# CSE 2021 (Approved): Introduction to Modeling and Simulation

## Course Description

Concepts of modeling and simulation; develop MATLAB skills to explore modeling concepts; project: design, implementation, verification/validation of model; oral and written project report.

**Transcript Abbreviation:** Modelng&Simulatn
**Grading Plan:** Letter Grade
**Course Deliveries:** Classroom
**Course Levels:** Undergrad
**Student Ranks:** Sophomore, Junior
**Course Offerings:** Spring
**Flex Scheduled Course:** Never
**Course Frequency:** Every Year
**Course Length:** 14 Week
**Credits:** 3.0
**Repeatable:** No
**Time Distribution:** 3.0 hr Lec
**Expected out-of-class hours per week:** 6.0
**Graded Component:** Lecture
**Credit by Examination:** No
**Admission Condition:** No
**Off Campus:** Never
**Campus Locations:** Columbus
**Prerequisites and Co-requisites:** Math 1151 (152) or equivalent, Phys 1250 (131)
**Exclusions:** Not open to students with credit for ENGR 1221 or CSE 1221
**Cross-Listings:**

**The course is required for this unit's degrees, majors, and/or minors:** No
**The course is a GEC:** No
**The course is an elective (for this or other units) or is a service course for other units:** Yes

**Subject/CIP Code:** 14.0901
**Subsidy Level:** Baccalaureate Course

## General Information

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| MATLAB is taught. |

## Course Goals

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| Be competent with discussing the importance of modeling to science and engineering, the history and need for modeling, the cost effectiveness of modeling, the time-effect of modeling; |
| Be familiar with defining modeling terms, listing questions that would check/validate model results, describing future trends and issues in science and engineering, and identifying specific examples of modeling in science and engineering; |
| Be familiar with utilizing the Modeling Process to identify key parameters of a model, estimating model outcomes, and utilizing MATLAB to implement the mathematical representation of the model; |
| Be familiar with constructing difference-based computer models, conducting and explaining the transformation of continuous functions and dynamics equations into discrete computer representations; |
| Be competent with writing simple MATLAB programs performing numerical calculations as needed for modeling and simulation; be competent with implementing finite difference modeling equations and creating simulations in MATLAB; |
| Be familiar with visualizing empirical data and the fitting function using MATLAB; |

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| Be familiar with identifying different types of models and simulations; describing iterative development of a model; explaining use of models & simulations for hypothesis testing; |
| Be familiar with discussing methods for reviewing models, their verification and validation; differences between predictions of model, actual results and relevance of these differences to the problem; suitability/limits of model; |
| Be familiar with documenting the development and implementation of a model and presenting it in oral and written form. |

## Course Topics

| Topic | Lec | Rec | Lab | Cli | IS | Sem | FE | Wor |
|---|---|---|---|---|---|---|---|---|
| Introduction to modeling; modeling concepts and definitions | 4.0 | | | | | | | |
| Introduction to MATLAB, scripts | 3.0 | | | | | | | |
| MATLAB arrays, array math | 4.0 | | | | | | | |
| MATLAB programming mechanisms (conditionals, loops, etc.) | 4.0 | | | | | | | |
| MATLAB i/0 | 1.0 | | | | | | | |
| Advanced graphing in MATLAB; curve fitting | 4.0 | | | | | | | |
| Linear models | 3.0 | | | | | | | |
| Nonlinear functions; modeling examples | 4.0 | | | | | | | |
| Stochastic models | 3.0 | | | | | | | |
| Final project overview and Requirements | 3.0 | | | | | | | |
| Accuracy and precision in modeling; verification and validation; project plan | 3.0 | | | | | | | |
| Project implementation; Project presentations | 4.0 | | | | | | | |
| Review/exams | 2.0 | | | | | | | |

## Grades

| Aspect | Percent |
|---|---|
| Homework | 15% |
| Project | 35% |
| Midterm Examination 1 | 12% |
| Midterm Examination 2 | 13% |
| Final Examination | 25% |

## Representative Textbooks and Other Course Materials

| Title | Author |
|---|---|
| *Introduction to Computational Science: Modeling and Simulation for the Sciences* | Angela B. Shiflet and George W. Shiflet |

## ABET-EAC Criterion 3 Outcomes

| Course Contribution | | College Outcome |
|---|---|---|
| ** | a | An ability to apply knowledge of mathematics, science, and engineering. |
| ** | b | An ability to design and conduct experiments, as well as to analyze and interpret data. |
| *** | c | An ability to design a system, component, or process to meet desired needs. |
| | d | An ability to function on multi-disciplinary teams. |
| *** | e | An ability to identify, formulate, and solve engineering problems. |

| Course Contribution | | College Outcome |
|---|---|---|
| * | f | An understanding of professional and ethical responsibility. |
| ** | g | An ability to communicate effectively. |
| * | h | The broad education necessary to understand the impact of engineering solutions in a global and societal context. |
| * | i | A recognition of the need for, and an ability to engage in life-long learning. |
| | j | A knowledge of contemporary issues. |
| *** | k | An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. |

**Prepared by:** Neelam Soundarajan