Course Objective: The objective of this course is to enable students to build mathematical models of real-world systems, analyze them and make predictions about behavior of the systems. Variety of modeling techniques will be discussed with examples taken from physics, chemistry, biology and other fields. The focus of the course will be on seeking the connections between mathematics and physical systems, studying various molding techniques to create mathematical description of these systems, and using this analysis to make predictions about the system's behavior.

Mathematical Modeling (BSM 603)										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	1	--	4	4	25	50	25	--	--	100

UNIT I 9hours

Mathematical Modelling – what and why?, Types of modelling, Limitations of a Mathematical Model. Identifying the Essentials of a problem, Mathematical Formulation (Motion of a simple pendulum, growth of phytoplanktons, motion of a raindrop). Solution of formulated problems (Simple Harmonic Motion, phytoplankton growth), Interpretation of the solutions.

UNIT II 10 hours

Free fall of a body, Upward Motion Under Gravity, Projectile Motion. Noewton's Law of Gravitation, Escape Velocity, Central forces – Basic Concepts, Modelling Planetary Motion, Kepler's laws, Limitations of the model. Physical Process, Mathematical Model of Plume Rise, Gaussian Model of Dispersion, Applications of Gaussian Model. Modelling Blood Flow problem and Oxygen transfer in Red cells. Formulation, solution, Interpretation and Limitations of the Models.

UNIT III 10 hours

Exponential growth model and Logistic growth model – Formulation, solution, Interpreation and Limitations of the models, Extension of the Logistic Model. Types of Interactions between two species, Predator-prey and Competing Species Models – Formulation, solution, Interpretation and Limitations of the models.

UNIT IV 10 hours

Basic definitions and fundamental concepts of Simple epidemic model, General epidemic model, Recurrent epidemic model without and with Undamped waves – Formulation, Solution,

Interpretation and Limitations of the models. Models of heating and cooling, Models for traffic flow. APPROXIMATE TOTAL 39 Hours
Text and Reference books 1. Principles of Mathematical Modeling, by Clive L. Dym, academic press, second edition. 2. Modeling and simulation of system using Matlab and Simulink, by Devendra K. Chaturvedi, CRC Press, Taylor & Francis Group. 3. Mathematical Modelling, by J. N. Kapur, Wiley publication.

Course Outcomes:

On completion of this course students will be able to:

1. Assess and articulate what type of modelling techniques are appropriate for a given physical system.
2. Construct a mathematical model of a given physical system and analyse it,
3. Make predictions of the behaviour of a given physical system based on the analysis of its mathematical model.