Introduction to Modeling and Simulation

CSE 2021

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.

Course Goals / Objectives:
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;
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:

- Introduction to modeling; modeling concepts and definitions
- Introduction to MATLAB, scripts
- MATLAB arrays, array math
- MATLAB programming mechanisms (conditionals, loops, etc.)
- MATLAB i/o
- Advanced graphing in MATLAB; curve fitting
- Linear models
- Nonlinear functions; modeling examples
- Stochastic models
- Final project overview and Requirements
- Accuracy and precision in modeling; verification and validation; project plan
- Project implementation; Project presentations
- Review/exams

Grades Breakdown:

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<thead>
<tr>
<th>Aspect</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
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<tr>
<td>Project</td>
<td>35%</td>
</tr>
<tr>
<td>Midterm Examination 1</td>
<td>12%</td>
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<tr>
<td>Midterm Examination 2</td>
<td>13%</td>
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<tr>
<td>Final Examination</td>
<td>25%</td>
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Designation:
Elective

Instruction Modes:
In Person (75-100% campus; 0-24% online)

Representative Textbooks and Other Course Materials:

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Year</th>
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<tbody>
<tr>
<td>Introduction to Computational Science: Modeling and Simulation for the Sciences</td>
<td>Angela B. Shiflet and George W. Shiflet</td>
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