

CALCULUS AND LINEAR ALGEBRA

(Common to the branches Chemical, Civil, CSE, ECE, EEE, IT, Mechanical, Mechanical (Robotics))

Course Code: 22BM1101

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Course Outcomes: At the end of the Course, the student shall be able to:

CO1: test the convergence of an infinite series and express functions in terms of power series. (L5)

CO2: apply the techniques of multivariable differential calculus to determine extrema and series expansions of functions of several variables. (L3)

CO3: use the concept of integration of higher dimensions to solve the problems in engineering. (L3)

CO4: justify solutions of linear system of equations analytically and compute eigenvalues and eigenvectors of a square matrix. (L5)

CO5: classify the nature of a quadratic form. (L4)

UNIT-I

10 Lectures

Sequences, Series and Mean Value Theorems: Sequence, infinite series, tests for convergence: comparison test, ratio test, root test, Rolle's Theorem, Lagrange's and Cauchy's mean value theorem (without proof); expansions of functions: Taylor's and Maclaurin's series (without proof). (Sections 4.3, 4.4, 9.1-9.6, 9.8, 9.9, 9.11 of the textbook)

Learning Outcomes:

At the end of the unit, the student will be able to

1. apply a mean value theorem to a continuous function. (L3)
2. classify the Taylor's and Maclaurin's series expansions of a function. (L4)
3. test the convergence of an infinite series. (L5)

UNIT-II

10 Lectures

Partial Differentiation: Introduction to partial derivatives, total derivatives, change of variables, Jacobians, Taylor's theorem for functions of two variables, maxima and minima of functions of two variables, Lagrange's method of undetermined multipliers. (Sections 5.5-5.7, 5.9, 5.11, 5.12 of the textbook)

Learning Outcomes:

At the end of the unit, the student will be able to

1. calculate the partial derivatives and use them to analyze a function. (L3)
2. discuss the maxima and minima of a function of several variables. (L2)
3. determine the Jacobian of an implicit function. (L3)

UNIT-III

10 Lectures

Multiple Integrals: Double integrals, change of order of integration, double integration in polar coordinates, areas enclosed by plane curves, triple integrals and change of variables. (Sections 7.1 - 7.5, 7.7 of the textbook)

Learning Outcomes:

At the end of the unit, the student will be able to

1. use the concept of integration of higher dimensions to evaluate a multiple integral. (L3)
2. determine the area of a region using multiple integrals. (L3)
3. describe the concept of change of order of integration in double integrals. (L2)

UNIT-IV

10 Lectures

Solving Systems of Linear Equations: Rank of a matrix (by echelon form and normal form), consistency of linear system of equations, eigenvalues and eigenvectors of a matrix, properties of eigenvalues. (Sections 2.7, 2.10, 2.13, 2.14 of the textbook)

Learning Outcomes:

At the end of the unit, the student will be able to

1. discuss the rank of a matrix using elementary operations (L2)
2. test the consistency of a systems of linear equations (L5)
3. determine the eigenvalues and eigenvectors of a matrix (L3)

UNIT-V

10 Lectures

Cayley-Hamilton Theorem and Quadratic Forms: Cayley-Hamilton theorem (without proof), finding the inverse and the power of a matrix by an application of the Cayley-Hamilton theorem, reduction to a diagonal form, reduction of a quadratic form to a canonical form, nature of the quadratic form. (Sections 2.15- 2.18 of the textbook)

Learning Outcomes:

At the end of the unit, the student will be able to

1. illustrate the inverse and the power of a matrix using Cayley-Hamilton theorem (L4)
2. determine an orthogonal matrix to obtain the diagonal form (L3)
3. examine the nature of a quadratic form (L3)

Text Books:

1. B. S. Grewal, *Higher Engineering Mathematics*, 44th edition, Khanna Publishers, 2017.

Reference Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10th edition, John Wiley & Sons, 2011.
2. Greenberg M D, *Advanced Engineering Mathematics*, 2nd edition, Pearson Education, Singapore, Indian Print, 2003.
3. Peter V. O'Neil, *Advanced Engineering Mathematics*, 7th edition, Cengage Learning, 2011.

Web References:

1. <https://nptel.ac.in/courses/111/106/111106051>