LINEAR ALGEBRA AND CALCULUS

I Semester: AE / CSE / IT / ECE / EEE / ME / CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
AHSB02	Foundation	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Analyze and solve linear system of equations by using elementary transformations.
II. Determine the maxima and minima of functions of several variables by using partial differential coefficients.
III. Apply Differential equations on real time applications.
IV. Apply multiple integration to evaluate mass area volume of the plane.
V. Analyze gradient, divergent and curve to evaluate the integration over a vector field.

COURSE LEARNING OUTCOMES (CLOs):

1. Demonstrate knowledge of matrix calculation as an elegant and powerful mathematical language in connection with rank of a matrix.
2. Determine rank by reducing the matrix to Echelon and Normal forms.
3. Determine inverse of the matrix by Gauss Jordon Method.
4. Interpret the Eigen values and Eigen vectors of matrix for a linear transformation and use properties of Eigen values
5. Understand the concept of Eigen values in real-world problems of control field where they are pole of closed loop system.
6. Apply the concept of Eigen values in real-world problems of mechanical systems where Eigen values are natural frequency and mode shape.
7. Use the system of linear equations and matrix to determine the dependency and independency.
8. Determine a modal matrix, and reducing a matrix to diagonal form.
9. Evaluate inverse and powers of matrices by using Cayley-Hamilton theorem.
10. Apply the Mean value theorems for the single variable functions.
11. Find partial derivatives numerically and symbolically and use them to analyze and interpret the way a function varies.
12. Find partial derivatives of and apply chain rule derivative techniques to multivariable functions.
13. Understand the techniques of multidimensional change –of –variables to transform the coordinates by utilizing the Jacobian. Determine Jacobian for the coordinate transformation.
14. Apply maxima and minima for functions of several variable's and Lagrange's method of multipliers.
15. Find the complete solution of a non-homogeneous differential equation as a linear combination of the complementary function and a particular solution.
16. Solving Second and higher order differential equations with constant coefficients.
17. Apply the second order differential equations for real world problems of electrical circuits.
18. Evaluate double integral and triple integrals of the given functions.
19. Utilize the concept of change order of integration and change of variables to evaluate double integrals.
20. Determine the area and volume of a given curve using double and triple integral.
21. Analyze scalar and vector fields and compute the gradient, divergence and curl.
22. Understand integration of vector function with given initial conditions.
23. Evaluate line, surface and volume integral of vectors.

24. Use Vector integral theorems to facilitate vector integration.

Module-I	THEORY OF MATRICES AND LINEAR TRANSFORMATIONS	Classes: 09

Real matrices: Symmetric, skew-symmetric and orthogonal matrices; Complex matrices: Hermitian, Skew-Hermitian and unitary matrices; Elementary row and column transformations; Rank of a matrix: Echelon form and normal form; Inverse by Gauss-Jordan method; Cayley-Hamilton theorem: Statement, verification, finding inverse and powers of a matrix; Linear dependence and independence of vectors; Eigen values and Eigen vectors of a matrix and Properties (without proof); Diagonalization of matrix by linear transformation.

Module -II	FUNCTIONS OF SINGLE AND SEVERAL VARIABLES	Classes: 09

Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem-without proof; Functions of several variables: Partial differentiation, chain rule, total derivative, Euler's theorem, functional dependence, Jacobian, maxima and minima of functions of two variables without constraints and with constraints; Method of Lagrange multipliers.

Module-III	HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS	Classes: 09

Linear differential equations of second and higher order with constant coefficients, non-homogeneous term of the type $f(x) = e^{ax}, \sin ax, \cos ax$ and $f(x) = x^n, e^{ax}v(x), x^n v(x)$; Method of variation of parameters; Applications to electrical circuits.

Module-IV	MULTIPLE INTEGRALS	Classes: 09

Double and triple integrals; Change of order of integration.
Transformation of coordinate system; Finding the area of a region using double integration and volume of a region using triple integration.

Module-V	VECTOR CALCULUS	Classes: 09

Scalar and vector point functions; Definitions of Gradient, divergent and curl with examples; Solenoidal and irrotational vector point functions; Scalar potential function; Line integral, surface integral and volume integral; Vector integral theorems: Green's theorem in a plane, Stoke's theorem and Gauss divergence theorem without proofs.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.
2. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.

Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
3. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
4. Dr. M Anita, Engineering Mathematics-I, Everest Publishing House, Pune, First Edition, 2016.

Web References:
1. http://www.efunda.com/math/math_home/math.cfm 2. http://www.ocw.mit.edu/resources/#Mathematics 3. http://www.sosmath.com/ 4. http://www.mathworld.wolfram.com/
E-Text Books:
1. http://www.e-booksdirectory.com/details.php?ebook=10166 2. http://www.e-booksdirectory.com/details.php?ebook=7400re