

# Course Information Sheet

## CSCI 4210

### Simulation and Modeling

**Brief Course Description**  
(50-words or less)

In this course, we will study complex dynamic systems, examining their performance, reliability, etc. The reason for doing this is to improve such systems either in the design phase (before a costly system is built) or the operation phase (tune or upgrade). A simulation model may be used for such studies. It is an approximation of the complex system that captures its essential properties and often mimics the behavior of the actual system. Behavior is studied by carrying out multiple runs of the simulation model to produce statistical outputs of properties such as system response time or throughput.

**Extended Course Description / Comments**

Further insight into system behavior can be gained by animating the model. The course will involve a major project to create a simulation model (or simulation oriented game) of a system chosen by the project group (2 students). The model will be created using Java or Scala and parts of JSIM, a simulation system coded in Java, or ScalaTion, a simulation system coded in Scala.

**Pre-Requisites and/or Co-Requisites**

CSCI 2720: Data Structures

**Approved Textbooks**

Banks, Carson, Nelson and Nicol  
Discrete-Event System Simulation: 5/e, 2010  
ISBN-13: 9780136062127

**Learning Outcomes**

Students will learn how to construct and analyze simulation models of complex systems.

1. A basic ability to categorize various mathematical modeling techniques.
2. A basic ability to select and use various probabilistic and statistical models.
3. An ability to explain and develop models following the event scheduling simulation world view.
4. An ability to explain and develop models following the process-interaction simulation world view.
5. A basic ability to derive and use various queueing models (e.g., M/M/1, M/G/1).
6. An ability to generate random number and random variates.
7. An ability to analyze and draw conclusions from the outputs of simulation models.
8. An ability to create simple computer games.
9. Experience with a term project/report involving the creation of a simulation model that includes 2D/3D animation.

**Relationship Between Course Outcomes and Learning Outcomes**

*Program Outcomes*

A    b    c    d    e    f    g    h    i    j    k

1	•								•
2	•								•
3			•						
4			•						•
5	•								•
6	•	•							•
7	•	•							
8		•	•	•				•	•
9		•	•	•		•		•	•

**Program Outcomes**

- a. An ability to apply knowledge of computing and mathematics appropriate to the discipline.
- b. An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution.
- c. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
- d. An ability to function effectively on teams to accomplish a common goal.
- e. An understanding of professional, ethical, legal, security and social issues and responsibilities.
- f. An ability to communicate effectively with a range of audiences.
- g. An ability to analyze the local and global impact of computing on individuals, organizations, and society.
- h. Recognition of the need for and an ability to engage in continuing professional development.
- i. An ability to use current techniques, skills, and tools necessary for computing practice.
- j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- k. An ability to apply design and development principles in the construction of software systems of varying complexity.

**Major Topics Covered  
(Approximate Course Hours)**

Introduction to Modeling and Simulation (2 hours)  
Simulation Examples (4 hours)  
Discrete Event Simulation (6 hours)  
Simulation Software (2 hrs)  
Simulation Engines: Concurrent Programming/Threads (8 hours)  
Animation Techniques (2D/3D) (4 hours)  
Statistical Models (4 hours)  
Markov Chains (2 hours)  
Queueing Models (2 hours)  
Verification and Validation (2 hours)  
Random Number Generation (2 hours)  
Random Variate Generation (2 hours)  
Output Analysis (4 hours)  
Simple Computer Games (6 hours)

**Assessment Plan for this Course**

Each time this course is offered, the class is initially informed of the Course Outcomes listed in this document, and they are included in the syllabus. At the end of the semester, an anonymous survey is administered to the class where each student is asked to rate how well the outcome was achieved. The choices provided use a 5-point Likert scale containing the following options: Strongly agree, Agree, Neither agree or disagree, disagree, and strongly disagree. The results of the anonymous survey are tabulated and results returned to the instructor of the course.

The course instructor takes the results of the survey, combined with sample student work on projects and responses to final exam questions corresponding to course outcomes, and reports these results to the ABET committee.

**How Data is Used to Assess Program Outcomes**

Each course Learning Outcome, listed above, directly supports one or more of the Program Outcomes, as is listed in "Relationships between Learning Outcomes and Program Outcomes". For CSCI 4210, all Program Outcomes (e, g, h) are supported.

**Course Master  
Course History**

1998: Course approved as semester replacement for CS 421 during quarter to semester transition.