ENGR 5104 APPLIED SYSTEMS ENGINEERING:
System Dynamics and Systems Thinking

Course Syllabus for Fall Semester 2015
Tuesdays 4:00 - 6:45 p.m.
Burruss 123A

INSTRUCTOR
DR. NAVID GHAFFARZADEGAN, ASSISTANT PROFESSOR
Grado Department of Industrial and Systems Engineering
Office: 231 Durham Hall; E-mail: navidg@vt.edu.
Office hours: Mondays 3:00-4:30pm, and other times by appointment. Office hours may need to change some weeks.

TEACHER ASSISTANT
Arash Baghaei Lakeh (arashb@vt.edu)
Office: 559 Whittemore
Office hours: Fridays 1:00-4:00pm by appointment.

COURSE WEBSITE: Scholar will be used as the online course environment for this course.

LINK TO WEBEX (only for students who registered for the webex version of the class):
https://virginiatech.webex.com/virginiatech/j.php?MTID=m8a6ce64751c54482b45d280e3f81e526

REQUIRED TEXTS

1. Sterman, John D. (2000), Business Dynamics: Systems Thinking and Modeling for a Complex World, Irwin McGraw-Hill, ISBN: 0-07-231135-5.

SUPPLEMENTARY TEXTS (NOT REQUIRED)

2. Senge, Peter M., Art Kleiner, Charlotte Roberts, Richard B. Ross, and Bryan J. Smith (1994), The Fifth Discipline Field book, A Currency Book, ISBN: 0-385-47256-0.

SOFTWARE (FREE)

3. VENSIM: See the Ventana Systems web site at http://www.vensim.com/

   In this course, the VENSIM Personal Learning Edition (VENSIM PLE), a FREE package offered by Ventana Systems will be used. VENSIM PLE is available for both Windows and Macintosh. Download VENSIM PLE from the VENSIM web site at http://www.vensim.com/freedownload.html

NOTE: This class is a distance learning class, and most lectures will be offered in the Blacksburg Campus. If for Any reason the webex communication or the video communication with the Northern Virginia Campus breaks, please go to the course website on the scholar, and watch the lecture through ECHO360 (by simply clicking on Echo360 from our course website).

COURSE LEARNING OBJECTIVES: The course is intended for people who wish to develop their system dynamics modeling skills to be applied to studying complex socio-technical systems. The course provides the conceptual and technical knowledge necessary to conceptualize dynamic policy problems, formulate appropriate simulation models, and use models to understand socio-technical systems and develop effective policy interventions. A principle focus of the course is the significance of information feedback and circular causality in the behavior of social systems.

METHOD OF GRADING:

Assignment	Type of Assignment	Weight in Overall Course Grade
1. Assignments (5)	Individual	50% (each 10%)
2. Research Project*	Team of 2-3	40%
3. Class participation**	Individual	10%
Total		**100%**

* The grade for *research project* is broken down to proposal (10%), first report (10%), presentation (10%), and final report (10%). The final project report is due on the official exam date: **December 15th, 2013, 12:00 PM**. Email it to navidg@vt.edu.

**The grade for class participation includes being present in the classes, and actively participating in the discussions. There will be 14 classes. One needs to be 'actively' present in at least 12 to get the complete grade for class participation.

INSTRUCTOR EXPECTATIONS: The following define what is expected of students in this course:

- To attend class prepared – be aware of all assignment due dates, including reading assignments, and read assigned materials *before* class.
- To participate in class discussions.
- To manage the learning process - seek clarification and feedback if needed.
- To complete assignments on time* and in a professional manner.
- To demonstrate courtesy and respect to peers and instructor by arriving on time, turning off or silencing cell phones, using laptops only for course work during class, and remaining attentive and focused during class.
- To demonstrate academic integrity and honesty at all times by adhering to the Virginia Tech Honor Code (see below).
- To adhere to the Virginia Tech Principles of Community at all times (see below).

* No late work for any assignments will be accepted without prior notification and request to the instructor.

HONOR CODE: All students must adhere to the Virginia Tech Honor Code for all assignments in this course, including out-of-class assignments that are part of the course grade. Any suspected violations of the Honor Code will be reported to the honor system. Honesty in your academic work will develop into professional integrity. The faculty and students of Virginia Tech will not tolerate any form of academic dishonesty.

PRINCIPLES OF COMMUNITY: Virginia Tech is a public land-grant university, committed to teaching and learning, research, and outreach to the Commonwealth of Virginia, the nation, and the world community. Learning from the experiences that shape Virginia Tech as an institution, we acknowledge those aspects of our legacy that reflected bias and exclusion. Therefore, we adopt and practice the following principles as fundamental to our on-going efforts to increase access and inclusion and to create a community that nurtures learning and growth for all of its members:

1. We affirm the inherent dignity and value of every person and strive to maintain a climate for work and learning based on mutual respect and understanding.
2. We affirm the right of each person to express thoughts and opinions freely. We encourage open expression within a climate of civility, sensitivity, and mutual respect.
3. We affirm the value of human diversity because it enriches our lives and the University. We acknowledge and respect our differences while affirming our common humanity.
4. We reject all forms of prejudice and discrimination, including those based on age, color, disability, gender, national origin, political affiliation, race, religion, sexual orientation, and veteran status. We take individual and collective responsibility for helping to eliminate bias and discrimination and for increasing our own understanding of these issues through education, training, and interaction with others.
5. We pledge our collective commitment to these principles in the spirit of the Virginia Tech motto of Ut Prosim (That I May Serve).

ACCOMMODATIONS: Students are encouraged to address any special needs or special accommodations with me during the first two weeks of the semester, or as soon as you become aware of your needs. Those seeking accommodations based on disabilities should obtain a Faculty Letter from the Services for Students with Disabilities office.

ACKNOWLEDGMENTS: Professor Hazhir Rahmandad (MIT) has significantly contributed to this course by providing his experiences and materials from the previous offerings of the course.

Course Outline:

Note for readings: **BD** = the required text book; Business Dynamics. (**Chng**: "challenges" in the book). **A#**: Assignment#. Other readings are journal articles or short news mostly available through the link provided.

	Topic	Reading	Written works due
W1: Aug 25	Course overview and logistics. Introduction to System Dynamics CASE: SARS		
W2: Sep 1	CASE: The Governor's Office of Regulatory Assistance	• BD, Ch.1 (Chg P14) • The GORA case [download from scholar].	A1
W3: Sep 8	Dynamic Thinking Problem Definition	• BD, Ch. 3 & 4	Pre-proposal project (1 page)
W4: Sep 15	Causal Loop Diagrams	• BD, Ch. 5 (Chg P145, Chg P147, Chg 176) - Skim sections 5.4, 5.6	Project Proposal
W5: Sep 22	Stock-Flow Diagrams CASE: Formulation Simple Urban Models	• BD, Ch. 6 (Chg P201, Chg P213, Chg P214) (Skim sections 6.2.7, 6.2.8, 6.2.9, 6.3.4, 6.3.6) • BD, Ch. 7 (Chg P239)	A2
W6: Sep 29	Model Formulation CASE: Urban Dynamics	• BD Ch. 8 (Chg P281-2, Chg P286), Appendix A (Chg P910)	
W7: Oct 6	Common Behaviors Oscillations, Overshoots	• BD Ch. 9.1 (Skim 9.1.2, 9.1.3); 9.2, 9.3 (Skim sections 9.3.5 - end) (Chg P310 part 1, Chg P335-337 part A)	A3
W8: Oct 13	Common Behaviors Growth (Market Growth, Diffusion Dynamics, Epidemics)	• BD Ch. 10 (Skim section 10.2)(Chg P403)	
W9: Oct 20	Model Formulation Delays, Co-flows, Aging Chains	• BD Ch 11 (Chg P425-426, Chg P435) • BD Ch 12 (Chg P495-7, Chg P503-4)	
W10: Oct 27	CASE: The Kaibab Model	• BD Ch 14.2-14.5 (Chg 566-67; Chg 575-76; Chg 583-84)	A4
W11: Nov 3	NO CLASS. Work on your project. Report 1 of the project is due on Nov 10.		
W12: Nov 10	Policy Analysis World Dynamics	• Ghaffarzadegan, Lyneis, & Richardson, (2011). How small system dynamics models can help the public policy process. SDR (http://onlinelibrary.wiley.com/doi/10.1002/sdr.442/abstract)	Project report 1
W13: Nov 17	Communication matters: Group Model Building Flight Simulators Model Validation	• BD, Ch21 (Chg P871), Ch 22 • BD, Ch.21 (Chg P871), Ch 22. • Richardson, G. P. and Andersen, D. F. (1995), Teamwork in group model building. SDR (http://onlinelibrary.wiley.com/doi/10.1002/sdr.4260110203/abstract)	A5
W14: Nov 24	NO CLASS. Thanksgiving!		

W15: Dec 1	Project Presentation		Email Slides
W16: Dec 8	What is different about system dynamics? Back to the Philosophy	• Forrester, J. W. (1971). Counterintuitive behavior of social systems. Theory and Decision, 2(2), 109-140. (http://web.mit.edu/sysdyn/road-maps/D-4468-1.pdf) • Two videos of Jay Forrester. ➢ http://mit150.mit.edu/infinite-history/jay-forrester-sm-%E2%80%9945-part-1 ➢ http://mit150.mit.edu/infinite-history/jay-forrester-sm-%E2%80%9945-part-2 • Richardson (2011) Reflections on the foundations of system dynamics. SDR (http://onlinelibrary.wiley.com/doi/10.1002/sdr.462/abstract)	Due: Dec 15, noon. Email • Final project report