



## FACULTY OF ENGINEERING & TECHNOLOGY

### First Year Bachelor of Engineering

**Course Code: 102000211**

**Course Title: Linear Algebra, Vector Calculus and ODE**

**Type of Course: Basic Science Course**

**Course Objectives:** The course is intended to develop computational proficiency involving procedures in Matrices, Linear algebra, Vector Calculus and Differential Calculus which are useful to all engineering disciplines.

#### Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
Lecture	Tutorial	Practical		Internal		External		Total
				Theory	J/V/P*	Theory	J/V/P*	
3	2	0	4	30 / 9	20 / 6	70 / 21	30 / 9	150 / 45

\* J: Jury; V: Viva; P: Practical

#### Detailed Syllabus:

Sr.	Contents	Hours
1	Applications of Matrices: Matrices and Elementary Row Operations, Echelon and Reduced Row Echelon forms of a Matrix, Solutions of System of Nonhomogeneous and Homogeneous Linear Equations: Gaussian Elimination and Gauss-Jordan Method, Inverse of a Matrix by Gauss-Jordan Elimination Method, Rank of a Matrix, Eigenvalues and Eigenvectors of a Matrix, Caley-Hamilton Theorem, Diagonalization	10
2	Linear Algebra: Vector Spaces, Subspaces of a Vector Space, Linear Independence and Dependence of Vectors, Span of a Set of Vectors, Basis and Dimension	8
3	Vector Calculus: Vector and Scalar Functions and Fields, Derivatives, Gradient of a Scalar Field, Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field, Line Integrals, Line Integrals Independent of Path, Green's Theorem in the Plane (Without Proof), Surface Integrals, Divergence Theorem of Gauss (Without Proof), Stoke's Theorem (Without Proof)	12
4	Differential Equations of First Order: Bernoulli's Equation, Exact Differential Equations, Equations Reducible to Exact Equations, Clairaut's Equation	5



<b>5</b>	Higher Order Ordinary Differential Equations: Linear Differential Equations with Constant Coefficients, Inverse Operator, Rules for Finding Particular Integral when $X=e^{ax}$ , $\sin(ax + b)$ , $\cos(ax+b)$ , $x^m$ , $e^{ax}V$ , $V$ being a function of $x$ . Method of Variation of Parameters, Method of Undetermined Coefficients, Euler – Cauchy differential equations, Legendre’s Linear Equation	<b>12</b>
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### Suggested Specification table with Marks (Theory) (Revised Bloom’s Taxonomy):

Distribution of Theory Marks						R: Remembering; U: Understanding; A: Application, N: Analyze; E: Evaluate; C: Create
R	U	A	N	E	C	
20%	40%	30%	10%	0%	0%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Reference Books:

<b>1</b>	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Student Edition
<b>2</b>	Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publishers
<b>3</b>	Engineering Mathematics Vol II S S Sastry, Prentice Hall of India
<b>4</b>	Elementary Linear Algebra Howard Anton, John Wiley & Sons
<b>5</b>	Introduction to Engineering Mathematics- Vol II H K Dass, S Chand Publication

### Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
<b>CO-1</b>	Use the matrix methods and certain techniques to solve the system of linear equations and to find eigen values, eigen vectors of a matrix to check whether it is diagonalizable.	<b>20</b>
<b>CO-2</b>	Understand the abstract notions of vector space and the dimensionality of it.	<b>20</b>
<b>CO-3</b>	Learn different notions of vector and scalar fields with their properties. Understanding the major theorems (Green's, Stokes', Gauss') and some applications of these theorems	<b>30</b>
<b>CO-4</b>	Apply some methods of differential equations like Bernoulli’s Equation, Exact, Clairaut’s which remains to study at their plus two level.	<b>10</b>
<b>CO-5</b>	To find solution of higher-order linear differential equations of constant coefficients by using different methods.	<b>20</b>



## List of Practicals / Tutorials:

1	System of Linear Equations- Non-Homogeneous and Homogeneous
2	Rank of a matrix and inverse of a matrix by Gauss Jordan Method
3	Eigen Values and Eigen Vectors. Cayley's Hamilton Theorem and it's applications
4	Diagonalization of a matrix.
5	Vector Spaces and Sub Spaces
6	Linear independence and linear dependence. Span of a vector space and Basis, Dimension
7	Gradient, directional derivative, divergence, curl
8	Line integral. Green's Theorem, Gauss Divergence Theorem and Stoke's Theorem
9	First Order differential equations- Bernoulli's Equation, Exact, Clairaut's
10	Higher order differential equations with constant coefficients having standard functions as X given in the syllabus
11	Method of Variation of Parameters, Method of Undetermined Coefficients, Legendre's Linear Equation

## Supplementary learning Material:

1	Lecture Note
2	NPTEL Video Lectures Matrices and Linear Algebra: <a href="https://nptel.ac.in/courses/111106051/">https://nptel.ac.in/courses/111106051/</a>
3	NPTEL Video Lectures Differential Equations <a href="https://nptel.ac.in/courses/111106100/">https://nptel.ac.in/courses/111106100/</a>
4	NPTEL Vector Calculus <a href="https://nptel.ac.in/courses/111/105/111105122/">https://nptel.ac.in/courses/111/105/111105122/</a>

## Curriculum Revision:

Version:	1
Drafted on (Month-Year):	Apr-20
Last Reviewed on (Month-Year):	Jul-20
Next Review on (Month-Year):	Apr-22