COURSE STRUCTURE

Course Code				
Course Category	Basic Sciences			
Course Title	Differential Equations and Transform Techniques (DETT)			
Teaching Scheme and Credits Weekly load hrs.	L	T	Laboratory	Credits
	3	1	--	3+1+0=4

Pre-requisites: Linear Algebra and Differential Calculus, Integral Calculus.

Course Objectives:

- To learn linear differential equations and their applications in Engineering.
- To learn partial differential equation and their applications.
- To understand Laplace transform techniques and solve differential equations using Laplace transforms.
- To understand Fourier transforms techniques and their applications.
- To learn Z transforms for solving difference equations.

Course Outcomes:

After completion of this course students will be able to

1. identify first order & higher order linear differential equations & solve these equations using various methods. (CL I & III)
2. understand the concept of partial differential equations used in boundary value problems (CL II & III)
3. solve heat equation & wave equation using the method of separation of variables CL III)
4. apply Laplace transform techniques to solve ordinary differential equations. (CL III)
5. apply Fourier transform techniques to solve differential equations involved in real life engineering problems. (CL III).
6. understand Z transforms concept with their properties for solving difference equations (CL II & III)

Course Contents:

Linear Differential Equation:
Review of first order differential equations, Linear Differential Equation of nth order with constant coefficients, Method of variation of parameters, Cauchy's and Legendre's Differential Equations, Applications of Linear differential equations-mass spring systems and electrical circuits. (branch specific).

Partial Differential Equations:
Basic concepts, Solution of Partial Differential equations, method of separation of variables for the solution of one- and two-dimensional Heat flow equations, Wave equation.

Laplace Transform:
Definition, Properties, Laplace Transform of standard functions, Laplace transform of some special functions, Inverse Laplace Transform, Applications of Laplace Transform for solving Ordinary differential equations.

Fourier Transform:
Introduction of Fourier series, half range sine & cosine series, Fourier Integral theorem, Fourier Sine and Cosine Transforms, Inverse Fourier Transform. Finite Fourier Transform, Applications of Fourier transforms to problems on one- and two-dimensional heat flow problems.

Z Transform:
Definition, Properties, Z- transform of standard sequences and their inverse, solution of difference equations.

Tutorial Exercises:

1. Linear Differential Equations solution by Shortcut method
2. General, Variation of Parameter methods
3. Applications of Linear Differential Equations.
4. Wave equation,
5. One dimensional Heat flow equations.
6. Two-dimensional Heat flow equations
7. Laplace transform of standard functions
8. Laplace transform of special functions
9. Inverse Laplace Transform
10. Solve ODE using Laplace transform
11. General Fourier transform
12. Fourier Sine and Cosine Transforms.
13. Applications of Fourier transforms to problems on one- and two-dimensional heat flow problems.
14. Problems on Z transforms-standard sequences
15. Inverse Z transform & solution of difference equation.

Note: Introduce Mathematical Software for few tutorial conduction. Tutorial shall be engaged in four batches (batch size of 15 students) per division.

LearningResources:

Reference Books:

1. KreyszigErwin, "Advanced Engineering Mathematics" 10th edition ,Wiley Eastern Limited 2015.
2. Greenberg Michael D.,"Advanced Engineering Mathematics", 2nd edition, Pearson   . 2009.

3. Grewal B.S., "Higher Engineering Mathematics" ,43rd edition Khanna Publishers 2014

Supplementary Reading:

1. O' Neil Peter, "Advanced Engineering Mathematics", 8th edition, Cengage Learning 2015.
2. **Weber H.J. and Arfken G.B.** "Mathematical Methods For Physicists" , 6th edition, Academic Press 2011.
3. Maurice D Weir,Joel Hass, Frank R Giordano, " Thomas' Calculus" , 14th edition, Pearson 2009.

Web Resources:

Web links:
- Introduction to second order LDE   https://www.youtube.com/watch?v=tGtCajxHoDw
- Fourier Transform, Fourier Series, and frequency spectrumhttps://www.youtube.com/watch?v=r18Gi8lSkfM

MOOCs: NPTEL, MIT OPEN COURSEWARE

- https://ocw.mit.edu/courses/mathematics/18-02sc-multivariable-calculus-fall-2010/
- https://ocw.mit.edu/courses/mathematics/18-03-differential-equations-spring-2010/video-lectures/lecture-9-solving-second-order-linear-odes-with-constant-coefficients/
- http://nptel.ac.in/courses/111103021/18
- *https://ocw.mit.edu/courses/mathematics/18-02-multivariable-calculus-fall-2007/video-lectures/lecture-8-partial-derivatives/*

Pedagogy:

- Team Teaching
- Tutorials and class tests/assignments
- Audio- Video technique

Assessment Scheme:
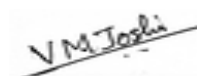**Class Continuous Assessment (CCA): 60 marks**

Class test/home assignments	Tutorial	Mid Term Test	Total
10 Marks	30 Marks	20 Marks	60 Marks

Term End Examination: 40 Marks

Syllabus:
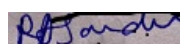
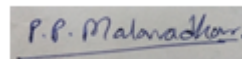| Module No.	Contents	Workload in Hrs.		
		Theory	Tutorial	Assess
1	**Linear Differential Equation:** Linear Differential Equation of nth order with constant coefficients, Method of variation of parameters, Cauchy's and Legendre's Differential Equations, Applications of Linear differential equations.	10	03	--
2	**Partial Differential Equations:** Basic concepts, Solution of Partial Differential equations, method of separation of variables Solution of one and two dimensional Heat flow equations, Wave equation.	09	03	--
3	**Laplace Transform**: Definition, Properties, Laplace Transform of standard functions, Laplace transform of some special functions, Inverse Laplace Transform, Applications of Laplace Transform for solving Ordinary differential equations.	10	04	--
4	**Fourier Transform:** Introduction of Fourier series, half range sine & cosine series, Fourier Integral theorem, Fourier Sine and Cosine Transforms, Inverse Fourier Transform. Finite Fourier Transform, Applications of Fourier transforms to problems on one- and two-dimensional heat flow problems.	09	03	--
5	**Z Transforms:** Definition, Properties, Z- transform of standard sequences and their inverse, solution of difference equations.	7	2	

Prepared By	**Checked By**	**Approved By**
VMJoshi	*RJJaudu*	*P. P. Malavadkar.*
Prof. Vaishali M. Joshi	Prof. Ramaa Sandu	Prof. Dr Prashant Malavadkar