LOK JAGRUTI UNIVERSITY (LJU)

L J INSTITUTE OF ENGINEERING AND TECHNOLOGY

Department of Mechanical Engineering

Master of Engineering (M. E) - Semester – I

Course Code:	**49050101**
Course Name:	**Advanced Engineering Mathematics-1**
Category of Course:	Core
Prerequisite Course:	UG level course in Engineering Mathematics

Teaching Scheme				
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**Total Hours**
2	**2**	**0**	**4**	**40**

Course Objectives	
1	To derive Metrix representation of system of linear equations, linear transformation and concepts of Inner products.
2	To understand the importance of basis and orthogonality in Eigen value and Eigen vector.
3	To develop the skill different types of methods of solving Differential equations.
4	To able to apply different conditions as per requirement in methods Advanced Engineering Mathematics.
5	To able to apply accurate Mathematical methods in real life problems of Mechanical Engineering.

Syllabus

Unit No.	Topic	Prerequisite Topic	Teaching Hours
01	**Basic of Matrix and Linear Algebra**		**04 (10%)**
	1.1 Introduction of Matrix and Linear algebra.	---	
	1.2 Matrices & System of linear equations.		
	1.3 Methods for solving system of linear Equations with geometrical approach.		
	1.4 Application of system of linear Equations		
02	**Vector space & Inner Product space**		**04 (10%)**
	2.1 Definition of Vector Space and Its Properties.	---	
	2.2 Linear combination and basis of Vector spaces.		
	2.3 Introduction to Inner Product Space with properties.		
	2.4 Orthogonalization of basis.		
03	**Eigen Vectors and Eigen Values**		**04 (10%)**
	3.1 Introduction to Eigen Value and Eigen Vectors	---	
	3.2 Properties of Eigen Value and Eigen Vectors, Algebraic and Geometric Multiplicity		
	3.3 Diagonalization of Square Matrix		
	3.4 Conversion of Quadratic form in to Canonical form		
04	**Linear Transformation**		**04 (10%)**
	4.1 Definition of Linear transformation with Examples	---	
	4.2Types of Linear transformations.		
	4.3 Matrices of Linear Transformation, Kernel and Range of Linear Transformation		
	4.4 Row space, Column space, Null space of Linear transformation		
05	**Matrix Decomposition and Approximations**		**04 (10%)**
	5.1 The Cholesky decomposition		
	5.2 QR factorization		
	5.3 Least squares method		
	5.4 Power method		
06	**Laplace Transformation**		**04 (10%)**
	6.1 Definition of Laplace transform and it's Properties	---	
	6.2 Inverse Laplace transform and it's Properties		
	6.3 Convolution Theorem with Examples		
	6.4 Unit step function and Dirac's Delta function		
07	**Fourier Series and Transform**		**04 (10%)**
	7.1 Introduction to Fourier series	---	
	7.2 Fourier Series of Discontinuous Functions		
	7.3 Fourier Sine and Cosine Series		
	7.4 Fourier Transform		
08	**Method to solving Ordinary Differential Equations-I**		**04 (10%)**
	8.1 Introduction to Differential Equations and its types.	---	
	8.2 Formation of Differential Equation.		
	8.3 Methods for solving 1^{st} order ODE.		
	8.4 Initial value problems of 1^{st} order ODE with Application.		
09	**Method to solving Ordinary Differential Equations-II**		**04 (10%)**
	9.1 Method for solving Higher order linear Ordinary Differential Equations.	---	
	9.2 Initial value problems in Higher order linear Ordinary Differential Equations.		
	9.3 Application of Laplace to solve Higher order linear ODE.		

10	**Method to solving Partial Differential Equations**		
	10.1 Introduction to Partial Differential Equations	**---**	**04 (10%)**
	10.2 Method of Separable Variables to solve PDE.		
	10.3 Introduction of Wave and Heat Equation and their Solutions.		
	10.4 Example's solution of Wave & Heat equations by Fourier Series.		

Course Outcome	
1	Students will understand fundamentals of Linear Algebra and their geometrical meanings.
2	Students will be able to solve problems in their relevant branch using mathematical methods of linear algebra.
3	Students will be able to apply knowledge of Laplace & Fourier Transform in different fields of mechanical branch.
4	Students will be able to get best accurate solutions Using Approximation methods.
5	Students will be able to develop Ordinary and partial Differential equations in their relevant fields.
6	Students will be able to solve mechanical system problems using IVP & BVP.
Suggested Reference Books	
1	Bronson, R. "Matrix Operations", Schaum's outline series, 2nd Edition, McGraw Hill, 2011.
2	Advanced Engineering Mathematics by Erwin Kreyszig.
3	O'Neil, P.V., "Advanced Engineering Mathematics ", Thomson Asia Pvt. Ltd., Singapore, 2003.
4	Introduction to Linear Algebra , Strang Gilbert 5th ed. Wellesley, MA: Wellesley-Cambridge Press
5	Differential Equations: Theory, Technique and Practice, G.F. Simmons, S. G. Krantz, Tata Mc GrawHill Publishing, 2007.
6	An introduction to Ordinary Differential Equations, James C. Robinson, Cambridge University Press, New York, 2008 (4th print).
7	Differential Equations and their Applications by M Braun
8	An Introduction to Ordinary Differential Equations by Earl A Coddington and Mathematics
9	Partial Differential Equations by Erich Miersemann Department of Mathematics Leipzig University.

Proposed Evaluation Scheme by Academicians (Percentage of Weightage out of 100%)					
Theory Descriptive Test		**MCQ Test**		**Hands on Project**	
Formulas and Derivation Test		**Numerical Test**		**Seminar**	

Practical Project/Hands On Project

Sr. No.	List of Practical Projects	Linked with Unit
1	Identify Matrix Transformation for Image editing features like zooming, scaling, rotating, etc..	Unit 1
2	Define Different Vector space with different Operations.	Unit 2
3	Describe geometric approach of Quadratic form in to Canonical form with example.	Unit 3
4	Derive general form of Projections.	Unit 4
5	Define problems in Least squares method.	Unit 5
6	Find and apply concepts of Laplace Transform in Mechanical branch.	Unit 6
7	Find and apply concepts of Fourier Transform in Mechanical branch	Unit 7
8	Construct one real life 1st order Ordinary Differential Equation	Unit 8
9	Construct one Higher order Ordinary Differential Equation and solve with IVP.	Unit 9
10	Describe Heat equation Solution with different boundary value Problems.	Unit 10