MS104	**Mathematics I**	**L-T-P-CR-CH : 3-1-0-4-4**

Course Objectives

CO1. To explain the basics of real analysis for further application in integration theory.

CO2. To elaborate the basics of vector algebra for applications using Green, Gauss and Stokes theorem.

CO3. To demonstrate the concepts of improper integrals and their convergence, Beta-Gamma functions as a special case.

CO4. To explain the theory of differential equations which will be useful every now and then while solving engineering problems.

CO5. To prepare the students for the remaining semester as this is prerequisite to the following semester courses.

CO6. To impart competence to the students for solving problems of the standards pertaining to standards of the various national level competitive examinations like GATE, UPSC, PSUs etc.

Learning Outcomes

Upon the completion of the course, the students will be able to:

LO1. Analyze the concepts of real analysis and its use in Power series, Taylor's series, series for exponential, trigonometric and logarithm functions which will appear in several multidisciplinary problems.

LO2. Evaluate multivariable calculus and its use involving limit, continuity and differentiability of functions of several variables, applied in various engineering problems.

LO3. Identify applications of Green, Gauss and Stokes theorems to evaluate line, surface and volume integrals in an easier way.

LO4. Determine some advance knowledge of integration such as improper integrals which will help the use of Beta-Gamma functions in several engineering problems.

LO5. Recall the theory of Ordinary Differential Equations, which is an inseparable tool for any engineering discipline.

SYLLABUS

Unit 1: Sequence and series (8 lectures)

Sequence and series of real numbers, tests for convergence. Power series, Taylor's series, series for exponential, trigonometric and logarithm functions.

Unit 2: Calculus (6 lectures)

Continuity and differentiability of single variable, Rolle's theorem, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders, Indeterminate forms, L'Hospital's rule.

Unit 3: Multivariable calculus (8 lectures)

Limit, continuity and differentiability of functions of several variables, partial derivatives, directional derivatives, total derivative. Euler's theorem on homogeneous functions. Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.

Unit 4: Multiple integrals (10 lectures)

Gradient, Curl, Divergence, Laplacian, line integral, multiple integral, change of order of integration and change of variables, surface integral, theorems of Green. Gauss and Stokes theorems, orthogonal curvilinear coordinates. Simple applications involving cubes, sphere and rectangular parallelepipeds.

Unit 5: Improper integrals (5 lectures)

Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 6: Ordinary differential equations (8 lectures)

First order differential equations – exact, linear and Bernoulli's form, second order differential equations with constant coefficients, Euler equations. Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equations.

Total **(45 lectures)**

Textbooks

1. Advanced Engineering Mathematics, H. K. Dass, S. Chand, 22nd edition, 2018.
2. Higher Engineering Mathematics: B. V. Ramana. McGraw Hill, 6th edition, 2010.
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science, 5th edition, 2016.
4. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 44th edition, 2017.

Reference Books

1. Ordinary and Partial Differential Equations, M. D. Raisinghania, S. Chand, 20th edition, 2020.
2. Introduction to Real Analysis, R. G. Bartle and D. R. Sherbert, John Wiley & Sons, Inc., 4th edition, 2011,
3. Mathematical Analysis, S. C. Malik and S. Arora, New Age International Private Limited, 4th edition, 2017.