CSE 561
Modeling & Simulation Theory and Application
Spring 2007

General:	Building/Classroom: BYAC-210 Lecture Days & Hours: Tu, Th., 4:40 – 5:55 pm Course Portal: http://my.asu.edu (SLN: **54608 / ONLINE**)
Instructor	Hessam S. Sarjoughian Computer Science & Engineering Dept. Bldg/Room: BY/476 Phone: (480) 965-3983 Fax: (480) 965-2751 Email: hss@asu.edu URLs: http://www.eas.asu.edu/~hsarjou/index.htm Office hours: Tu. & Th. 11:00 - 12:15 pm; and by appointment
Teaching Support	TA: TBD Email: TBD Bldg/Room: TBD
Textbooks	**Required Notes:** • *Introduction to DEVS Modeling & Simulation with JAVA: Developing Component-based Simulation Models*, B.P., Zeigler and H.S. Sarjoughian (available from ACIMS) **Reference Textbook:** • *Theory of Modeling & Simulation*, 2nd Ed., B.P. Zeigler, H. Praehofer, T.G. Kim, 2000 **Other Related Reference Textbooks:** • *Model-Based Systems Engineering: an introduction to the mathematical theory of discrete systems and to the tricotyledon theory of system design*, W. Wymore, 1993 • *Simulation Model Design and Execution: Building Digital Worlds*, P. Fishwick, 1995 • *Simulation Modeling and Analysis*, 3rd Edition, A. Law and W. Kelton, 1999 **Reference Textbooks on Java:** • *Onto Java online,* 3rd Edition, P.A. Winston and S. Narasimhan http://www.ai.mit.edu/people/phw/OnToJava/ [beginner and intermediate levels] • *Thinking in Java*, B. Eckel, http://www.mindview.net/, [intermediate and advanced levels] **Articles:** • *Selected seminal papers on agent-based, network, and supply-chain enterprise simulation modeling concepts, approaches, and application domains*
Software	**Tools and Documentation:** DEVSJAVA simulation and SESM modeling tools will be used. Eclipse (http://www.eclipse.org/) or JBuilder (http://www.borland.com/jbuilder/index.html) IDEs will be used for simulation model development. For further details refer to the course webpage on http://my.asu.edu.

Guest Lectures:

Dr. John Fowler, Professor of Industrial Engineering, Fulton School of Engr., ASU
Dr. Karl G. Kempf, Director of Decision Technologies, Intel Co., Adjunct Professor at ASU

Prerequisites:
Graduate standing. Programming maturity is assumed. Prior object-orientation modeling experience is helpful, although not assumed.

Course Objectives: Present concepts of computer-based modeling and simulation applicable to various domains of engineering and science. Provide theoretical concepts, methods, and hands-on experience with object-oriented modeling and simulation. Students are expected to gain a sound foundation and

associated experience for computer-based tool set for constructing, simulating and analyzing models of complex systems using modeling & simulation tools.

Course Description:
The course covers modeling and simulation concepts and discrete-event in particular. Application of theories, methods, and practices are covered during the semester. The course materials are divided into two parts. The first part provides background review and discussion on systems modeling concepts and overview of object-oriented programming languages. This first part contains comprehensive discussions on how to formulate and execute (simulate) models in a software engineering-like lifecycle. During this part, students are engaged in details study of modeling elements, simulation protocols, and their relationships including verification and validation. In-class description of modeling and simulation techniques will be illustrated by examples developed in the SESM/CM (Scaleable Entity Structure Modeler with Complexity Measures) modeling and DEVSJAVA simulation environments. During the semester students will gain hands-on experience (via homework assignments and projects). Students will create increasingly more complex models, which can be subsequently simulated and analyzed. The second part focuses on selected advanced topics aiding individual and team members' projects. An important part of the course experience is through the class project. Each project involves demonstrating the application of course concepts, theory, and techniques (see Project section below) to student's application of interest. Students may also choose to focus on M&S methodologies and theories.

Online Students:
Lectures will be made available via video streaming. Information is available on the Course webpage.

Homework Assignments/Exams:
There will be 4-6 homework assignments. Homework assignments include conceptualizations, model formulations, simulations, etc. Late homework will be accepted only in exceptional circumstances which need to be discussed with the instructor for approval and as long as the solution is not discussed or made available. Use standard size paper and include your name and homework assignment number at the top or on the cover page. Midterm and final exams will be based on the course materials – i.e., lectures, homework assignments, and readings. Final exam is comprehensive with emphasis on materials covered after the midterm exam. See table below for dates and locations.

	% final grade	Date/Time	Location (on-campus)	Location (off-campus)
Homework	30%	NA	BYAC-210	Remote Site
Mid. Exam	30%	04/04/07[§] 4:40 – 5:55 pm	BYAC-210	Remote Site

§ Tentative

Project:
Early in the semester, students will consult with the instructor to determine a project topic that benefits from their overall academic objectives or current professional activities (see table below for due dates). Possible modeling and simulation domains are numerous including *artificial and ecological agents, computer and social networks, embedded devices and networks, enterprise engineering, software design, and system biology* (see Blackboard and ACIMS website for a sample of previous project topics). Projects can be carried out either individually or as two-member teams. Projects can focus on student's interest including thesis or dissertation research topic.

	% final grade	Preliminary Project Description (due date, % final grade)	Final Project Report (due date, % final grade)	Presentation (due date, % final grade, time)
Project	**40%**	03/28/07, **30%**	04/27/07, **60%**	05/08/07, **10%** 4:40 – 6:30

Final project report format and grading:

- Introduction and problem description: **20%**

- Analysis and simulation model formulation: **30%**
- Simulation models, approach, and results: **40%**
- Conclusions: **10%**

Grading Policy and Grade Distribution:
Course grade is based on 10-point scale (it may be relaxed at the discretion of the instructor). Students are **responsible** for all material covered and discussed during lectures as well as announcements made either during class, email, and/or Blackboard. Examinations may not be taken separately except in special situations with prior arrangement **at least one week in advance**. Participation is an essential part of the course and highly encouraged. Grade distributed is

% total score	≥97	≥93	≥90	≥86	≥83	≥80	≥75	≥70	≥60	<60
Letter grade	A+	A	A-	B+	B	B-	C+	C	D	E
Points for GPA	4.33	4.00	3.67	3.33	3.00	2.67	2.33	2.00	1.00	0.00

	Homework	**Midterm Exam**	**Project**
Grade Distribution	30%	30%	40%

Withdrawals: In-Person withdrawal deadline is **March 30th**; Interactive ASU withdrawal deadline is **April 1st**; complete withdrawal deadline is **May 1st**. Ceasing attendance does not automatically drop you from the course. IF YOU ARE STILL ON THE CLASS ROLL AT THE END OF THE SEMESTER, YOU WILL RECEIVE 0's FOR ANY WORK NOT COMPLETED AND WILL BE GRADED ACCORDINGLY..

Academic Integrity and Ethics:
ASU's Code of Academic Integrity (http://www.asu.edu/studentlife/judicial/integrity.html and http://www.asu.edu/studentlife/judicial) states that students shall not "represent the work of others as their own." The Computer Science and Engineering department requires all students to adhere to ASU's policy on Academic Honesty. This policy will be applied to all work submitted for grade, including term paper, exams, and homework assignments. The minimum penalty for submitting work that is not your own is an **E** grade. Note: You are encouraged to discuss class assignments with your instructor and your fellow students. However, any work submitted as part of course work must be your own work. I.e., final work submitted by student must represent his/her own individual efforts unless stated otherwise by the instructor. University policy states that any act of cheating will result in receiving an **XE** for the course indicating failure due to disciplinary action.

Topics Covered*:

1. Introduction to modeling and simulation
2. Modeling theories, worldviews, and application domains
3. Conceptual model development and simulation approaches
4. System-theoretic and object-oriented modeling principles and methods
5. Modeling approaches and simulation techniques
6. Hierarchical, modular, component-based modeling
7. Multi-aspect, multi-resolution component-based system modeling
8. DEVSJAVA simulation and SESM modeling environments
9. Design of simulation experiments
10. Discrete event simulation protocol concepts and techniques
11. Simulation design complexity
12. Agent-based simulation modeling
13. Model composability and simulation interoperability
14. Model validation and simulation verification

* subject to change.