COURSE CONTENT

MATRICES AND CALCULUS								
I Semester: CE/ CSD/ CSE/ CSM/ ECE/ EEE/ ME								
Course Code	**Category**	**Hours/ Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
2510001	**Basic sciences**	3	1	0	4	40	60	100
Contact Classes:45	**Tutorial Classes:15**	**Practical Classes: Nil**				**Total Classes:60**		
Prerequisites: Mathematics courses of 10+2 year of study.								

Course Overview:

This course provides a strong mathematical foundation for all engineering branches by covering matrix theory, linear algebra, eigenvalues and eigenvectors, functions of single and several variables, special functions, and multiple integrals. It equips students to model and solve real-world engineering problems, analyze system consistency using matrix rank, and apply calculus and matrices in simulations, color image processing, and optimization.

Course Objectives:

1. Types of matrices and their properties, concept of a rank of the matrix and applying this concept to know the consistency and solving the system of linear equations.
2. Concept of eigen values, eigen vectors and reduction of quadratic form to canonical form by orthogonal transformation.
3. Geometrical approach to the mean value theorems and their application to the mathematical problems. Evaluation of improper integrals using Beta and Gamma functions.
4. Partial differentiation, concept of total derivative and finding maxima and minima of function of two and three variables.
5. Evaluation of multiple integrals and their applications.

Course Outcomes: After Completion of the Course, Students should be able to

1. Recall the concepts of rank, Echelon form, Normal form, and the properties of non singular matrices.
2. Explain the process of finding eigenvalues and eigenvectors of a matrix and their role in diagonalization.
3. Relate Beta and Gamma functions to standard integrals and solve related problems.
4. Apply Euler's theorem and compute total derivatives for multivariable functions.
5. Use methods for changing variables in double and triple integrals, including transformations to polar, spherical, and cylindrical coordinates.

UNIT-I: Matrices

Rank of a matrix by Echelon form and Normal form, Inverse of Non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations, L-U decomposition method.

UNIT-II: Eigen values and Eigen vectors

Eigen values, Eigen vectors and their properties (without proof), Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem, Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonical forms by Orthogonal Transformation.

UNIT-III: Calculus

Mean value theorems: Rolle's Theorem, Lagrange's Mean value theorem with their Geometrical Interpretation and applications, Cauchy's Mean value Theorem, Taylor's Series (without proofs).

Beta and Gamma functions and their applications (properties without proof).

UNIT-IV: Multivariable Calculus (Partial Differentiation and applications)

Partial Differentiation: Euler's Theorem, Total derivative, Jacobian, Functional dependence-independence. Applications: Maxima and minima of functions of two variables and three variables using method of Lagrange multipliers.

UNIT-V: Multivariable Calculus (Integration)

Evaluation of Double Integrals (Cartesian and polar coordinates), change of order of integration (only Cartesian form), Evaluation of Triple Integrals, Change of variables (Cartesian to polar) for double and triple integrals (Cartesian to Spherical and Cylindrical polar coordinates). Applications: Areas (by double integrals) and volumes (by triple integral).

TEXTBOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. R.K. Jain and S.R.K. Iyengar, Advanced Engineering Mathematics, Narosa Publications, 5thEditon, 2016.

REFERENCEBOOKS:

1. Erwin kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons, 2006.
2. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
4. H. K. Dassand Er. Rajnish Verma, Higher Engineering Mathematics, S Chand and Company Limited, New Delhi.

ELECTRONIC RESOURCES:

1. **https://www.youtube.com/watch?v=9B-1H5POaOE**
2. **https://www.youtube.com/watch?v=UXqfV-mI61M**
3. **https://www.youtube.com/watch?v=q6LnRouvdws&t=7s**
4. **https://www.youtube.com/watch?v=tk0Ix_za8Ew**
5. **https://www.youtube.com/watch?v=zd6o3wOSu_0**

MATERIALS ONLINE:

1. Course template
2. Tutorial question bank
3. Definitions and terminology
4. Assignments
5. Model question paper–I
6. Model question paper–II
7. Lecture notes
8. E-Learning Readiness Videos (ELRV)