CVM UNIVERSITY
Aegis: Charutar Vidya Mandal (Estd.1945)

# FACULTY OF ENGINEERING & TECHNOLOGY

## Effective from Academic Batch: 2022-23

**Programme:** **Bachelor of Technology (Electrical Engineering)**

**Semester:** **II**

**Course Code:** **202000211**

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

**Course Group: 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) | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory | | J/V/P* | | Total |
| Lecture | Tutorial | Practical | | Internal | External | Internal | External | |
| 3 | 2 | 0 | 4 | 50 / 18 | 50/17 | 25 / 9 | 25/9 | 150 /53 |

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

**Detailed Syllabus:**

| Sr. | Contents | Hours |
|---|---|---|
| 1 | Applications of Matrices:<br>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:<br>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:<br>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 |



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| | | |
|---|---|---|
| **4** | Differential Equations of First Order:<br>Bernoulli's Equation, Exact Differential Equations, Equations Reducible to Exact Equations, Clairaut's Equation | **5** |
| **5** | Higher Order Ordinary Differential Equations:<br>Linear Differential Equations with Constant Coefficients, Inverse Operator, Rules for Finding Particular Integral when X=eax, sin(ax + b), cos(ax+b), xm, eaxV, V being a function of x. Method of Variation of Parameters, Method of Undetermined Coefficients, Euler – Cauchy differential equations, Legender's Linear Equation | **12** |

**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 independence. 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, Legender's Linear Equation |

**Reference Books:**



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





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**Supplementary learning Material:**

| | |
|---|---|
| **1** | Lecture Note |
| **2** | NPTEL Video Lectures Matrices and Linear Algebra: https://nptel.ac.in/courses/111106051/ |
| **3** | NPTEL Video Lectures Differential Equations https://nptel.ac.in/courses/111106100/ |
| **4** | NPTEL Vector Calculus https://nptel.ac.in/courses/111/105/111105122/ |

**Pedagogy:**

- Direct Classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment (Tutorials)
- Interactive methods
- Seminar/Poster presentation

**Internal Evaluation:**

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

**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.

**Course Outcomes (CO):**

| Sr. | Course Outcome Statements | %weightage |
|---|---|---|
| **CO-1** | 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. | **20** |
| **CO-2** | Understand the abstract notions of vector space and the dimensionality of it. | **20** |



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| | | |
|---|---|---|
| **CO-3** | 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 | **30** |
| **CO-4** | Apply some methods of differential equations like Bernoulli's Equation, Exact, Clairaut's which remains to study at their plus two level. | **10** |
| **CO-5** | To find solution of higher-order linear differential equations of constant coefficients by using different methods. | **20** |

| **Curriculum Revision:** | |
|---|---|
| Version: | **2** |
| Drafted on (Month-Year): | Jun-22 |
| Last Reviewed on (Month-Year): | - |
| Next Review on (Month-Year): | Jun-25 |



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