COMPUTATIONAL METHODS AND INTEGRAL CALCULUS

I B. Tech. - I Semester	L	T	P	C
Course Code: A3HS02	4	1	-	4

COURSE OVERVIEW:
The course matter is divided into 5 chapters covering duly-recognized areas of theory and study. This Course deals with more advanced Engineering Mathematics and Statistics topics which provide students with the relevant mathematical and statistical tools required in the analysis of problems in engineering and scientific professions. The topics covered include probability, random variables and distributions, solutions of algebraic and transcendental equations, interpolation, curve fitting, numerical integration and numerical solution of ordinary differential equations, Improper integration, multiple integrals and their applications, Vector integral theorems (Green's, Stoke's and Gauss's divergence theorems). The mathematical skills derived from this course forma necessary base to analytical and design concepts encountered in the programme.

PREREQUISITE(S): NIL

COURSE OBJECTIVES:
1. Develop an understanding of the role of distributions in engineering.
2. Acquaint students with the fundamental concepts of solving algebraic and transcendental equations.
3. Develop an understanding of the role of Numerical Analysis in engineering.
4. To gain experience of doing independent study and research.

COURSE OUTCOMES:
Up on successful completion of this course, student will be able to:
1. Classify discrete and continuous distribution functions.
2. Determine numerical solution of Non Linear equations.
3. Discuss the Stability of a system of equations.
4. Demonstrate the use of curve fitting in correlation and regression analysis.
5. Explain numerical differentiation and integration.
6. Examine numerical interpolation and approximation of functions.
7. Interpret errors in Numerical Methods.
8. Evaluate double integrals by changing variables, changing order and triple integration to find the area and volume of given region.
9. Apply Beta and Gamma functions to evaluate improper integrals.
10. Apply Green's theorem to evaluate line integrals along simple closed contours on the plane, Stoke's theorem to give physical interpretation of the curl of a vector field and Divergence theorem to give physical interpretation of the divergence of a vector field.

SYLLABUS

UNIT – I **(10 Lectures)**

ALGEBRAIC AND TRANSCENDENTAL EQUATIONS:
Introduction – Graphical interpretation of solution of equations. Bisection method - Regula-falsi method - Iteration method - Newton-Raphson method – Solving system of non-homogeneous equations by L – U decomposition method (Crouts method) – Jacobi's Method – Gauss Seidel iteration method.

UNIT - II **(10 Lectures)**

INTERPOLATION: Finite differences: Forward, Backward and Central differences - Other difference operators and relations between them - Differences of a polynomial – Missing terms - Newton's forward interpolation, Newton's backward interpolation, Gauss's forward and backward interpolation formulae and Stirling's formula. Interpolation with unequal intervals – Lagrange's interpolation.

CURVE FITTING: Method of least squares - Fitting a straight line, second degree parabola and non-linear curves of the form $y= a e^{bx}$, $y= a x^{b}$, $y = a b^{x}$ by the method of least squares.

UNIT - III **(10 Lectures)**

NUMERICAL INTEGRATION:
Newton-cotes quadrature formula - Trapezoidal rule - Simpson's one-third rule - Simpson's three-eighth rule.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS: Taylor's series method – Picard's method - Euler's - modified Euler's Method - Runge-Kutta method

UNIT- IV **(12 Lectures)**

IMPROPER INTEGRATION, INTEGRALS & APPLICATION BETA AND GAMMA FUNCTIONS: Relation between them, their properties – Evaluation of improper integrals using Gamma/Beta function.

MULTIPLE INTEGRALS: Double and triple integrals – Change of order of integration-Change of variables in double integrals.Finding the area and volume of a region using double and triple integration

UNIT – V **(12 Lectures)**

VECTOR CALCULUS: Scalar and vector point functions - Gradient, divergence, curl and their related properties -Solenoidal and irrotational vector point functions - Scalar potential function - Laplacian operator - Line integral - work done - surface integrals - volume integral - Vector integral theorems - Green's theorem in a plane - Stoke's theorem - Gauss divergence theorem (all theorem statements and their verification)

TEXT BOOKS:

1. Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K.Iyengar and R.K. Jain, New Age International Publishers
2. Higher Engineering Mathematics by Dr.B.S.Grewal, Khanna publishers.

REFERENCE BOOKS:

1. Introductory Methods of Numerical Analysis by S. S. Sastry, PHIL Learning Pvt.Ltd
2. Advanced Engineering Mathematics by E. Kreyszig, John Wiley & Sons Publisher.
3. Advanced Engineering Mathematics by Lawrence Turyn, CRC press