DIFFERENTIAL EQUATIONS AND INTEGRAL TRANSFORMS

(Common to CSE (AI & ML), CSE (DS))

Course Code: 22BM1105

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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 a linear differential equations of higher order (L3)

CO3: determine the solution of a partial differential equation (L3)

CO4: Illustrate the techniques of Laplace transform to solve problems that arise engineering (L4)

CO5: Evaluate the Fourier series and/or Fourier transform of a periodic function (L5)

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)**

Partial Differential Equations:

First order partial differential equations, solutions of first order linear and nonlinear PDEs. Solutions to homogeneous and non-homogeneous higher order linear partial differential equations. (Sections 17.1 – 17.3, 17.5, 17.6, 17.8-17.12 of the textbook)

Learning Outcomes:

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

1. discuss various techniques to form a partial differential equation (L2)
2. determine the solution of a higher order homogeneous linear partial differential equation (L3)
3. solve a higher order non-homogeneous linear partial differential equation (L3)

UNIT-IV **(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-V **(10 Lectures)**

Fourier Series and Fourier Transforms:

Euler's formulae, conditions for a Fourier expansion, functions having points of discontinuity, change of interval, even and odd functions - half range series, typical waveform. Fourier integrals, Fourier cosine and sine integrals, Fourier transform, Fourier sine and Fourier cosine transforms and properties. (Sections 10.1 – 10.8, 22.1 – 22.5 of the textbook)

Learning Outcomes:

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

1. evaluate the Fourier series expansion for different periodic functions (L5)
2. analyze the properties of Fourier transforms (L4)
3. determine the Fourier transform for a given function (L3)

Text Book:

1. 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://onlinecourses.nptel.ac.in/noc19_ma20/preview