ORDINARY DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS

Course Code:22BM1103

L	T	P	C
3	0	0	3

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

CO1: solve first order differential equations arising in various engineering fields **(L3)**

CO2: solve linear differential equations of higher order and use the knowledge to study certain problems that arise in engineering **(L3)**

CO3: illustrate the techniques of Laplace transform to solve problems that arise engineering **(L4)**

CO4: summarize various concepts of vector differentiation **(L5)**

CO5: use calculus to vector functions and interpret vector integral theorems **(L3)**

UNIT-I **10 Lectures**

First Order Differential Equations and Applications:

Linear and Bernoulli differential equations, Exact differential equations, Equations reducible to exact equations, Orthogonal trajectories, Simple electric circuits, Newton‟s law of cooling. (Sections 11.9 - 11.12, 12.3, 12.5, 12.6 of the textbook)

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

1. solve a first order differential equation using various techniques (L3)
2. use a first order differential equation to get the solution of a simple electric circuit (L3)
3. discuss the method of finding orthogonal trajectories of a function (L2)

UNIT-II **10 Lectures**

Higher Order Linear Differential Equations:

Linear differential equations of higher order with constant coefficients, Complete solution, Operator D, Rules for finding the complementary function, Inverse operator, Rules for finding the particular integral, Method of variation of parameters, Cauchy‟s linear equation, L-C-R circuit problems. (Sections 13.1 - 13.7, 13.8 (i), 13.9 (i), 14.5(ii) of the textbook)

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

1. determine the solution of a linear differential equation of higher order (L3)
2. explain the method of variation of parameters to find a particular solution of second order differential equations (L2)
3. solve a higher order differential equation by analyzing a physical situation (L3)

UNIT-III **10 Lectures**

Laplace Transforms:

Definition of Laplace transform, existence conditions, properties of Laplace transform, periodic functions, transforms of derivatives, transforms of integrals, multiplication by t, division by t, evaluation of integrals by Laplace transforms, inverse Laplace transforms, convolution theorem (without proof), unit step function, unit impulse function, applications to ordinary differential equations with initial conditions. (Sections 21.1-21.5, 21.7-21.15, 21.17, 21.18 of the textbook)

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

1. illustrate Laplace and inverse Laplace transforms to various functions (L4)
2. determine certain improper integrals using Laplace transforms (L3)
3. solve an ordinary differential equation through Laplace transforms (L3)

UNIT-IV **10 Lectures**

Vector Differential Calculus:

Scalar and vector point functions, vector operator del, gradient, directional derivative, divergence and curl, solenoidal and irrotational vector functions, vector identities: del applied twice to point functions, del applied to products of point functions (Sections 8.4-8.9 of the textbook).

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

1. illustrate the concepts of gradient, divergence and curl (L4)
2. determine the directional derivative of a scalar point function (L3)
3. apply del operator to a vector point functions (L3)

UNIT-V **10 Lectures**

Vector Integral Calculus:

Line integral - circulation, work done, surface integral-flux, volume integral, Green‟s theorem in the plane, Stoke‟s theorem and the divergence theorem (without proof), irrotational fields (Sections 8.11-8.16, 8.18 of the textbook)

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

1. determine the work done in moving a particle along a path (L3)
2. interpret surface and volume integrals (L2)
3. apply vector integral theorems to multiple integrals (L3)

Textbook:

B. S. Grewal, *Higher Engineering Mathematics*, 44th Edition, Khanna Publishers, 2017.

Reference Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th Edition, John Wiley & Sons, 2011.
2. Greenberg M D, *Advanced Engineering Mathematics*, 2nd Edition, Pearson Education, Singapore, Indian Print, 2003.
3. Peter V. O‟Neil, *Advanced Engineering Mathematics*, 7th Edition, Cengage Learning, 2011.

Web References:

1. https://www.coursera.org/courses?query=vector%20calculus
2. https://www.khanacademy.org/math/differential-equations/first-order-differential-equations

***