# LINEAR ALGEBRA AND CALCULUS

**I Semester: Common for All Branches**

| Course Code | Category | Hours / Week | | | Credits | Maximum Marks | | |
|---|---|---|---|---|---|---|---|---|
| | | L | T | P | C | CIA | SEE | Total |
| AHSC02 | Foundation | 3 | 1 | - | 4 | 30 | 70 | 100 |
| Contact Classes: 45 | Tutorial Classes: 15 | Practical Classes: Nil | | | | Total Classes: 60 | | |

**Prerequisite: Basic principles of algebra and calculus**

## I. COURSE OVERVIEW:

The Linear algebra is a sub-field of mathematics concerned with vectors, matrices, and linear trans- forms. Calculus is the branch of mathematics which majorly deals with derivatives and integrals. Linear algebra is a key foundation to the field of machine learning. The course includes types of Matrices, Rank, methods of finding rank, Eigen values and Eigen vectors, maxima and minima of functions of several variables, solutions of higher order ordinary differential equations and Fourier series. Matrices are used in computer animations, color image processing. Eigen values are used by engineers to discover new and better designs for the future. The laws of physics are generally writ- ten down as differential equations. So, differential equations and Fourier series expansions have wide applications in various engineering and science disciplines. This course enables the students to gain basic knowledge on the mathematics which is used in modeling the real time engineering problems very often.

## II. COURSE OBJECTIVES:

**The students will try to learn:**

I. The principles of Eigen value analysis and linear transformations, Matrix rank finding methods
II. The calculus of functions of several variables and the concept of maxima-minima for a three-dimensional surface.
III. The analytical methods for solving higher order differential equations with constant coefficients.
IV. Fourier series expansions in standard intervals as well as arbitrary intervals.

## III. COURSE OUTCOMES:

**After successful completion of the course, students should be able to:**

| | | |
|---|---|---|
| CO 1 | **Compute** the rank and inverse of real and complex matrices with elementary transformation methods. | Apply |
| CO 2 | **Use** the Eigen values, Eigen vectors for developing modal and Spectral matrices from the given matrix. | Apply |
| CO 3 | **Make use of** Clayey Hamilton theorem for finding positive and negative powers of the matrix. | Apply |
| CO 4 | **Utilize** the mean–value theorems and partial derivatives in estimating the extreme values for functions of several variables | Apply |
| CO 5 | **Solve** the Second and higher order linear differential equations with constant coefficients by using substitution and method of variation of parameters.. | Apply |
| CO 6 | **Apply** the Fourier Series expansion of periodic, even and odd functions in analyzing the square wave, sine wave rectifiers. | Apply |

## IV. SYLLABUS:

**MODULE-I: THEORY OF MATRICES (09)**

Real matrices: Symmetric, skew-symmetric and orthogonal matrices; Complex matrices: Hermitian, Skew- Hermitian and unitary matrices; Elementary row and column transformations, finding rank of a matrix by reducing to Echelon form and Normal form; Finding the inverse of a matrix using Gauss-Jordan method;

**MODULE –II: LINEAR TRANSFORMATIONS (09)**

Cayley-Hamilton theorem: Statement, verification, finding inverse and powers of a matrix; Linear dependence and independence of vectors; Linear transformation; Eigen values and Eigen vectors of a matrix; Diagonalization of matrix by linear transformation.

**MODULE –III: FUNCTIONS OF SINGLE AND SEVERAL VARIABLES (09)**
Mean value theorems: Rolle's theorem, Lagrange's theorem, Cauchy's theorem-without proof.

Functions of several variables: Partial differentiation, Jacobian, functional dependence, maxima and minima of functions with two variables and three variables. Method of Lagrange multipliers.

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

**MODULE –V: FOURIER SERIES (09)**
Fourier expansion of periodic function in a given interval of length $2\pi$; Fourier series of even and odd functions; Fourier series in an arbitrary interval, Half- range Fourier sine and cosine expansions.

## V. 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.


## VI. 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.


## VII. 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

## VIII. E-TEXT BOOKS:

1. http://www.e-booksdirectory.com/details.php?ebook=10166
2. http://www.e-booksdirectory.com/details.php?ebook=7400re