bernoulli equations).

Applications - Growth and decay models - Newton's law of cooling - Applications to electrical circuits (LR and RC circuits) - Geometrical applications - Orthogonal trajectories.

Unit-V

Linear differential equations of the higher order and applications: Equations with constant coefficients-Particular integrals for functions of the type e^{ax} , x^n , $\sin ax$, $\cos ax$, $e^{ax} \cdot V(x)$ Exponential shift - Method of variation of parameters.

Applications - Deflection of beams, Simple harmonic motion (simple pendulum, spring-mass systems) and RLC circuits.

Teaching Methodologies

1. Tutorial sheets uploaded in website
2. NPTEL video lectures
3. MATLAB exercises for visualization

Text Books

1. Advanced Engineering Mathematics: R.K.Jain and S.R.K.Iyengar-Narosa Publishing House
2. Advanced Engineering Mathematics: Erwin Kreyszig, Wiley.
3. Higher Engineering Mathematics: B.S.Grewal-Khanna Publications.

References

1. Introduction to Linear Algebra-Gilbert Strang
2. Schaum's outline series on Linear Algebra
3. GRIET reference manual