25MT105 CALCULUS AND ORDINARY DIFFERENTIAL EQUATIONS

Hours Per Week :

L	T	P	SL	C
3	2	0	3	4

PREREQUISITE KNOWLEDGE: Basics of Algebra, Functions, Differentiation and Integration.

COURSE DESCRIPTION AND OBJECTIVES:

This course aims to develop a fundamental understanding of calculus and differential equations, focusing on their applications in engineering and science. Students will explore single-variable and multi-variable calculus, integral calculus and various techniques for solving ordinary differential equations (ODEs). The objective is to equip students with analytical skills and problem-solving techniques that are essential for real-world applications.

MODULE–1

UNIT-1 **18L+12T+0P+18SL=48 Hours**

DIFFERENTIAL CALCULUS (FUNCTIONS OF ONE VARIABLE):

Mean value theorems and applications, Taylor's and Maclaurin's series expansion with remainders, Indeterminate forms, Concavity and convexity of a curve, Points of inflection, Curve sketching.

UNIT-2

INTEGRAL CALCULUS:

Integrations as the limit of a sum, Fundamental theorem of integral calculus, Mean value theorems, Reduction formulae, Rectification, Improper integrals, Tests of convergence (Only statements).

PRACTICES:

- Verify and interpret the Mean Value Theorem.
- Expand functions using Taylor & Maclaurin series and analyse errors.
- Analyse concavity and classify points of inflection.
- Apply the fundamental theorem of calculus to compute definite integrals.

MODULE–2

UNIT-1 **27L+18T+0P+27SL=72 Hours**

MULTIPLE INTEGRALS:

Double and triple integrals, Change of order of integration, Change of variables - Jacobians of Transformations.

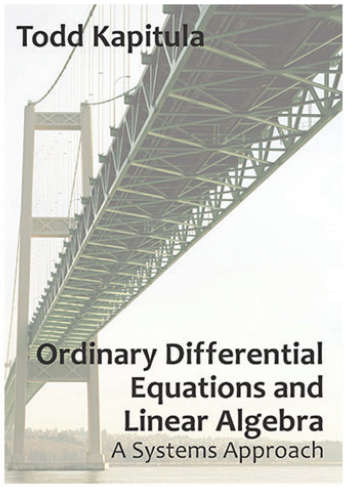
Applications: Computations of areas and volumes, Center of mass and centroid, Moment of inertia.

UNIT-2

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS:

Introduction, Order and degree, Formation of ODE from a given one-parameter family of curves, Solutions: Variable separable method, homogeneous, equation reducible to variable separable type, linear and Bernoulli's equations.

Applications: Newton's law of cooling, Natural growth and decay.



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SKILLS:

- ✓ *Understanding function behaviour using calculus principles.*
- ✓ *Evaluating integrals and applying reduction formulas.*
- ✓ *Solving multiple integrals with variable changes and transformations.*
- ✓ *Mastering techniques for solving ODEs and applying them in scientific contexts.*

UNIT-3

SECOND ORDER ORDINARY DIFFERENTIAL EQUATIONS:

Homogeneous and non-homogeneous equations, Complementary functions, Particular integrals, Solution with constant equations: method of undetermined coefficients, variation of parameters.

PRACTICES:

- Solve simple first-order ODEs using separation of variables.
- Evaluate the area under a curve using definite integrals.
- Solve a real-world problem by computing the volume of a solid using triple integrals with appropriate limits.
- Compare and contrast the use of Cartesian vs. polar coordinates in evaluating a given double integral.
- Apply ODEs to Newton's Law of Cooling and natural growth/decay problems.
- Solve circular motion problems using ***Āryabhaṭa's Bhūgola-Nyāya*** (Rotating Earth Principle) and compare with modern calculus. Understand angular speed and how fast things change.

COURSE OUTCOMES:

Upon successful completion of the course, students will have the ability to:

CO No.	Course Outcomes	Blooms Level	Mapping with POs
1	Apply calculus concepts in problem-solving	Apply	1, 2, 5
2	Analyze the behavior of functions and integrals	Analyze	1, 2, 6
3	Apply multiple integrals and transformations	Apply	1, 4, 5
4	Evaluate solutions of ODEs	Evaluate	1, 4, 10
5	Create solutions for real-world applications	Create	1, 11

MAPPING OF SUSTAINABLE DEVELOPMENT GOALS (SDGS) AND INDIAN KNOWLEDGE SYSTEM (IKS):

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley, 10th Edition, 2011.
2. Kanti B. Datta, Varma, P. Sekhar, "Calculus, Linear Algebra and Ordinary Differential Equations", Cengage Learning, 1st Edition, 2024.

REFERENCE BOOKS:

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, Latest Edition.
2. S.L. Ross, "Differential Equations for Engineers", New Age International Publishers, Latest Edition.
3. James Stewart, "Calculus", Cengage Learning, 8th Edition, 2015.