Syllabus – BEE 529

Course Name - Biosystems Modeling Techniques

Course Credits - 3 Credits

Prerequisites, Co-requisites and Enforced Prerequisites - None

Instructor:

Dr. John Bolte
116 Gilmore Hall
737-6303
Office hours: Anytime you can find me. Emailing me with an appointment request is a good idea.
EMail: boltej@engr.orst.edu

Course Objectives:

Develop skills in the formulation of deterministic and statistical models describing biotic and abiotic relationships. Develop an understanding of systems approaches to describing biological systems. Develop an understanding of the analysis tools necessary to accurately simulate biological systems. 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.

Specific learning objectives include:

- Formulate deterministic and stochastic models describing biotic and abiotic relationships
- Apply a systems approach to conceptualizing biological and abiotic systems
- Translate systems conceptualizations into a mathematical description of the systems
- Apply procedures for solving the resulting mathematical systems
- Analyze the resulting system response
- Apply methods for model calibration, validation and evaluation
- Work in a team context to design, implement and evaluate a model in a group setting.

Text:

Most text material is available on this website (in Blackboard), some additional materials will be handed out in class.

Useful References:

- James W. Haefner Modeling Biological Systems: Principles and Applications
Law and Kelton, Simulation, Modeling and Analysis.
Carnahan, Luther and Wilkes, Applied Numerical Methods.
Conte and deBoor, Elementary Numerical Analysis
Draper and Smith, Applied Regression Analysis
Halfton, Theoretical Systems Ecology
Hall and Day, Ecosystems Modeling in Theory and Practice
O’Neill, Systems Ecology
Keen and Spain, Computer Simulation in Biology

**Grading:**

- Midterm - 25%
- Final - 25%
- Homework - 30%
- Individual Project - 15%
- Group Project – 5%

**Schedule:**

- Planned by not guaranteed!

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Measures</th>
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</thead>
</table>
| 1    | Basic Principles:  
- Intro to general systems theory  
- Dynamic vs steady state systems  
- Open vs closed systems  
- Top Down vs. Bottom Up  
- The Process of Modeling  
  Introduction to Simile with examples: | Homework 1: Find a Model |
| 2    | Modeling Basics  
- System components: Flows, storages, sinks, influences.  
- System boundaries  
- Mathematical foundation (differential equations) | Homework 2: Population Models |
| 3    | Class Project Identification  
Linear Systems  
Nonlinear Systems | Group Process  
Group Contract  
Homework 3: Linear Systems |
| 4-5  | Quantitative Representation of Fundamental Processes (Continued)  
- Production and Recycle  
- Population/Growth Models  
  Competition/Cooperation - Predator/Prey Models  
- Mass/Energy Balances  
- Biological Reactors  
  Numerical Methods in One Dimension – Euler and Runge Kutta Techniques | Homework 4: Plant Model  
Mid-term Examination |
| 6-7 | Quantitative Representation of Fundamental Processes – Fate and Transport  
Mid-term Examination  
Numerical Methods in Multiple Dimensions – Grid Methods | Homework 5:  
Multidimensional Systems |
|---|---|
| 8 | Sensitivity Analysis  
Parameter Estimation  
Validation | Homework 6: Sensitivity Analysis |
| 9 | Stochastic Models | Homework 7: Stochastic Models |
| 10 | Projects  
Final Examination | Projects  
Final Examination |

**Measurable Student Learning Outcomes and Evaluation of Student Performance:**
Measurable student learning outcomes and evaluation approach is given in the following table. Student performance will be measured using homework assignments, mid/final examinations, and a modeling project.

<table>
<thead>
<tr>
<th>Measurable Student Learning Outcome</th>
<th>Evaluation of Student Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formulate deterministic and stochastic models describing biotic and abiotic relationships.</td>
<td>Homework assignments; project; midterm/final exam</td>
</tr>
<tr>
<td>Apply a systems approach to conceptualizing biological and abiotic systems.</td>
<td>Homework assignments; project; midterm/final exam</td>
</tr>
<tr>
<td>Translate systems conceptualizations into a mathematical description of the systems.</td>
<td>Homework assignments; project; midterm/final exam</td>
</tr>
<tr>
<td>Apply procedures for solving the resulting mathematical systems.</td>
<td>Homework assignments</td>
</tr>
<tr>
<td>Analyze the resulting system response.</td>
<td>Homework assignments 5, 7; project</td>
</tr>
<tr>
<td>Apply methods for model calibration, validation and evaluation.</td>
<td>Homework 7</td>
</tr>
<tr>
<td>Work in a team context to design, implement and evaluate a model in a group setting.</td>
<td>Group Project Self-evaluation</td>
</tr>
</tbody>
</table>

**Learning Resources:**

[x] Lecture  
[] Discussion  
[] Recitation  
[] Laboratory  
[] Seminar  
[] Independent Studies  
[] Research  
[] Activity  
[] Experimental  
[] Internship  
[] Correspondence  
[] Tutorial  
[] Practicum  
[] Exper/Co-op Education  
[] Programmed Instruction  
[] Thesis  
[] Studio  
[X] Project  
[] Telecourse/Distance Learning  
[] Externship  
[] World Wide Web  
[] Workshop  
[] Activity  
[] Programmed Instruction  
[] Modular
Students with Disabilities:
“Accommodations are collaborative efforts between students, faculty and Services for Students with Disabilities (SSD). Students with accommodations approved through SSD are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations, but who have not yet obtained approval through SSD should contact SSD immediately at 737-4098.”

Academic Dishonesty and Student Conduct:
http://oregonstate.edu/admin/stucon/achon.thtm

At Oregon State University academic dishonesty is defined by the Oregon Administrative Rules 576-015-0020.1.a-c as: An intentional act of deception in which a student seeks to claim credit for the work or effort of another person or uses unauthorized materials or fabricated information in any academic work. Academic dishonesty includes:

CHEATING – Use or attempted use of unauthorized materials, information or study aids or an act of deceit by which a student attempts to misrepresent mastery of academic interest of information. This includes unauthorized copying or collaboration on a test or assignment or using prohibited materials and texts.

FABRICATION – falsification or invention of any information (including falsifying research, inventing or exaggerating data and listing incorrect or fictitious references.

ASSISTING – Helping another commit an act of academic dishonesty. This includes paying or bribing someone to acquire a test or an assignment, changing someone’s grades or academic records, or taking a test/doing an assignment for someone else (or allowing someone to do these things for you). It is a violation of Oregon state law to create and offer to sell part or all of an education assignment to another person (ORS 165.114).

TAMPERING – altering or interfering with evaluation instruments and documents.

PLAGIARISM – representing the word or ideas of another person as one’s own OR presenting someone else’s words, ideas, artistry or data as one’s own. This includes copying another person’s work (including unpublished material) without appropriate referencing, presenting someone else’s opinions and theories as one’s own, or working jointly on a project, then submitting it as one’s own.