



## Modeling and Simulations

Course Code	Course Num.	Course Name	Credit Hours	Lec	Lab	Tut	Prerequisites
MAT	463	Modeling and Simulations	4	3	0	2	Mat333 and Mat 334

### *Objectives:*

This course provides an introduction to system modeling using both computer simulation and mathematical techniques. Emphasis will be on continuous and discrete-events simulation model development methodologies and implementation techniques.

### *Syllabus:*

**Introduction to Mathematical Modeling Process:** Concept; Objectives; Methods and tools Mathematics is the natural modeling language; Definition of mathematical models.  
**Modeling Continuous Systems:** Modeling with Differential Equations: Population dynamic; Electrical Circuits; Mechanical Systems; Biological models (Lotka-Volterra systems, Predator-Prey systems). Modeling with Partial Differential Equations: Linear Temperature Diffusion; One-dimensional Hydrodynamic model. Case Studies: Heat diffusion, Wave vibration, Laplace Equation.

**Modeling Discrete Systems:** Modeling with difference equations; Modeling with data; Discrete Velocity Models; Continuous Vs. Discrete Models

**Simulation:** Block-Digrams; State-Space Model; Transfer Functions, State-space Vs. transfer function. Stability and pole locations; Introduction to Matlab\Simulink (Starting Simulink, Basic Elements, Building a System, Running Simulations); Simulation of some models (case study models) and Analysis of Simulation results

### *References:*

- Kai Veltn, **Mathematical Modeling and Simulation: Introduction for Scientists and Engineers**, Wiley 2009.
- Steven T. Karris: **Introduction to Simulink® with Engineering Applications**, Orchard Publications (2006).

