

Bachelors with Mathematics as Major

5th Semester

MMT522J2: Mathematics/Applied Mathematics: MATHEMATICAL MODELING & NUMERICAL METHODS

Credits: 4 THEORY + 2 TUTORIAL

Theory: 60 Hours & Tutorial: 30 Hours

Course Objectives: To understand role of mathematics in various disciplines, modeling real life situations. The objective of this course is to acquaint students with various analytical and numerical methods of finding solution of different type of problems, which arises in different branches of physics, chemistry, biology, humanities, social science etc.

Course Outcome: Students can handle physical and abstract problems to find an exact or approximated solutions. After getting trained a student can opt for advance courses in Applied Mathematics, Numerical analysis in higher mathematics.

Theory: 4 Credits

Unit- I

Introduction to Modeling, types of models, classification of mathematical models, flowchart of mathematical model, some basic models on simple pendulum, simple harmonic motion, projectile motion, gravitational laws. Population dynamics: exponential growth and logistic growth models. Lotka-Volterra population models.

Unit – II

Modeling heat conduction in solids, Fourier law of diffusion. Modeling heat transfer in biological tissues, fluids flow in human body, viscosity, classification of fluids, Poisselle's law, Simple mathematical models on chemical kinetics and law of mass action.

Unit – III

Rate of convergence, Errors: Relative, Absolute, Round off, Truncation. Numerical solution of nonlinear equations: Bisection method, Regula- Falsi method, Newton- Raphson method, Fixed-point Iteration method. Polynomial interpolation: Lagrange and Newtons divided difference interpolation, Central difference & averaging operators.

Unit – IV

Forward and backward difference interpolation, Hermite and Spline interpolation, piecewise polynomial interpolation. Numerical Integration: Some simple quadrature rules, Trapezoidal rule, Simpsons 1/3rd rule, Simpsons 3/8th rule.

Tutorials: 2 Credits

Unit – V

Problems based on SHM, projectile motion, ecology and population dynamics. Problems on heat and mass transport in human body, problems on chemical kinetics.

Unit – VI

Problems on numerical approximation of algebraic and transcendental equations, some problems on Numerical differentiation and integration.

Recommended Books

1. J. N. Kapur, Mathematical Modeling, New Age International Publications, 2021.
2. MA Khanday, Introduction to Mathematical Modeling and Biomathematics, Dilpreet Publishers New Delhi, 2016.
3. J. N. Kapur, Mathematical methods in Biology and Medicine, Payal Book Distributor, 2008.
4. B. Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
5. Kendall E. Atkinson: An Introduction to Numerical Analysis, 2008.
6. S. S. Sastry, Introductory method for Numerical Analysis, PHI New Delhi, 2012.