Linear Algebra and Calculus

Course Objectives

The main purpose of this course is to:

- Understand linear algebra, system of linear equations and its applicability in different Engineering fields.
- Introduce the concepts of vector spaces and linear mapping.
- Incorporate the knowledge of calculus to support to their concurrent and subsequent engineering studies.
- Expose the concept of integral calculus.
- Express a periodic function by Fourier series and to learn their applications.

Linear Algebra and Calculus

Syllabus

Course Code	Course Title				Category
18BTMT101	Linear Algebra and Calculus				BSC
Contact Hours per Week			CA	FE	Credits
L	T	D/P			
3	1		40	60	4
Prerequisite: Matrix algebra, Basics of limit continuity and differentiability.					

Linear Algebra and Calculus

Syllabus - Course Content

Unit-I-Matrices (9)

Rank, Canonical form, Normal Form, System of Linear Equations, Orthogonal Transformations, Eigen Values and Eigen Vectors, Diagonalization of Matrices, Cayley Hamilton Theorem, Applications to problems in Engineering.

Unit-II-Linear Algebra and Mapping (9)

Vector Spaces, Subspaces, linear dependence and independence of vectors, bases, dimensions. Row and Column Linear mappings, representation by matrices, rank-nullity theorem.

Unit-III-Limit, Continuity and differentiation of univariate function (9)

Limit, Continuity, indeterminate forms, Rolle's Theorem, Lagrange's theorem and Cauchy's theorem, Successive Differentiation, Leibnitz Theorem.

Linear Algebra and Calculus

Syllabus - Course Content

Unit-IV-Infinite Series & Expansion of Functions (9)

Convergence of sequence and series, Tests for Convergence, Comparison test, Ratio Test, Raabe's Test, Cauchy's Test, Integral Test, Alternating Series, Absolute and Conditional Convergence, Range of Convergence, Power series, Taylor's series, McLaurin's Series, Expansion of Standard functions.

Unit-V-Integral Calculus and Fourier Series (9)

Reduction Formulae, Beta and Gamma Functions, Dirichlet's conditions, Full range and half range Fourier series, Harmonic analysis, Applications to problems in Engineering.

Linear Algebra and Calculus

Course Outcomes

After learning this course, students shall be able to:

- Apply matrices on system of linear equation to solve real life problems.
- Resolve the problems based on vector calculus.
- Apply concepts of calculus to resolve engineering problems.
- Understand applications of integral calculus.
- Express periodic function in terms of Fourier sine and Fourier cosine series. Evaluate complicated and improper integrals by using reduction formulae and Beta-Gamma functions respectively.

Linear Algebra and Calculus

Course Materials

Text Books:

1. Erwin Kreyszig, *"Advanced Engineering Mathematics"*, Wiley Eastern Ltd, 12th edition.
2. Maurice D. Weir, Joel Hass, Frank R. Giordano, *"Thomas' Calculus"*, Pearson Education, 12th edition.
3. Serge Lang, *"Linear Algebra"*, Springer, 3rd edition.

References:

4. Howard Anton and Chris Rorres, *"Elementary Linear Algebra"*, John Wiley and Sons, 10th edition.
5. C.R. Wylie, *"Advanced Engineering Mathematics"*, McGraw Hill Publications, New Delhi, .
6. Peter V. O' Neil, *"Advanced Engineering Mathematics"*, Thomson Brooks/Cole, Singapore, 7th edition.
7. Shanti Narayan, *"Differential Calculus"*, S. Chand and Company, New Delhi.
8. George Simmons, *"Differential Equation with Applications"*, (2nd edition) McGraw-Hill Education (India) Private Limited, New Delhi.
9. B. S. Grewal, *"Higher Engineering Mathematics"*, Khanna Publication

Linear Algebra and Calculus - Teaching Plan

Unit-I: Matrices

1. Introduction to syllabus, Summary of Course objectives and outcomes
2. Introduction to matrices, Rank of a matrix with examples
3. Canonical forms, Normal form with illustrations
4. Solution of System of Linear equations – Non homogeneous system
5. Solution of System of Linear equations – finding unknown constants
6. Solution of System of Linear equations – Homogeneous system
7. Linear and Orthogonal Transformations
8. Eigen Values and Eigen Vectors – Definition and Properties
9. Eigen Values and Eigen Vectors – Illustrations
10. Eigen Values and Eigen Vectors – More Illustrations
11. Diagonalization of Matrices
12. Cayley Hamilton Theorem and Applications to problems in Engineering

Unit-II: Linear Algebra and Mapping

13. Vector space- Introduction, Definition and examples
14. Subspaces and examples
15. Theorems and examples of vector spaces and subspaces
16. Linear Dependence and Independence of vectors
17. Linear Span, Basis and dimensions of a vector space
18. Theorems and Examples on Basis
19. Row and Column spaces, Null Space
20. Rank-Nullity Theorem with applications
21. Examples on Rank Nullity Theorem and Assignment discussion

UNIT-III: LIMIT, CONTINUITY AND DIFFERENTIATION OF UNIVARIATE FUNCTION

22. Introduction to Limit and Continuity

23. Indeterminate forms $\left(\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty, \infty - \infty\right)$, L' Hospital rule with examples

24. Evaluation of limits for different forms $(0^0, 1^\infty, \infty^0)$

25. Mean value theorems (Rolle, Lagrange and Cauchy's Mean Value Theorems)

26. Introduction to Successive Differentiation

27. Problems on successive Differentiation

28. Leibnitz Theorem for n^{th} derivative of product of functions with examples

29. Miscellaneous Problems and Applications and Assignment discussion

Unit-IV: Infinite Series and Expansion of Functions

30. Introduction to Infinite sequences and series
31. P-Series test, Geometric series test and Comparison Test with illustrations
32. Cauchy's n^{th} Root Test with illustrations
33. D' Alembert Ratio Test with illustrations
34. Raabe's Test, Logarithmic Test and Range of Convergence with illustrations
35. Alternating series, Absolute and Conditional Convergence with illustrations
36. Introduction to Taylor series and Maclaurin's series
37. Taylor series and Maclaurin's series – More Illustrations
38. More illustrations on expansion of functions with Applications and Assignment discussion

Unit-V: Integral Calculus and Fourier Series

39. Reduction Formulae of some standard functions
40. Problems on Reduction Formulae
41. Introduction to Gamma function with illustrations
42. Introduction to Beta Function with illustrations
43. Introduction to Fourier series, Dirichlet's conditions
44. Fourier series for even and odd functions with illustrations
45. Half range Fourier and Sine and Cosine series with illustrations
46. Harmonic Analysis with illustrations
47. Assignment discussion and Previous Year University Questions papers solutions with marking scheme

Questions?
Thanks