ENGINEERING MATHEMATICS – II

ORDINARY DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS

I/IV B.Tech. II – Semester

[R-20 Regulation]

[Common for ALL Branches]

	Credits:3
Instruction: 3 Periods & 1 E/week	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 Outcomes : At the end of the course the student will be able to

1	Demonstrate solutions to first order differential equations by various methods and solve basic application problems related to electrical circuits, orthogonal trajectories and Newton's law of cooling.
2	Discriminate among the structure and procedure of solving a higher order differential equations with constant coefficients and variable coefficients.
3	Apply various numerical methods to solve linear and non-linear equations.
4	Familiar with numerical integration and differentiation.
5	Understand Laplace transforms and its properties, and finding the solution of ordinary differential equations.

CO – PO Mapping :

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	**3**	**2**	**1**									**1**
CO-2	**3**	**2**	**1**									**1**
CO-3	**3**	**2**	**2**									**1**
CO-4	**3**	**2**	**2**									**1**
CO-5	**3**	**2**	**1**									**1**

SYLLABUS

UNIT – I: ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER AND ITS APPLICATIONS [12 Hrs]

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 Hrs]

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 and solve basic application problems described by second order linear differential equations with constant coefficients.

UNIT – III: NUMERICAL SOLUTIONS OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS [10 Hrs]

Solution of algebraic equation by Bisection method – Newton-Raphson method – Regula-Falsi method.

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 Hrs]

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 $\frac{1}{3}^{rd}$ – rule and $\frac{3}{8}^{th}$ – 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 APPLICATIONS [16 Hrs]

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

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

TEXT BOOKS:

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. **N. P. Bali, "***Engineering Mathematics*", Lakshmi Publications.
2. **George B. Thomas, Maurice D. Weir and Joel Hass, "***Thomas Calculus*", 13/e, Pearson Publishers, 2013.
3. **H. K. Dass**, "*Advanced Engineering Mathematics*", S. Chand and company Pvt. Ltd.
4. **Michael Greenberg**, "*Advanced Engineering Mathematics*", Pearson, Second Edition.