LINEAR ALGEBRA AND CALCULUS

I Semester: Common for 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		

COURSE OBJECTIVES:

The course should enable the students to:

I. Determine rank of a matrix and solve linear differential equations of second order.
II. Determine the characteristic roots and apply double integrals to evaluate area.
III. Apply mean value theorems and apply triple integrals to evaluate volume.
IV. Determine the functional dependence and extremum value of a function.
V. Analyze gradient, divergence, curl and evaluate line, surface, volume integrals over a vector field.

COURSE OUTCOMES (COs):

CO 1: Determine rank by reducing the matrix to Echelon and Normal forms. Determine inverse of the matrix by Gauss Jordon Method and Solving Second and higher order differential equations with constant coefficients.
CO 2: Determine a modal matrix, and reducing a matrix to diagonal form. Evaluate inverse and powers of matrices by using Cayley-Hamilton theorem. Evaluate double integral. Utilize the concept of change order of integration and change of variables to evaluate double integrals. Determine the area.
CO 3: Apply the Mean value theorems for the single variable functions. Apply triple integrals to evaluate volume.
CO 4: Determine the maxima and minima for a function of several variable with and without constraints.
CO 5: Analyze scalar and vector fields and compute the gradient, divergence and curl. Evaluate line, surface and volume integral of vectors. Use Vector integral theorems to facilitate vector integration.

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. Find the complete solution of a non-homogeneous differential equation as a linear combination of the complementary function and a particular solution.
5. Solving Second and higher order differential equations with constant coefficients.
6. Interpret the Eigen values and Eigen vectors of matrix for a linear transformation and use properties of Eigen values.
7. Understand the concept of Eigen values in real-world problems of control field where they are pole of closed loop system.
8. Apply the concept of Eigen values in real-world problems of mechanical systems where Eigen values are natural frequency and mode shape.
9. Use the system of linear equations and matrix to determine the dependency and independency.
10. Determine a modal matrix, and reducing a matrix to diagonal form.
11. Evaluate inverse and powers of matrices by using Cayley-Hamilton theorem.
12. Apply double integrals to evaluate area of a given function.
13. Utilize the concept of change order of integration and change of variables to evaluate double integrals.
14. Apply the Mean value theorems for the single variable functions.
15. Apply triple integrals to evaluate volume of a given function.

16. Find partial derivatives numerically and symbolically and use them to analyze and interpret the way a function varies.
17. Understand the techniques of multidimensional change of variables to transform the coordinates by utilizing the Jacobian. Determine Jacobian for the coordinate transformation.
18. Apply maxima and minima for functions of several variable's and Lagrange's method of multipliers.
19. Analyze scalar and vector fields and compute the gradient, divergence and curl.
20. Understand integration of vector function with given initial conditions.
21. Evaluate line, surface and volume integral of vectors.
22. Use Vector integral theorems to facilitate vector integration.

Module-I	**THEORY OF MATRICES AND HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS**	**Classes: 09**

THEORY OF MATRICES: 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.

HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS: 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 $f(x)=x^n, e^{ax}v(x), xv(x)$; Method of variation of parameters.

Module-II	**LINEAR TRANSFORMATIONS AND DOUBLE INTEGRALS**	**Classes: 09**

LINEAR TRANSFORMATIONS: 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.

DOUBLE INTEGRALS: Evaluation of double integrals in Cartesian coordinates and Polar coordinates; Change of order of integration; Area as a double integral; Transformation of coordinate system.

Module-III	**FUNCTIONS OF SINGLE VARIABLES AND TRIPLE INTEGRALS**	**Classes: 09**

FUNCTIONS OF SINGLE VARIABLES: Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem-without proof and geometrical interpretation.

TRIPLE INTEGRALS: Evaluation of triple integrals in Cartesian coordinates; volume of a region using triple integration.

Module-IV	**FUNCTIONS OF SEVERAL VARIABLES AND EXTREMA OF A FUNCTION**	**Classes: 09**

FUNCTIONS OF SEVERAL VARIABLES: Partial differentiation, functional dependence, Jacobian.

EXTREMA OF A FUNCTION: Maxima and minima of functions of two variables without constraints and with constraints; Method of Lagrange multipliers.

Module-V	**VECTOR DIFFERENTIAL AND INTEGRAL CALCULUS**	**Classes: 09**

VECTOR DIFFERENTIAL CALCULUS: Scalar and vector point functions; Definitions of Gradient, divergent and curl with examples; Solenoidal and irrotational vector point functions; Scalar potential function.

VECTOR INTEGRAL THEOREMS: Line integral, surface integral and volume integral, 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 Introduction2nd Edition, Brooks/Cole, 2005.
4. Dr. M Anita, Engineering Mathematics-I, Everest Publishing House, Pune, 1st Edition, 2016.

Web References:

1. http://www.efunda.com/math/math_home/math.cfm
2. http://www.ocw.mit.edu/resourcs/#Mathematics
3. http://www.sosmath.com
4. http://www.mathworld.wolfram.com

E-Text Books:

1. http://www.keralatechnologicaluniversity.blogspot.in/2015/06/erwin-kreyszig-advanced-engineering-mathematics-ktu-ebook-download.html
2. http://www.faadooengineers.com/threads/13449-Engineering-Maths-II-eBooks