SYST 611 - System Methodology and Modeling

Theme: Foundations and applications of Dynamic Modeling

The approaches presented in this course are primarily concerned with capturing a system's behavior and changes over time. Due to the inherent interdisciplinary nature of the field of dynamic modeling, an effort is made to present a variety of modeling methodologies from different disciplines, e.g., engineering, computer science, economics, etc., together with their applications to non-trivial, real-world systems. Different model types (or languages) are characterized by way of representations, i.e., graphical or text-based grammars.

The course starts with a general introduction to dynamic models. The state machines are presented as the simplest and general method for modeling dynamic systems. The issues of composition, abstraction, and execution of models, are illustrated with the help of state machines. The same issues are revisited with each of the modeling formalism covered in the course.

Continuous and discrete time systems are presented as special classes of state machines. Different representational formalisms (e.g., operator equations, difference/differential equations, block diagrams) are presented by highlighting their representational and computational (dis)advantages over others. System Dynamics is presented as a computer-aided approach to modeling complex domains (e.g., social and economic.)

Discrete event systems (DES) are introduced as another class of dynamic systems. A review of concepts from Discrete Mathematics, that are relevant for DES modeling, is done to prepare students for more in-depth study of DESs. This review includes a short introduction to topics in Sets, Discrete Probability, Graph Theory, Logic, and Languages and then illustrates how these are used within dynamic systems modeling.

A number of DES modeling and simulation formalisms and techniques are introduced as extensions to Finite State Machines (FSM). These formalisms are presented as means to capture both a system's specifications and its behavior. This presentation is accompanied by several modeling examples of DES.

The course concludes with an introduction to the topics of modeling stochastic behavior and decision analysis.

Instructor: Prof. Abbas K. Zaidi
SEOR, Nguyen Eng. Room 2237
Ph: 703 993 1774
szaidi2@gmu.edu

Class Information:

When: Monday 7:20 – 10:00 PM, Fall 2014

Where: Room TBA, Mason Inn Hotel

Office Hours:

Mondays	5:30 – 6:30 PM
Wednesdays	5:30 – 7:00 PM and by appointment via phone/email (preferred)

Hardware/Software Requirements

A part of this course requires students to implement dynamic models using some software. These software will be introduced in-class and information to download them will be provided via Blackboard. Students are required to have the software ready for use on their individual computers for the homework assignments.

Overview of Course Structure

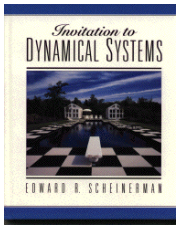
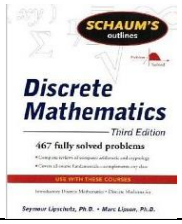
S.No.	Topics	No. of Lectures Required	Relevance to SE Concentration Tracks
1.	Definitions and Taxonomy of System Types and Models Synthesis, Analysis, and Theory of Models • State Machines	1	All tracks
2.	Linear Time Invariant (LTI) Systems • Continuous Time and Discrete Time Systems Nonlinear Systems • Stability • Linearization	4	C4I,FSE, ATS, and ABSI
3.	System Dynamics • Modeling Examples of Real World Systems	2	ABSI, ATS, C4I and FSE
4.	Overview of Concepts from Discrete Mathematics for the Study of Discrete Event Systems (DES)	1	ABSI, C4I, SIS, SEA
5.	Discrete Event Systems (DES) Modeling and Simulation • Finite State Machines • DEVS • Process Algebra • Petri Nets	3	ABSI, ATS, C4I and SMG
6.	Stochastic Systems • Decision Analysis • Markov Chains	2	C4I, SEA, SMG, and FSE

Tentative Course Schedule (subject to change as course progresses)

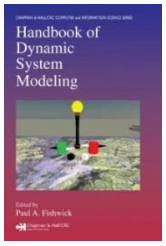
Date	Lecture Topic(s)
25-Aug	Introduction to Systems, System Taxonomy, Review of Mathematical Concepts
1-Sep	*Labor Day. No Class*
8-Sep	Modeling Concepts; State Machines
15-Sep	Discrete-Time Systems I
22-Sep	Discrete -Time Systems II; Markov Chains
29-Sep	Continuous -Time Systems
6-Oct	System Dynamics I
13-Oct	*Columbus Day. Class Meets on Oct 14.*
14-Oct	System Dynamics II
20-Oct	**Midterm**
27-Oct	**Student Presentations**
3-Nov	Finite-State Automata
10-Nov	Finite-State Automata Composition
17-Nov	Discrete Event Systems with Petri Nets
24-Nov	Discrete Event Systems, DEVS
1-Dec	Decision Analysis
8-Dec	Review of Material
15-Dec	**Final Exam**

Reading and Reference Material:

a) Required

Book Id.	Title	Comment
1	Invitation to Dynamical Systems By Edward R. Scheinerman 	Required text for continuous and discrete time dynamical systems (the first half of the course.) ***Available Online*** *(by the author)*
2	Schaum's Series on Discrete Mathematics 	Strongly recommended for review of Discrete Mathematics' concepts

a) Recommended

3	Handbook of Dynamic System Modeling By Paul A. Fishwick (Editor) Chapman & Hall/CRC Computer & Information Science Series Publication Date: June 1, 2007 | ISBN-10: 1584885653 | ISBN-13: 978-1584885658 | Edition: 1	Recommended as a reference handbook 

1) Handouts/Lecture notes prepared by the instructor.
2) Supplementary Material: A collection of relevant papers made available via Blackboard

Student Evaluation Criteria: Homework 50%; Midterm 25%; Final 25%

The following scale can be used by students for self-assessment. The instructor may decide to relax/change it a little for final grade assignment.

94-100	A
88-93	A-
83-87	B+
77-82	B
70-76	B-

Academic Integrity

GMU is an Honor Code university; please see the Office for Academic Integrity for a full description of the code and the honor committee process. The principle of academic integrity is taken very seriously and violations are treated gravely. What does academic integrity mean in this course? Essentially this: when you are responsible for a task, you will perform that task. When you rely on someone else's work in an aspect of the performance of that task, you will give full credit in the proper, accepted form. Another aspect of academic integrity is the free play of ideas. Vigorous discussion and debate are encouraged in this course, with the firm expectation that all aspects of the class will be conducted with civility and respect for differing ideas, perspectives, and traditions. When in doubt (of any kind) please ask for guidance and clarification.

Disabilities Statement

If you have a documented learning disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with Office of Disability Services (SUB I, Rm. 4205; 993-2474;http://ods.gmu.edu) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

Mason Diversity Statement

George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

The reflection of Mason's commitment to diversity and inclusion goes beyond policies and procedures to focus on behavior at the individual, group and organizational level. The implementation of this commitment to diversity and inclusion is found in all settings, including individual work units and groups, student organizations and groups, and classroom settings; it is also found with the delivery of services and activities, including, but not limited to, curriculum, teaching, events, advising, research, service, and community outreach.

Acknowledging that the attainment of diversity and inclusion are dynamic and continuous processes, and that the larger societal setting has an evolving socio-cultural understanding of diversity and inclusion, Mason seeks to continuously improve its environment. To this end, the University promotes continuous monitoring and self-assessment regarding diversity. The aim is to incorporate diversity and inclusion within the philosophies and actions of the individual, group and organization, and to make improvements as needed.

Student Support Resources on Campus

Resources that you may find helpful may be found at:

http://ctfe.gmu.edu/teaching/student-support-resources-on-campus/