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|---|---|
| **INSTITUTE** | **FACULTY OF ENGINEERING AND TECHNOLOGY** |
| **PROGRAM** | **BACHELOR OF TECHNOLOGY (MECHANICAL ENGINEERING - ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)** |
| **SEMESTER** | **3** |
| **COURSE TITLE** | **APPLIED DIFFERENTIAL EQUATIONS** |
| **COURSE CODE** | **01MA1301** |
| **COURSE CREDITS** | **5** |

**Objective:**

1 The subject aims to make the learner able to apply the knowledge of differential equations and numerical methods to solve core Engineering and real-world problems.

2 The subject aims to make the learner able to apply the knowledge of differential equations and numerical methods to solve core Engineering and real-world problems

3 Apply Laplace transform and Fourier series to solve differential equations

4 Classify and apply the standard methods to solve ordinary differential equations.

5 Expand various functions in terms of sine and cosine functions.

6 Employ partial differential equations in engineering problems.

**Course Outcomes:** After completion of this course, student will be able to:

1 Apply Laplace transforms and their properties to solve ordinary differential equations.

2 Apply classical methods to solve homogeneous and non-homogeneous differential equations in engineering problems.

3 Apply Fourier series and Fourier integrals to represent periodic and non-periodic functions.

4 Formulate and classify partial differential equations and solve first-order and second-order PDEs using Lagrange's method and separation of variables.

**Pre-requisite of course:**Basic concept of Derivative, Partial Derivative and Integration

**Teaching and Examination Scheme**

| Theory Hours | Tutorial Hours | Practical Hours | ESE | IA | CSE | Viva | Term Work |
|---|---|---|---|---|---|---|---|
| 3 | 2 | 0 | 50 | 30 | 20 | 25 | 25 |

| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 1 | **Fourier Series, Fourier integral and Some Special Functions**<br>Periodic function, Trigonometric series, Fourier series for functions of any period,, Even and odd functions, Half-range Expansion, Fourier integrals, Definitions of: Gamma function, Beta function, Error function, and complementary Error function, Heaviside's function, pulse unit height, and duration function, Sinusoidal Pulse function, Rectangle function, Gate function, Dirac's Delta function, Signum function, Sawtooth wave function, Triangular wave function, Halfwave rectified sinusoidal function, Full rectified sine wave, square wave function | 10 |
| 2 | **Laplace Transforms**<br>Laplace transforms definition, Laplace transforms of some elementary functions,, Inverse transforms, Linearity and shifting properties,, Laplace transforms of derivatives and integrals, Differentiation and integrations of Transforms, Convolution theorem and its application to obtain inverse Laplace transform,, Laplace transform of periodic functions, Unit step function, Unit impulse function (Dirac delta function), second shifting property,, Applications of Laplace transforms to solve ODE and system of ODE | 10 |
| 3 | **Higher-Order ODE with Applications**<br>Solution of homogeneous linear differential equations with constant coefficients, , Nonhomogeneous linear differential equations, , Variation of Parameters, Euler-Cauchy's differential equations with variable coefficients, , Application of ODE: Mechanical vibration system, Newtons Colling law | 12 |
| 4 | **Partial Differential Equations**<br>Formation of PDE, Classification of 2nd order PDE, Solution of Partial Differential Equations, Lagrange's linear partial differential equation, , Special types of Nonlinear PDE of the first order, method of separation of variables, Homogeneous and Non-homogeneous PDE, Application of PDE: Heat, wave, Laplace equations and their solution by the method of separation of variables and Fourier series | 8 |
| 5 | **Application of ODE and Laplace by MATLAB**<br>Laplace transforms of some function, Inverse Laplace transform of some function, Solution of the Differential equation, Solution of Differential equation with IVP and BVP | 2 |
| **Total Hours** | | **42** |

**Suggested List of Experiments:**

| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 1 | **Laplace Transforms**<br>LAB 1, LAB 2, LAB 3 | 6 |
| 2 | **Fourier Series, Fourier integral and Some Special Functions**<br>LAB 1, LAB 2 | 6 |

**Suggested List of Experiments:**

| Contents : Unit | Topics | Contact Hours |
|---|---|---|
| 3 | **Higher-Order ODE with Applications**<br>LAB 1, LAB 2, LAB 3 | 6 |
| 4 | **Partial Differential Equations**<br>LAB 1, LAB 2 | 4 |
| 5 | **Application of ODE and Laplace by MATLAB**<br>LAB 1, LAB 2 | 6 |
| **Total Hours** | | **28** |

**Textbook :**

1 Advanced Engineering Mathematics, Erwin Kreyszig, Ed., John Wiley & Sons, 1999

2 Higher Engineering Mathematics, B.S.Grewal, Khanna publishers, 2010

**References:**

1 Engineering mathematics Vol. 2,, Engineering mathematics Vol. 2,, Baburam,, Pearson, 2012

2 Advanced Engineering Mathematics, Advanced Engineering Mathematics, H. K. Dass, S Chand Publishing, 2009

3 Elementry Differential Equation, Elementry Differential Equation, W.E. Boyce and R. Diprima, John Wiley, 2005

4 Advanced Engineering Mathematics, Advanced Engineering Mathematics, Wylie & Barrett, Pearson, 2008

5 Advanced Engineering Mathematics, Advanced Engineering Mathematics, Greenberg M D, Pearson, 2009

**Suggested Theory Distribution:**

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

| Distribution of Theory for course delivery | | | | | |
|---|---|---|---|---|---|
| **Remember / Knowledge** | **Understand** | **Apply** | **Analyze** | **Evaluate** | **Higher order Thinking / Creative** |
| 15.00 | 15.00 | 40.00 | 15.00 | 10.00 | 5.00 |

**Instructional Method:**

1 At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.

2 Lectures will be taken in class room with the use of multi-media presentations, black board – mix of both.

3 Attendance is compulsory in lectures and laboratory which carries a 5% component of the overall evaluation

**Instructional Method:**

4 Minimum two internal exams will be conducted and average of two will be considered as a part of 15% overall evaluation

5 Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval. It carries a weightage of 5%.

**Supplementary Resources:**

1 http://mathworld.wolfram.com/

2 http://en.wikipedia.org/wiki/Mat

3 http://nptel.ac.in/courses/111103021/

4 http://nptel.ac.in/courses/111104031/

5 http://mathworld.wolfram.com/LaplaceTransform.html

6 http://mathworld.wolfram.com/FourierSeries.html