

CALCULUS AND LINEAR ALGEBRA

Course Code: 19BM1101

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Course Outcomes:

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

- CO1:** test the convergence of an infinite series and express a function in terms of power series.
- CO2:** apply the techniques of multivariable differential calculus to determine extrema and series expansions of a function of several variables.
- CO3:** extend the concept of integration to higher dimensions and use it to solve problems in engineering.
- CO4:** solve a linear system of equations analytically and compute eigenvalues and eigenvectors of a square matrix.
- CO5:** diagonalize a matrix and identify the nature of a quadratic form.

UNIT- I: Sequences, Series and Mean value theorems

10 Lectures

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 this unit, the student will be able to

1. apply mean value theorems to find local extrema of a continuous function (L3)
2. discuss Taylor's and Maclaurin's series expansion of a function (L2)
3. determine the convergence of an infinite series (L3)

UNIT- II: Partial differentiation

10 Lectures

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, 5.6, 5.7, 5.9, 5.11, 5.12 of the textbook)

Learning Outcomes:

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

1. calculate partial derivatives and use them to analyze a function (L3)
2. discuss the maxima and minima of a function of several variables (L2)
3. examine the dependency of functions using jacobian (L3)

UNIT- III: Multiple integrals**10 Lectures**

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 this unit, the student will be able to

1. discuss multiple integral of a function of several variables (L2)
2. determine areas and volumes using multiple integrals (L3)
3. describe the concept of change of order of integration in double integrals (L2)

UNIT- IV: Matrix operations and solving systems of linear equations**10 Lectures**

Rank of a matrix (echelon form and normal form), consistency of linear system of equations, eigen values and eigen vectors of a matrix, properties of eigen values.

(Sections 2.7, 2.10, 2.13, 2.14 of the textbook)

Learning Outcomes:

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

1. express the rank of a matrix using elementary operations (L2)
2. discuss the consistency of systems of linear equations (L2)
3. determine eigen values and eigen vectors of a matrix (L3)

UNIT- V: Cayley-Hamilton theorem and Quadratic forms**10 Lectures**

Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, reduction to diagonal form, reduction of quadratic form to canonical form, nature of the quadratic form.

(Sections 2.15- 2.18 of the textbook)

Learning Outcomes:

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

1. determine the inverse and power of a matrix using Cayley-Hamilton theorem (L3)
2. model an orthogonal matrix to obtain the diagonal form (L3)
3. discuss the nature of a quadratic form (L2)

Textbook:

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

References:

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.