ENGINEERING MATHEMATICS-II

Ordinary Differential Equations & Numerical Methods

Common to all branches

Course Code - Category: CSE 121 - BS **Credits:3**

L	T	P	E	O
3	0	0	1	6

Sessional Marks:40

End Exam: 3 Hours End Exam Marks:60

Course Objective:

Create and analyze mathematical models using first and higher order differential equations to solve application problems such as electrical circuits, orthogonal trajectories and Newton's law of cooling and also familiarize the student in various topics in numerical analysis such as interpolation, numerical differentiation, integration and direct methods for solving linear system of equations**.**

Course outcome:

By the end of the semester, the student will be able to:	
CO1	Demonstrate solutions to first order differential equations by various methods and solve basic application problem related to electrical circuits, orthogonal trajectors and Newton's law of cooling.
CO2	Discriminate among the structure and procedure of solving a higher order differential equations with constant coefficients and variable coefficients
CO3	Apply various numerical methods to solve linear and non-linear equations
CO4	Familiar with numerical integration and differentiation
CO5	Understand Laplace transforms and its properties and finding the solution of ordinary differential equations

Unit - I: Ordinary Differential equations of ftrst order and its applications 12 Periods

First order linear differential equations, Bernoulli's equations, exact differential equations, equations reducible to exact equations, orthogonal trajectories, simple electric circuits (L –R circuit problems), Newton's law of cooling.

Learning outcome: At the end of this unit, the student will be able to

- Solve the first order differential equations and solve basic application problems described by first order differential equations.

Unit - II: Higher order Linear Differential Equations and its applications 10 Periods

Definitions, rules for finding the complementary function, rules for finding the particular integral, method of variation of parameters, equations reducible to linear equations with constant coefficient, Cauchy's homogeneous linear equation, Legendre's linear equation. Applications: L – C – R circuit problems.

Learning outcome: At the end of this unit, the student will be able to

- Solve the complete solution of linear differential equations with constant coefficient
- Solve basic application problems described by second order linear differential equations with constant coefficients.

Unit - III: Numerical solutions of algebraic and transcendental equations 10 Periods

Solution of algebraic equation by Bisection method, Newton-Raphson, Regula-Falsi methods. Solution of simultaneous linear algebraic equations, Gauss elimination, Gauss Jordan, Gauss Seidel.

Learning outcome: At the end of this unit, the student will be able to

- Find numerical solution to a system of equations by using different methods.

Unit - IV: Interpolation, Numerical Differentiation & Integration 12 Periods

Interpolation, Newton forward and backward interpolation formula, Lagrange's formula for unequal intervals. Numerical differentiation - Newton's forward and backward differences to compute first and second derivatives. Numerical integration - Trapezoidal rule, Simpson's one third rule and three eighth rules.

Learning outcome: At the end of this unit, the student will be able to

- Find derivative and integral of a function by using different numerical methods.

Unit - V: Laplace Transforms and its application 16 Periods

Introduction, definitions, transforms of elementary functions, properties of Laplace transforms, transforms of periodic functions, transforms of derivatives, transforms of integrals, Multiplication by t, division by t, evaluation of integrals by Laplace transforms. Inverse Laplace transforms – other methods of finding inverse transforms (excluding residue method), Convolution theorem (without proof), application's to differential equations, unit step function (without proof) and unit Impulsive functions (without proof).

Learning outcome: At the end of this unit, the student will be able to

- Examine the properties of Laplace transformation.
- Apply the Laplace and inverse Laplace transformations for different types of functions.
- Evaluate ordinary differential equations by using Laplace transformation technique.

Textbooks:

1. **B. S. Grewal** "*Higher Engineering Mathematics*" 44/e, Khanna Publishers, 2017.
2. **Erwin Kreyszig "**Advanced Engineering Mathematics" 10/e, John Wiley& Sons, 2011.

References:

1. **R. K. Jain and S. R. K. Iyengar** "Advanced Engineering Mathematics" 3/e, Alpha Science International Ltd., 2002.
2. **George B. Thomas, Maurice D. Weir and Joel Hass, "***Thomas Calculus"* 13/e, Pearson Publishers, 2013.