## 2PT01: NUMERICAL METHODS AND STATISTICAL ANALYSIS
### CREDITS - 3 (LTP: 3, 0, 0)

**Course Objective:**

To introduce numerical techniques used in engineering analysis.

**Teaching and Assessment Scheme:**

| Teaching Scheme (Hours per week) | | | Credits | Assessment Scheme | | | | |
|---|---|---|---|---|---|---|---|---|
| L | T | P | C | Theory Marks | | Practical Marks | | Total Marks |
| | | | | ESE | CE | ESE | CE | |
| 3 | 0 | 0 | 3 | 60 | 40 | 0 | 0 | 100 |

**Course Contents:**

| Unit No. | Topics | Teaching Hours |
|---|---|---|
| 1 | **Error Analysis**<br>Floating point number representation, Round-off errors and truncation errors in numerical computation, error propagation, and numerical instability. | 05 |
| 2 | **Roots of Equations:**<br>Bracketing Methods: Bisection method, Regula-Falsi method, Open Methods: Newton-Raphson method, Secant method, Brent's Methods, Multiple roots, Error Analysis. | 05 |
| 3 | **Solution of Simultaneous Linear Equations:**<br>Gauss Elimination with backward substitution, Gauss-Jordon and Gauss Seidel method, LU Decomposition and Matrix Inversion, Error Analysis and System Condition. | 04 |
| 4 | **Polynomial Interpolation:**<br>Lagrange methods, Forward/Backward/Central Difference Operators, Properties of Operators, Newton's forward and backward interpolation formulae, Gauss's forward and backward difference formulae, Interpolation with unequal interval: Newton's divided difference formula. Case Studies | 07 |
| 5 | **Numerical Integration and Differentiation:**<br>Trapezoidal rule, Simpson's 1/3 and 3/8 rule, Gauss quadrature.<br>Newton's Forward-difference, Backward-difference and Divided-difference formula. Case Studies. | 05 |
| 6 | **Numerical Solution of Ordinary Differential Equations:**<br>Initial-Value and Boundary-Value Problems, Single Step and Multi-Step Methods, Taylor series method, Euler's method, Euler's modified method, Runge-Kutta method of 2nd, 3rd and 4th orders, Multistep methods: Predictor and Corrector methods, Case Studies. | 06 |

| Unit No. | Topics | Teaching Hours |
|---|---|---|
| 7 | **Probability and Statistics:** Review of fundamental concepts of probability and sampling theorems, Conditional probability, Standard deviation function of Discrete and Continuous distributions, Normal, Poisson and Binomial distributions, Linear Regression analysis and curve fitting. | 08 |
| | **Total** | **40** |

**List of References:**


1. Steven Chapra and Raymond Canale, *"Numerical Methods for Engineers",* 6th edition, Tata McGraw-Hill.
2. Balagurusamy E., *"Numerical Methods",* Prentice Hall of India.
3. Steven C Chapra, *"Applied Numerical Methods with MATLAB",* 3rd edition, Tata McGraw Hill Publishing Co Ltd.
4. Sastry S. S., *"Introductory Methods of Numerical Analysis",* 5th edition, Prentice Hall of India.
5. Rao V. Dukkipati, *"Applied Numerical Methods Using MATLAB",* New Age International Publishers.
6. *Erwyn Kreyszig, "Advanced Engineering Mathematics", 10th edition, John Wiley and Sons, 2008.*


**Course Outcomes (COs):**

At the end of this course students will be able to …

1. Evaluate errors associated with computations.
2. Demonstrate the numerical techniques for root finding.
3. Demonstrate the numerical techniques for accurate and efficient solution of linear system of equation.
4. Demonstrate the numerical techniques to interpolate data-points.
5. Apply numerical techniques to solve integration and differentiation equation used in mechanical engineering.
6. Apply probability and techniques to practical problems in mechanical engineering.