| MA202T Numerical and Statistical Methods | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Teaching Scheme | | | | | Examination Scheme | | | | | |
| L | T | P | C | Hrs./Week | Theory | | Internal Assessment | Term Work | Practical /Viva | Total Marks |
| | | | | | ES (3.0Hrs) | MS (2.0Hrs) | | | | |
| 3 | 1 | --- | 7 | 7 | 50 | 25 | 25 | --- | --- | 100 |

**Course objective:**

Numerical methods provide the technique to solve ordinary differential equations, integrals, algebraic and transcendental equations. The course will also develop an understanding of the elements of error analysis for numerical methods. Ordinary differential equations occur in many scientific disciplines. Thus the course will further develop problem solving skills. This course provides an introduction to probability theory and random variables. In addition the course also covers various distributions – discrete as well as continuous. The students also get to know about the theory of least squares and statistical averages. They also learn about to collect and analyze the data that help in decision making.

**UNIT 1** **10**

**Numerical Solution of System of linear equations & non-linear equations:** Solution of transcendental and non-linear equations by Bisection, RegularFalsi, Newton's Raphson and Secant method. Solution of a system of linear simultaneous equations by LU Decomposition, Cholesky Decomposition, Jacobi and Gauss Seidel methods. Concept of Ill-conditioned system.

**UNIT 2** **14**

**Interpolation and Numerical Integration**: Introduction of Finite differences, Operators, Newton Gregory Forward Interpolation Formula, Newton Gregory Backward Interpolation Formula, Gauss's Forward and Backward Interpolation Formula, Stirling's Central Difference Formula, Lagrange's Interpolation Formula for unevenly spaced data, Inverse Interpolation, Divided Differences, Properties of Divided Differences, Newton's Divided Difference Formula, Relation between Divided Differences and Ordinary Differences.

Formulae for Derivatives, Newton-Cotes's Quadrature Formula, Trapezoidal rule, Simpson's one-third rule, Simpson's Three-Eighth rule, Weddle's rule, Romberg's method, Double Integration.

Numerical solution of first order ordinary differential equation by Taylor series method, Picard's method, Euler's method, Modified Euler's method and Runge-Kutta ($4^{th}$ order only) method. Multi step methods: Adams-Moulton method and Milne's method.

**UNIT 3** **6**

**Probability:** Various approaches of probability-classical, frequency (statistical), subjective and axiomatic. Theorems on probability, conditional probability, Independence, Baye's Theorem.

Random variable-discrete and continuous. Distribution function and their properties, probability mass and density functions.

**UNIT 4** **8**

**Statistics:** Mathematical Expectation, Moment Generating Function and its properties. Probability distributions: Bernoulli, Binomial, Negative Binomial, Poisson and Normal Distributions. Theory of least squares and curve fitting. Correlation-Simple, Multiple and Partial, Regression lines and Regression coefficients.

**APPROXIMATE TOTAL 38 Hours**

**Texts and References**


1. B.S. Grewal, Numerical Methods in Engineering and Science with Programs in C & C++,Khanna Publishers (2010).
2. S.S. Sastry, Introductory Methods for Numerical Analysis,$4^{th}$ Ed., Prentice Hall of India (2009).
3. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, $5^{th}$Ed.,

New Age International (2007).
4. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, S. Chand Publisher (2007).
5. R.K. Jain & S.R.K. Iyenger,Advanced Engineering Mathematics, 3rd Ed., Narosa (2002).

**Course outcome:** Students who successfully complete this course should be able to demonstrate understanding of :

1. Common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
2. Apply numerical methods to obtain approximate solutions to mathematical problems.
3. Derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
4. Analyze and evaluate the accuracy of common numerical methods.
5. Basic probability axioms and rules and the moments of discrete and continuous random variables as well as be familiar with common named discrete and continuous random variables.
6. How to derive the probability density function of transformations of random variables and use these techniques to generate data from various distributions.
7. How to calculate probabilities, and derive the marginal and conditional distributions of bivariate random variables.
8. Distinguish between different types of data.
9. Construct the probability distribution of a random variable, based on a real-world situation, and use it to compute various raw and central moments of higher order.
10. Assess which distribution for summarizing a data set are most appropriate and highlight interesting features of the data.