Syllabus: SYST 659 Complex Systems Engineering Management

Course Instructors: Renee Stevens e-mail rsteveb9@gmu.edu telephone (to be provided)
Larrie D. Ferreiro lferreir@gmu.edu 703-805-5423

Course Objectives

- The key objective of this course is to broaden the student's understanding and appreciation of the range of factors that are relevant to the engineering, development and acquisition of large-scale, complex "megasystems"
  - Different circumstances warrant different systems engineering and project management approaches – not a "one size fits all"
  - At the conclusion of the course, students should be able to identify circumstances that warrant different approaches, be able to recognize which processes warrant tailoring, and be able to discuss how to do so.
- This course requires a basic understanding of current best practices in the disciplines of project/program management and business.
- The course will encourage and develop systems thinking and will help the students to continue to build strategic thinking skills. It is structured in three parts:
  - First third of the semester will cover the fundamentals of systems engineering. It will use textbook and independent readings to develop an understanding of the factors that determine the context for systems that we engineer and acquire. It will conclude with a take-home midterm examination.
  - Second third of the semester will expand upon the emerging concepts of system-of-systems (S-o-S) engineering and provide an understanding of how managing S-o-S differs in both scope and context from traditional systems. It will conclude with an individual presentation.
  - Final third of the course will focus on different approaches that may be appropriate for different circumstances related to complex megasystems, often composed of many interrelated systems-of-systems. These approaches will address requirements development, risk management, design patterns and tenets, stakeholder relations, and discovery engineering. This will conclude in a group presentation and an accompanying group paper on an assigned topic.
- A key aspect of this course is teamwork. It is the norm not only within a project team but between the team and its external stakeholders. The students should view this as an additional opportunity to build teamwork skills.
- Students will be expected to complete the assigned readings prior to the class so that they are better positioned to participate in classroom discussion.
- Many (not all) of the reading assignments will be accompanied by a list of questions. Students are expected to provide written answers to the questions and submit them to the professor as attachment to email (not embedded in email via Black Board before the class. Answers to each question should be short (2 to 3 paragraphs). Use MS Word or compatible

application. Note: Students are expected to write fluently, use correct grammar, spelling and punctuation. Good engineering and project management requires good communication skills!

- This course is expected to be very interactive and student participation is not only encouraged, but expected. Students should be prepared to provide relevant comments, drawing on the readings and responses to assigned questions, their personal knowledge, as well as their class research.

Grading allocation:

- 25% take home exam
- 25% individual presentation
- 25% group project
- 20% classroom participation
- 5% peer evaluation

Reading Material:

- Alexander Kossiakoff and William N. Sweet. ***Systems Engineering Principles and Practice*, 2nd Edition.** New York, John Wiley & Sons, Inc., 2011.
- Stevens, R. ***Systems Engineering in the Twenty-First Century: The Opportunity and Challenge of Mega-systems*.** Boca Raton, FL. Auerbach Publications, Taylor and Francis Group, 2011.

Course outline

Class	Class Objectives	Reading Material

Class 1	• Describe course objectives, organization and approach
	• Describe class projects and expectations
	• Class Introductions
	• Discussion: Setting the context – trends for information systems
	  o Challenges and opportunities
	  o Socio-technical systems (not just technology)
	  o POET (political, operational, economic, and technical) aspects of developing and acquiring information systems	

Class 2	• Introduction to the Systems Engineering process • Systems Engineering management tools	• Kossiakoff, Chs. 4 and 5

Class 3	• Translating user needs to systems requirements	• Kossiakoff, Chs. 6 and 7 • Johnson – Three Approaches to Big Technology
Class 4	• Risk reduction as a fundamental part of Systems Engineering • Conducting tradeoff studies at different levels of the Systems Engineering process	• Kossiakoff, Ch. 10 • Sato – Local Engineering and Systems Engineering
Class 5	• System integration • Systems testing	• Kossiakoff, Ch. 10 • Westwick – Reengineering Engineers *Receive Take-Home Midterm*
Class 6	• Megasystem concepts o System of systems o Megasystems framework (linearity, complexity, decision making) o Tame vs wicked problems o Profiler	• Stevens, Chs. 3 and 4 • Rittel, Horst and Melvin Webber, "Dilemmas in a General Theory of Planning", pp 155-169. Policy Sciences, Vol 4., Elsevier Scientific Publishing Co, Amsterdam, 1973.
Class 7	• Class exercise on profiling a system • An example of emergent behavior • System of systems engineering • Engineering challenge of megasystems	• Stevens, Ch. 5 *Hand in Take-Home Midterm*
Class 8	• Mega-systems case study: Developing the Electronic Product Code Network	• Stevens, Ch.8
Class 9 and 10	Mid semester presentations (~15 mins)	*Students provide briefing slides with annotations per directions*
Class 11	• Observations from case studies • Implications for project managers o Changing requirements o Cross-project/cross-system interoperability and integration o Managing diverse stakeholders o Discovery engineering • Discussion and expectations for group project and presentation	• Stevens, Chs. 9 and 10
Class 12	• Diagnosing complexity and uncertainty • Acquisition under uncertainty o Types and sources of uncertainty o Mapping development and acquisition strategies to types of uncertainty	Stevens papers to be provided

	○ Building in options ○ Impact of organizational culture and individual leader perspectives	
Class 13	• Establishing the project mind-set: systems thinking • Putting the infrastructure in place: how to manage different types of systems	Readings to be provided
Class 14	Dry run for final class project reports out (~30 min each*) See Note	*Teams deliver briefing slides with annotations*
Class 15	Final Report out for final class project (~30 min each*) See Note	*Teams deliver briefing slides with annotations* *Peer evaluations due for each team*

* Note: times will be adjusted based on the size of the class.

Administrative notes

Closings and cancellations: In the event of inclement weather or another major event, the university announces class cancellation, delay of classes and changes to administrative office hours through the university switchboard, 703-993-1000; the George Mason home page, www.gmu.edu; GMU-TV; and local radio and television stations. If there is any doubt as to the status of the class, contact the instructors.

Privacy: Students must use their MasonLIVE email account to receive important University information, including messages related to this class. See ***http://masonlive.gmu.edu*** for more information.

Academic Integrity (not just about cheating!): GMU has an ***Honor Code*** with clear guidelines regarding academic integrity: *Student members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.* These three fundamental and rather simple principles are to be followed at all times are:

(1) Do not plagiarize: all work submitted must be your own (in other words, never cut and paste whole phrases from a book or from the web);
(2) Give credit when you use someone else's words: when using the work or ideas of others, including fellow students, give full credit through accurate citations; and
(3) Ask if you don't know what to do: if you are uncertain about the ground rules on a particular assignment, ask the instructors for clarification.

Plagiarism is generally thought of as a moral issue – it is dishonest to use someone else's words as your own, without properly crediting the source. However: an equally important issue is that, when you copy someone else's words, you are not learning. You

are (or someone else is) contributing valuable time and resources for you to attend university and learn stuff so you can have a bright future. If you copy and don't learn, you are wasting your time and that person's significant contribution to your future. Don't do it.

Accommodating students with specific needs: If you have a documented learning disability or other condition that may affect you academic performance you should: 1) make sure this documentation is on file with ***Office for Disability Services*** (http://ods.gmu.edu) to determine the accommodations you need; and 2) speak with the instructors to discuss your accommodation needs.

Computers and other electronic devices in class: You are expected to pay attention to and be engaged with what is happening in class, both when your fellow students are making presentations or discussing readings, as well as during a lecture. You can't do that while surfing or texting or tweeting. Your may use your computers, phones and tablets during class ONLY when you are viewing course material (reading selection, etc.) or otherwise engaged in class activity. Otherwise, it becomes very obvious to both the instructors and to your classmates that you aren't engaged and it distracts everyone. More importantly, you are not learning! Don't do it.

Common courtesy and common sense prevails. Use your phones only during breaks, and please do so outside class. Leave your phones on beep or buzz if you need to be available for emergency calls, and take the calls outside of class.