**ENGINEERING MATHEMATICS – I**

# MATRIX ALGEBRA & MULTIVARIABLE CALCULUS

**I/IV B.Tech. I – Semester**

**[R-19 Regulation]**

**[Common for ALL Branches]**

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| | **Credits:3** |
| Instruction: 3 Periods & 1 E/week | Sessional Marks:40 |
| End Exam: 3 Hours | End Exam Marks:60 |

**Course Objective:**

To provide the students with sufficient knowledge in calculus and matrix algebra, this can be used in their respective fields.

**Course Outcomes :** At the end of the course the student will be able to

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| **1** | Apply elementary transformations to reduce the matrix into the echelon form and normal form to determine its rank and interpret the various solutions of system of linear equations. |
| **2** | Identify the special properties of a matrix such as the eigen value, eigen vector, employ orthogonal transformations to express the matrix into diagonal form, quadratic form and canonical form. |
| **3** | Equip themselves familiar with the functions of several variables and mean value theorems. |
| **4** | Evaluate double and triple integrals techniques over a region in two dimensional and three dimensional geometry. |
| **5** | Familiarize with special functions to evaluate some proper and improper integrals using Beta and Gamma functions. |

**CO – PO Mapping :**

| | PO-1 | PO-2 | PO-3 | PO-4 | PO-5 | PO-6 | PO-7 | PO-8 | PO-9 | PO-10 | PO-11 | PO-12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO-1 | 3 | 2 | - | - | | | | | | | | 1 |
| CO-2 | 3 | 2 | - | - | | | | | | | | 1 |
| CO-3 | 3 | 2 | 1 | - | | | | | | | | 1 |
| CO-4 | 3 | 2 | 1 | - | | | | | | | | 1 |
| CO-5 | 3 | 2 | 1 | 1 | | | | | | | | 1 |

# SYLLABUS

## UNIT – I: LINEAR EQUATIONS [10 Hrs]

Rank of matrix – Normal form of a matrix – PAQ form – Gauss Jordan method of finding the inverse – Consistency of linear system of equations.

**Learning outcome:** At the end of this unit, student will be able to solve the system of equations using the rank.

## UNIT – II: LINEAR TRANSFORMATIONS AND QUADRATIC FORMS [14 Hrs]

Linear transformations – Orthogonal transformations – Vectors (linearly independent & dependent) – Eigen values – Eigen vectors – Properties of eigen values – Cayley-Hamilton theorem (without proof) – Reduction to diagonal form – Reduction of quadratic form to canonical form – Nature of the Quadratic form.

**Learning outcome:** At the end of this unit, student will be able to identify the special properties of a matrix such as the eigen values, eigen vectors, diagonal form and nature of the quadratic forms.

## UNIT – III: SINGLE AND MULTI VARIABLE CALCULUS [12 Hrs]

Rolle's theorem – Lagrange's mean value theorem – Cauchy's mean value theorem (All theorems without proof).

Partial derivatives – Total derivatives – Chain rule – Change of variables – Jacobians – Taylor's series expansion of two variable function – Maxima and minima of functions of two variables – Method of Lagrange's multipliers.

**Learning outcome:** At the end of this unit, student will be able to

1. Analyze the behavior of functions by using mean value theorems.
2. Estimate the maxima and minima of multivariable functions.

## UNIT – IV: MULTIPLE INTEGRALS [14 Hrs]

Double integrals – Change of order of integration – Double integration in polar coordinates – Areas enclosed by plane curves – Evaluation of triple integrals – Volumes of solids – Change of variables between cartesian – Cylindrical and spherical polar coordinates – Calculation of mass – Center of gravity.

**Learning outcome:** At the end of this unit, the student will be able to

1. Evaluate double integrals of functions of several variables in two dimensions using cartesian and polar coordinates.
2. Apply double and triple integration techniques in evaluating areas and volumes bounded by a region.

## UNIT – V: SPECIAL FUNCTIONS [10 Hrs]

Beta and Gamma functions and their properties – Relation between Beta and Gamma functions – Evaluation of double and triple integrals by using Beta and Gamma functions – Error function.

**Learning outcome:** At the end of this unit, the student will be able to conclude the use of special functions in multiple integrals.

**TEXT BOOKS**:


1. **B. S. Grewal**, "*Higher Engineering Mathematics*" , 44/e, Khanna Publishers, 2017.
2. **Erwin Kreyszig**, "*Advanced Engineering Mathematics*", 10/e, John Wiley\& Sons, 2011.


**REFERENCES**:


1. **N. P. Bali, "***Engineering Mathematics*", Lakshmi Publications.
2. **George B. Thomas, Maurice D. Weir and Joel Hass, "***Thomas Calculus*", 13/e, Pearson Publishers, 2013.
3. **H. K. Dass**, "*Advanced Engineering Mathematics*", S. Chand and company Pvt. Ltd.
4. **Michael Greenberg**, "*Advanced Engineering Mathematics*", Pearson, Second Edition.