Syllabus – BEE 320: Biosystems Analysis and Modeling

Course Credits - 4 Credits

Instructor: John Bolte, 116 Gilmore Hall, john.bolte@oregonstate.edu


Prerequisites, Co-requisites and Enforced Prerequisites – Required prerequisite of BEE 222. Unenforced (recommended) prerequisite of MTH 256 and instructor consent.

Course Description:
This course is a foundation course in simulation modeling that provides a broad survey of applicable methodologies for modeling a broad range of biotic and abiotic relationships. The course examines both empirical and mechanistic approaches to modeling, and emphasizes practical skills for representing and analyzing systems.

This is a hybrid-format course, with both online and in-class activities required to complete the course. Course grading is based on weekly online quizzes, homework assignments, and group and individual projects. It is expected that student will review the week’s online assignments prior to Monday and complete the weekly Online Quiz. There will be an optional in-class session Monday to address any questions related to the online materials, but students will be expected to have reviewed the material prior to Monday’s (optional) class.

Course Content:

Objectives:
1. Develop skills in the formulation of deterministic and statistical models describing biotic and abiotic relationships.
2. Develop an understanding of systems approaches to describing biological systems.
3. Develop an understanding of the analysis tools necessary to accurately simulate biological systems.
4. Develop the ability to apply these models to designing ecological systems.

Students will be responsible for two projects in the course: A “group project” focusing on a system design question, and an “individual” project developing a simulation model in an area chosen by the student.

General Weekly Pattern of Activities:

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<tr>
<th>Week</th>
<th>Monday</th>
<th>Wednesday</th>
<th>Friday</th>
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<tbody>
<tr>
<td></td>
<td>(Online, Optional In-class)</td>
<td>(In class)</td>
<td>(Recitation: In class)</td>
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<tr>
<td>1-8</td>
<td>Review Assigned Readings, online activities</td>
<td>Prior homework due (reviewed in class that day)</td>
<td>Solve Problems relevant to the week’s reading/homework</td>
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<td></td>
<td>Weekly Quiz</td>
<td>New Homework assigned and discussed</td>
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<td></td>
<td>Optional In-class session to review assigned readings</td>
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<tr>
<td>9-11</td>
<td>Project Meetings</td>
<td>Project Meetings</td>
<td>Project Presentations</td>
</tr>
<tr>
<td>Week</td>
<td>Monday</td>
<td>Wednesday</td>
<td>Friday</td>
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| 1    | 9/18   | Intro – Overview of modeling  
(O) Intro to Modeling | Intro – continued Get Set Up with Python,  
Jupyter Notebooks  
(O) Quiz Setup: Intro to Linear Regression | HW1: Find-A-Model (Overton Criteria) |
| 2    | 9/25   | (O) Linear Regression  
(O) Quiz | HW 1 Review; Linear Regression in Python/ Excel | Online Quiz  
HW2: Linear Regression |
| 3    | 10/2   | (O) Nonlinear Regression  
(O) Quiz | HW 2 Review; Nonlinear Regression in Python/Excel | Online Quiz  
HW3: Nonlinear Regression |
| 4    | 10/9   | Systems and Mechanistic Models  
(O) Quiz | HW3 Review; Solving ODE’s in Python | Online Quiz  
HW4: Plant Carbon Allocation Model |
| 5    | 10/16  | (O) Generalized Quantitative Processes  
(O) Quiz | HW4 Review; Process Representation | Online Quiz  
HW 5 Fish Pond Model |
| 6    | 10/23  | (O) Multidimensional Models  
(O) Quiz | HW5 Review; PDEs in Python | Online Quiz  
HW 6: Constructed Wetlands Design |
| 7    | 10/30  | (O) Stochastic Models  
(O) Quiz | HW6 Review; Stochastic Models | Online Quiz  
HW 7: Monte Carlo Model |
| 8    | 11/6   | (O) Model Validation, Testing  
(O) Quiz | HW7 Review; Sensitivity Analysis | Online Quiz |

Course Schedule: *(Online activities are indicated with an (O) and in italics)*
Measurable Student Learning Outcomes and Evaluation of Student Performance:

Measurable student learning outcomes and evaluation approach are given in the following table. The letters at the end of each learning outcome are correlated to the ABET requirements for learning outcomes. Student performance will be measured using homework assignments, quizzes, and modeling projects as follows: homework (45%), quizzes (30%), individual project (15%), group project (10%).

Homework will be assigned more or less weekly throughout the course. It is expected that homework assignments are submitted on time (Wednesdays before class), as we will be reviewing the homework in class. Late homework will not be accepted unless you have a documented reason for being late. You will be able to drop your lowest homework grade; the others will count.

<table>
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<tr>
<th>ABET program Learning Objective</th>
<th>Measurable Course Learning Outcome</th>
<th>Evaluation of Student Performance</th>
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<tbody>
<tr>
<td>Ability to apply knowledge of Math., Science &amp; Engineering</td>
<td>1. Formulate deterministic and stochastic models describing biotic and abiotic relationships. 2. Apply a systems approach to conceptualizing biological and abiotic systems. 3. Translate systems conceptualizations into a mathematical description of the systems</td>
<td>Homework assignments; project;</td>
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<tr>
<td>Ability to Identify, Formulate &amp; Solve Engineering Problems</td>
<td>1. Formulate deterministic and stochastic models describing biotic and abiotic relationships. 2. Apply procedures for solving the resulting mathematical systems.</td>
<td>Homework assignments; project;</td>
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3. Apply methods for model calibration, validation and evaluation.

| Ability to Model and Design Ecological Systems | 1. Formulate deterministic and stochastic models describing biotic and abiotic relationships.  
2. Translate systems conceptualizations into a mathematical description of the systems. | Homework assignments; project; |
| Apply procedures for solving the resulting mathematical systems. (A,E) | Homework assignments |
| Apply methods for model calibration, validation and evaluation. E,M,N | Projects |
| Work in a team context to design, implement and evaluate a model in a group setting. (D,G) | Group Project Self-evaluation |

Learning Resources:

No textbook is required for this class. A good reference is Modelling Dynamic Biological Systems, by Bruce Hannon and Matthies Ruth, Springer, New York. ISBN 038794850-3 (optional text). All materials covered in class will be available on the course Canvas site.

Additional materials available on request.

Students with Disabilities:
Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval please contact DAS immediately at 541-737-4098 or at http://ds.oregonstate.edu. DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

Academic Dishonesty and Student Conduct:
Academic misconduct is any action that misrepresents a student or group’s work, knowledge, or achievement, provides a potential or actual inequitable advantage, or compromises the integrity of the educational process. A complete description of prohibited behaviors as available at: http://studentlife.oregonstate.edu/code. These include the following:

a) Cheating. Unauthorized assistance, or access to or use of unauthorized materials, information, tools, or study aids. Examples include, but are not limited to, unauthorized collaboration or copying on a test or assignment, using prohibited materials and texts, unapproved use of cell phones, internet, or other electronic devices, etc.
b) **Plagiarism.** Representing the words or ideas of another person or presenting someone else's words, data, expressed ideas, or artistry as one's own. Examples include, but are not limited to, presenting someone else's opinions and theories as one's own, using another person's work or words (including unpublished material) without appropriate source documentation or citation, working jointly on a project and then submitting it as one's own, etc.

c) **Falsification.** Fabrication or invention of any information. Examples include, but are not limited to, falsifying research, inventing or falsely altering data, citing fictitious references, falsely recording or reporting attendance, hours, or engagement in activities such as internships, externships, field experiences, clinical activities, etc.

d) **Assisting.** Any action that helps another engage in academic misconduct. Examples include, but are not limited to, providing materials or assistance without approval, altering someone's work, grades or academic records, taking a test/doing an assignment for someone else, compelling acquisition, selling, bribing, paying or accepting payment for academic work or assistance that contributes to academic misconduct, etc.

e) **Tampering.** Interfering with an instructor’s evaluation of work by altering materials or documents, tampering with evaluation tools, or other means of interfering.

f) **Multiple submissions of work.** Using or submitting work completed for another or previous class or requirement, without appropriate disclosure, citation, and instructor approval.

g) **Unauthorized recording and use.** Recording and/or dissemination of instructional content without the express permission of the instructor(s), or an approved accommodation coordinated via Disability Access Services.