Course Details

Course Name:	**Linear Algebra and Ordinary Differential Equations**	**Course Code:**			EMAT102L
Department :	**Mathematics**	**Type:**			Fundamental
L-T-P Structure	**3-1-0**	**Credits**	**4**	**Pre-requisite:**	EMAT101L
Course Objectives	Main objectives of the course are: **CO1:** to present basic concepts of matrices and matrix algebra. **CO2:** to study methods of solving system of linear equations. **CO3:** to present basic concepts of vector spaces. **CO4:** to classify differential equations by their order, linearity and homogeneity. **CO5:** to solve first/second order linear differential equations. **CO6:** to solve systems of linear differential equations using matrix techniques and eigenvalues.				
Course Outcome	At the end, students will be able to 1. solve systems of linear equations by using Gaussian elimination to reduce the augmented matrix to row echelon form or to reduced row echelon form. 2. understand the basic ideas of vector algebra: linear dependence and independence and spanning. 3. be familiar with the concepts of dimension of a subspace and the rank and nullity of a matrix. 4. to find the eigenvalues and eigenvectors of a square matrix using the characteristic polynomial. 5. be familiar with the notion of a linear transformation. 6. apply the fundamental concepts of ordinary differential equations. 7. solve the problems choosing the most suitable method. 8. solve linear differential equations of both first and higher order.				

Lecture Wise Plan:

Course Contents :	Topics	No. of Lectures
1.	Matrices, System of linear equations, Gauss elimination method, Elementary matrices, Invertible matrices, Gauss-Jordon method for finding inverse of a matrix, Determinants	**3**
2.	Basic properties of determinants, Cofactor expansion, Determinant method for finding inverse of a matrix, Cramer's Rule, Vector space, Subspace and Examples	**3**
3.	Linear span, Linear independence and dependence and Examples, Basis, Dimension, Extension of a basis of a subspace, Intersection and sum of two subspace, Examples	**3**
4.	Linear transformation, Kernel and Range of a linear map, Rank-Nullity Theorem, Rank of a matrix, Row and column spaces, Solvability of system of linear equations, some applications, Inner product	**4**
5.	Cauchy-Schwartz inequality, Orthogonal basis, Gram-Schmidt orthogonalization process, Orthogonal projection, Orthogonal complement, Projection theorem, Fundamental subspaces. Fundamental subspaces and their relations, An application (Least square solutions and least square fittings)	**4**
6.	Eigen-values, Eigen- Vectors, Characterization of a diagonalizable matrix, Diagonalization: Example, An application. Diagonalization of a real symmetric matrix, Representation of a real linear map by matrices (optional)	**4**
7.	Introduction to DE, Order of DE, First Order ODE $F(x, y, y') = 0$, Concept of solution (general solution, singular solution, implicit solution etc.)	**3**
8.	Geometrical interpretations (direction fields), Separable form, Reduction to separable form, Exact equations, Integrating factors [of the form F(x) and F(y)]	**3**
9.	Linear equations, Bernoulli equation, orthogonal trajectories. Picard's existence and uniqueness theorem (without proof), Picard's iteration method. Second order linear ODE: fundamental system and general solutions of homogeneous equations, Wronskian, Reduction of order	**3**
10.	Characteristic equations: real distinct roots, complex roots, repeated roots, Non-homogeneous equations: Undetermined coefficients and Variation of parameters	**3**

11.	Extension to higher order differential equations, Euler Cauchy equation, Real analytic solutions of Linear second order equations.	**3**
12.	Linear system of Differential equations: Fundamental matrix and Linearly independent solutions.	**2**
13.	Laplace transform: Laplace and inverse Laplace transforms, First shifting theorem, Existence, Transforms of derivative and integral. Laplace transform: Differentiation and Integration of transforms, unit step function, Second shifting theorem	**2**
14.	Laplace transform: Convolution and applications, Initial value problems	**2**
	Total Lectures	**42**

Text Books:

1. ***Linear Algebra*** - G. Strang, "Introduction to linear algebra", 4th Edition, Brooks/Cole India, 2006.
2. ***Ordinary Differential Equations*** - S. L. Ross, "Differential Equations", 3rd Edition, Wiley India, 1984.

Reference Books:

1. ***Linear Algebra*** - K. Hoffman and R. Kunze, "Linear Algebra", 2nd Edition, Prentice Hall India, 2004.
2. ***Ordinary Differential Equations*** - G.F. Simmons, "Differential equations with applications and historical notes", 2nd Edition.
3. ***Ordinary Differential Equations***- E. A. Coddington, "An Introduction to Ordinary Differential Equations", Prentice Hall India, 1995.

Moodle (LMS) Page of the course:
http://lms.bennett.edu.in/bennett_tech/course/view.php?id=233

Special Instructions:

1. Students must attend every class. They are expected to arrive on time for class.
2. Please turn off cell phones when you enter the class. Your participation is essential.

EVALUATION COMPONENTS:

Components of Course Evaluation	Percentage Distribution
Mid Term Examination	25
End Term Examination	50
Quiz Examination	10
Tutorial Tests	10
Online Quiz Tests	5
Total	**100**