Course Name: Mathematical Modeling and Simulation
Course Code: MA-242
Course Type: Discipline Elective

Contact Hours/Week: 03L **Course Credits: 03**

Course Objectives

- Develop proficiency in understanding various types of models including finite, statistical, stochastic, verbal, and mechanical analogies.
- Master the formulation of models by applying laws and conservation principles to discrete and continuous systems, along with constitutive relations.
- Enhance analytical skills by manipulating models into their respective forms, evaluating them through case studies, and rendering variables dimensionless for simplification and insight into solutions.

Unit No.	Course Content	Lectures
UNIT-01	Model and its different types; Finite models; Statistical models; Stochastic models; Verbal models and mechanical analogies; Fuzzy subsets	7
UNIT-02	Formulation of a model; Laws and conservation principles; Discrete and continuous models; Constitutive relations; Difference and differential equations	7
UNIT-03	Manipulation into its most respective form; Evaluation of a model; Case studies; Rendering variables and parameters dimensionless; Reducing the number of equations and simplifying them; Gaining partial insights into the form of the solution	7
UNIT-04	Continuum model; Transport phenomena; Diffusion and air pollution models	5
UNIT-05	Microwave heating; Communication and Information technology; Applications in finance, healthcare, and environmental science	5
UNIT-06	Further case studies; Advanced topics in modeling and simulation; Optimization techniques in modeling; Sensitivity analysis; Validation and verification of models	5

Course Outcomes

Upon successful completion of the course, the student will be able to-
CO1: Learn to form models.
CO2: Learn to analyze them and numerically simulate the models.
CO3: Learn various real life models like diffusion, transport models.

Books and References

1. R. Aris, Mathematical Modelling Techniques, Dover, 1994.
2. C. L. Dym and E. S. Ivey, Principles of Mathematical Modelling, Academic Press, 1980.
3. M. S. Klamkin, Mathematical Modelling: Classroom Notes in Applied Mathematics, SIAM, 1986.
4. A. Friedman and W. Littman, Industrial Mathematics for Undergraduates, SIAM, 1994.