(Effective from the academic year 2023-24 admin

ENGINEERING MATHEMATICS I (CALCULUS AND ALGEBRA)

(Common to CS, DS, AI&ML, EE & ME)

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This course is designed for the students of all B. Tech programs as a prerequisite for the core program. The course imparts concepts of calculus and matrix algebra that are essential in applications in solving engineering problems.

Course Objectives:

- To familiarize the students with the theory of matrices and quadratic forms.
- To explain the series expansions using mean value theorems.
- To teach basic concepts of partial derivatives.
- To explain the evaluation of double integrals and their applications.
- To demonstrate the evaluation and applications of triple integrals.

UNIT I: Matrices 14 L

The rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous linear equations, eigenvalues, eigenvectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalization of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.

Learning Outcomes:

After completion of this unit, the student will be able to

- solve the system of homogeneous and non-homogeneous linear equations (L3)
- find the eigenvalues and eigenvectors of a matrix(L3)
- identify special properties of a matrix(L3)

UNIT II: Mean Value Theorems 8 L

Rolle’s theorem, Lagrange’s mean value theorem, Cauchy’s mean value theorem, and Taylor’s and Maclaurin’s theorems with remainders (without proof).

Learning Outcomes:

After completion of this unit, the student will be able to

- demonstrate the given function as a series of Taylor's and Maclaurin's with remainders (L2)
- illustrate series expansions of functions using mean value theorems (L2)

UNIT III: Multivariable Calculus **10 L**

Partial derivatives, total derivatives, chain rule, change of variables, Jacobian, maxima, and minima of functions of two variables, method of Lagrange multipliers.

Learning Outcomes:

After completion of this unit, the student will be able to

- interpret partial derivatives as a function of several variables(L2)
- apply Jacobian concept to deal with the problems in change of
- variables (L3)
- evaluate maxima and minima of functions(L3)

UNIT IV: Multiple Integrals-I **10 L**

Double integrals, change of order of integration, double integration in polar coordinates, the area enclosed by plane curves.

Learning Outcomes:

After completion of this unit, the student will be able to

- apply double integrals in cartesian and polar coordinates(L3)
- calculate the areas bounded by a region using double integration techniques (L3)

UNIT V: Multiple Integrals-II **10 L**

Evaluation of triple integrals, change of variables (cartesian, cylindrical and spherical polar coordinates), volume as triple integral.

Learning Outcomes:

After completion of this unit, the student will be able to

- apply multiple integrals in cartesian, cylindrical and spherical geometries (L3)
- evaluate volumes using triple integrals(L3)

Textbook(s):

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, 10/e, John Wiley & Sons,2018.
2. B. S. Grewal, *Higher Engineering Mathematics*, 44/e, Khanna Publishers, 2017.

References:

1. R.K. Jain and, S.R.K. Iyengar, *Advanced Engineering Mathematics*, 3/e, Alpha Science International Ltd.,2002.
2. George B. Thomas, Maurice D. Weir and Joel R. Hass, Thomas, *Calculus*, 13/e, Pearson Publishers,2014.
3. Glyn James, *Advanced Modern Engineering Mathematics*, 4/e, Pearson Publishers,2011.

Course Outcomes:

After completion of this unit, the student will be able to

- Utilize the techniques of matrix algebra for practical applications(L3)
- apply mean value theorems to engineering problems(L3)
- utilize functions of several variables in optimization(L3)
- employ the tools of calculus for calculating the areas(L3)
- calculate volumes using multiple integrals(L3)