



## SYLLABUS

Course Code	Course Num.	Course Name	Credit Hours	Lec.	Lab.	Tut.	Private study	Pre-requisites	Course Level	Teaching Language
MAT	463	Modeling and Simulation	4	2	2	1	6	MAT333 <sup>1</sup> & MAT434 <sup>2</sup>	8 <sup>3</sup>	English

### A. Course Description

This course provides an introduction into modeling and simulation approaches and basic concepts of computation, covering methods and tools mathematics, modeling continuous and discrete systems and modeling with partial differential equations. Students will use MATLAB to explore a range of programming and modeling concepts. They will analyze one of a variety of scientific problems by designing a representative model, implementing the model, completing a verification and validation process of the model, and changing the model to reflect corrections, improvements and enhancements.

### B. Course Outcomes

At the end of this course the student will be able to:

- Be familiar with mathematical modeling and Simulation.
- Analyze, design and begin to control rigorous mathematical models in continuous and discrete approaches.
- Use processes undertaken to arrive at a suitable mathematical model.
- Apply the fundamental analytical techniques and simulation methods used to develop insight into system behaviour.
- Be familiar with a range (e.g., industrial, biological, and environmental) of study cases, associated conceptual models and their solutions using graphical, numerical and analytical approaches.
- Apply master simulation techniques using Simulink\ Matlab software.

<sup>1</sup> For the B.Sc. in Applied Mathematics.

<sup>2</sup> For the B.Sc. in Applied Mathematics.

<sup>3</sup> For the B.Sc. in Applied Mathematics.



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## C. References:

### Required Textbook

- *Mathematical Modeling and Simulation: Introduction for Scientists and Engineers*, Kai Veltn, Wiley 2009. (Main Reference 1)
- *Introduction to Simulink® with Engineering Applications*, Steven T. Karris, Orchard Publications, 2006. (Main Reference 2)

### Other references:

- *Simulation Modeling and Analysis with Expertfit Software*, Averill Law, McGraw-Hill Science, 2007.
- *A Concrete Approach to Mathematical Modelling*, M. M. Gibbons, Wiley-Interscience, 2007.
- *Topics in Industrial Mathematics*; H. Neunzert, A. Siddiqui; Kluwer Academic Publishers, 2000.
- *Mathematical Modeling Physical systems: An Introduction*; D. Basmadjian, Oxford University Press, 2003.

## D. Topics Outline

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

## E. Office Hours

Office hours give students the opportunity to ask in-depth questions and to explore points of confusion or interest that cannot be fully addressed in class.



## F. Exams & Grading System

The semi-official dates of the exams for this course are:

- **Midterm 1:** 6<sup>th</sup> or 7<sup>th</sup> week.
- **Midterm 2:** 11<sup>th</sup> or 12<sup>th</sup> week.
- **Quizzes & Homeworks:** During the semester.
- **Final Exam:** 16<sup>th</sup> week.

Your course grade will be based on your semester work as follows:

Midterm 1: 20 %	Midterm 2: 20 %	Final Exam: 40 %
Quizzes, Homework, Attendance & Participation: 20 %		

The grading distribution:

A <sup>+</sup>	A	B <sup>+</sup>	B	C <sup>+</sup>	C	D <sup>+</sup>	D	F
[95, 100]	[90, 95]	[85, 90]	[80, 85]	[75, 80]	[70, 75]	[65, 70]	[60, 65]	[0, 60]

## G. Student Attendance/Absence

Only three situations will be considered as possible excused absences:

- Occurrence of a birth or death in the immediate family will be excused. (“Immediate family” is defined by the University as spouse, grandparents, parents, brother, or sister).
- Severe illness in which a student is under the care of a doctor and physically unable to attend class will be excused. Students are not excused for a doctor's appointment. Do not make appointments that conflict with rehearsals. Notes from the University Health Center will be accepted.

[Executive Rules for Study Regulations and Exams](http://goo.gl/ykm7t3)  
[goo.gl/ykm7t3](http://goo.gl/ykm7t3)

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