***George Mason University***
***SYST / HIST 202 – Fall 2017***
***Engineering Systems in a Complex World***
***Thursdays, 4:30-7:10pm, West Building Room 1008***

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Office hours: By appointment

# *Course Syllabus*

*This syllabus is the agreement between you, the student, and me, the professor. Please read it carefully.*

***Course Goals and Objectives:*** This course is cross-listed as both a systems engineering course and a history course. The reason is that it accomplishes two goals simultaneously: first, students examine complex engineering systems in global society, by looking at them through the lens of history; and second, students study global history through the social and technical development of complex systems. In this course, students will use historical case studies and critical analyses to think strategically and globally about the management and execution of technical systems in the context of politics, organization, economics, technology and society (POETS), and learn how to employ such historical analyses as engineering decision-making tools. Students will be required to critically analyze articles and books, and will work in groups to investigate and present topics of current national and international relevance. At the conclusion of this course, the student will have demonstrated:

- A strategic understanding of the mutual impact, interaction and interconnectedness between engineering complex systems and society, accounting for political, organizational, economic, technological and societal issues at a global scale;
- The ability to critically analyze how different societies and cultures apply the tenets of systems engineering to their specific challenges and needs.

This course fulfills the following objectives:

- ABET criteria 3h, "the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context."
- The GMU Global Understanding portfolio, which requires students to "see the world from multiple perspectives, reflect upon their positions in a global society, and be prepared for future engagement as global citizens".

***Methodology:*** The course is conducted in a student-led, Harvard-style case study format. It consists of: lectures; extensive reading of books and articles on historical case studies; in-class discussions with both small and large groups; independent book reviews; group research projects and presentations. The student-led case-study method is particularly effective for analyzing and synthesizing complex subjects. These case study discussions will require each student to come prepared with their written responses to questions on assigned reading, and to participate by sharing their understanding and interpretation of the material. A typical class will consist of about 45 minutes lecture, 45 minutes of small-group discussion, and 45 minutes large-group discussion.

As with almost all university-level courses, you should expect to spend a considerable amount of time on your homework assignments. The general rule of thumb for university courses has traditionally been at least two hours of homework per week for every class hour. You should therefore not be surprised to spend six or more hours per week outside class on your SYST – HIST 202 assignments.

***Prerequisites:*** None

***Grading*** *(Note that there are no quizzes, midterm or final):*

| | | | |
|---|---|---|---|
| Homework: | 30% | Book Review and Presentation: | 20% |
| Class Participation: | 15% | (5% preview, 10% final report, 5% presentation) | |
| Lead Large-Group Class Discussion: | 10% | Capstone Team Project: | 25% |
| | | (5% proposal, 5% mid-review, 15% final presentation) | |

| Letter Grade | Grade Point | Remark |
|---|---|---|
| A | 4.00 | Excellent |
| A- | 3.67 | Excellent |
| B+ | 3.33 | Good |
| B | 3.00 | Good |
| B- | 2.67 | Good |
| C+ | 2.33 | Competent |
| C | 2.00 | Competent |
| C- | 1.67 | Unsatisfactory |
| D | 1.00 | Unsatisfactory |
| F | 0.00 | Failing |

***Class Attendance:*** You are expected to attend classes in order to effectively participate in the discussions and presentations. At the university level, it is a generally-recognized tenet that you will learn as much from your fellow students as you will from any individual professor. In this course, much of your learning will occur through the group discussions of readings, presentations by your fellow students, and through the interactions in your team project. This cannot happen if you are not in class. Therefore, both your attendance and how active you are in discussions will be taken into account for grading.

All students experience events that may prevent them from attending class – personal circumstances, religious holidays, etc. If you can't attend a class, or if you must arrive late or leave early, let me know as far ahead of time as possible. If you are assigned to lead a discussion or make a presentation and you have to miss class, you MUST tell me well ahead of time, in order that I can make adjustments. If you fail to do so, I may not be able to make adjustments and you may not receive credit.

***Materials*****:** There is no course textbook and you are not required to buy any books for class. I will provide readings for class assignments on GMU's Blackboard system. Students will use the GMU Library or other library resources for books to review, and for performing group research and presentations. You will need access to the GMU Blackboard system on a continual basis, and I will be communicating with you via GMU e-mail. Your devices (computer, laptop, tablet, etc.) need to be configured to the latest versions of these systems, so check with GMU's Computing and Technology resource page for those requirements.

## *Class Schedule and Assignments*

| Class | Topics | HW to be completed | Class Assignment |
|---|---|---|---|
| **1** | **Course Introduction; Introduction to Systems Engineering** | None | Introduction and course objectives<br>Lecture: What is systems engineering? |
| **2** | **Origins of Complex Systems Engineering:** The rise of modern systems engineering post-World War II and in the early Cold War | 1. Johnson , "Three Approaches to Big Technology"<br>2. Sato, "Local Engineering and Systems Engineering" | Readings: Presentations and discussion<br>Lecture: Origins of SE |
| **3** | **Military Systems and Society:** The shaping function of the military on systems engineering, and how it is applied to the larger society | 1. Hughes, "SAGE"<br><br>***Provide professor with book selection for individual book review*** | Readings: Presentations and discussion<br>Lecture: What do we mean by POETS? |
| **4** | **Transportation as a Complex System:** The societal shaping of transportation systems technologies in the global context | 1. Schrag, "Mapping Metro"<br>2. Ibsen, "Boeing vs. Airbus"<br><br>***Form teams to select project topic*** | Readings: Presentations and discussion<br>Lecture and discussion: Technology is neither good nor bad, nor is it neutral |
| **5** | **Computers and Communications:** The societal shaping of information technologies in the global context | 1. Light, "When Computers were Women"<br>2. Balbi, "Italian Broadcasting"<br><br>***Submit book review preview*** | Readings: Presentations and discussion<br>Lecture: SE vs PM<br>Book Reviews: Previews |
| **6** | **Energy as a Complex System:** Global considerations of energy systems, including supply production, transport, infrastructure and users. | 1. Nye, *Electrifying America*<br>2. Hecht, "Politics and Reactors in France"<br>***Provide professor with team project proposal*** | Readings: Presentations and discussion<br>Lecture: Organizing Complex Systems |
| **7** | **The Environment as a Complex System:** How differing global perspectives towards the environment are reflected in the analysis and response to climate and other environmental changes | 1. Edwards, "Climate Models"<br>2. Wesselink, "Dutch Response to Katrina" | Readings: Presentations and discussion<br><br>Team Project: Present Proposal |
| **8** | **The Organization as a Complex System:**<br>How system complexity extends to the organizations that create those systems, and how both academic and business management have evolved to organize them. | 1. Chandler, "Railroads and Management"<br><br>***Submit individual book review report***<br>***Submit individual book review presentation*** | Readings: Presentations and discussion<br><br>Book Reviews: Presentations |
| **9** | **Health Care as a Complex Systems**<br>How modern health care systems grew out of post-war policies | 1. Scofea, "Development of Employer-Provided Health Insurance"<br>2. Toland, "How did America end up with this health care system?<br>***Submit Mid-Project Review*** | Readings: Presentations and discussion<br><br>Team Project: Mid-Project Review<br><br>Book Reviews: Presentations |

| Class | Topics | HW to be completed | Class Assignment |
|---|---|---|---|
| **10** | **The Household as a Complex System:** How advancements in domestic technologies change the relationships between occupants (e.g., roles of men and women), and with the technologies themselves. | 1. Cowan, *More Work for Mother* Ch 3<br>2. Cowan, *More Work for Mother* Ch 4<br>3. Time magazine – Smart Home<br>4. Vox - Household Robots | Readings: Presentations and discussion<br><br>Book Reviews: Presentations |
| **11** | **Safety of Complex Systems:** How differing cultural viewpoints influence social responses to anticipating and controlling the safety of complex technical systems. | 1. Langewiesche, "ValuJet 592"<br>2. Hicks, "Normal Accidents in Military Operations" | Readings: Presentations and discussion<br><br>Book Reviews: Presentations |
| **12** | **Complexity and Decision-making under Uncertainty:** Ethical dilemmas of developing and managing complex systems when many outcomes (e.g., hazards, unintended consequences) are vague or unknown. | 1. Hansson, "Safe Design"<br>2. *Challenger* Case Study<br>3. *Columbia* Case Study | Readings: Presentations and discussion |
| **13** | **Capstone Team Presentations** | ***Submit team project presentation*** | **Team Project Presentations Engineering: Lone or social activity?** |
| **Exam week** | **Deliver final project presentations (if required)** | ***Deliver final corrected projects*** | -------- |

***Homework and Class Discussions:*** We use the Harvard Business School case study method to analyze the homework readings (articles and book chapters) using critical, open-ended questions. This involves three steps: (1) Homework -- individual analysis of the reading by answering the questions in writing; (2) In-Class Small-Group Discussion – 3-5 individuals who discuss the questions and compare notes, and (3) In-Class Large-Group Discussion, where the whole class is led by a student in discussing the questions. Where the class size is small enough, we will dispense with the small-group discussions and go straight to the large-group discussion.

Each reading selection will be accompanied by a list of reading questions in a separate Word document. *Most of the questions are framed as if you are an employee writing for your boss.* This is intentional – university is preparation for your career, and clear, concise writing is vital to your achievement. Therefore, answer the questions as if you were writing a memo at work. Provide SHORT BUT COMPLETE (2-3 paragraphs each) answers to each of these questions and submit them to before the class using Blackboard. You will be graded on: critical thinking in answering the questions; your use of SPECIFIC examples from the readings and from other sources (which I strongly encourage you to use) in order to support your arguments; and the clarity of your writing, which includes proper spelling, punctuation and grammar. Please bring in a hard copy of your answers to class to use as a reference during group discussions.

You will submit all your homework on Blackboard using any supported format (MS Word, PDF, etc.). Please label the file with YOUR last name and class number, in the following format: LASTNAME-CLASS X. And PLEASE use the spell-check and grammar check

before submitting the work – good engineering requires good writing skills (I encourage you to visit GMU's Writing Center ). I will review the document, add my comments and grade, and then post it back to you via Blackboard.

Students will be assigned, on a rotating basis, to lead the large-group class discussions; that is, one student will lead the discussion for each reading, 1-2 readings per class. (In other words, you may be leading class discussions several times during the course.) Each of those students leading the large-group discussion will submit and present in class a PowerPoint presentation (template is provided). If you are one of those students for that particular class, you will be graded on how well you develop your answers, the clarity of your presentation, and how well you engage with your fellow students in eliciting their ideas and points of view. Note that, even if you are presenting, you are STILL expected to turn in the written HW for that class.

You should turn in your homework on time (i.e., by the day of the class). If you cannot, please let me know the reason and we will work out a schedule. Otherwise, I will reduce your homework score by half a grade (for example, from an A to a B+) if it is one week late, a full grade (A to B) for more than a week, and I will mark "incomplete" (equivalent to a 0) for more than two weeks late. To repeat: If you are assigned to lead a discussion and you have to miss class, you MUST tell me well ahead of time, in order that I can make adjustments. If you fail to do so, I may not be able to make adjustments and you may not receive credit.

***Independent Book Review:*** Students will read a book from the class reading list (see suggested list in the Book Review- Preview Assignments Folder), then write a review of the book and present the main points to the class. You will make selection by Class 3, present a short (2-minute) preview in Class 5, and submit the review in Class 8. Book reviews will be presented during Classes 8 to 11.

In order to make certain that the entire class benefits from the wide selection of books (that is, to make sure that we don't get two or three people reading and presenting the same book), I ask the students to provide me a rank-order list of their preferred books, from 1$^{st}$ to 4$^{th}$ place. I will make every attempt to assign you your top choice. You may instead choose another, relevant book outside the list, subject to my approval.

You may choose to purchase the book, check the book out from the GMU Library or use GMU's Interlibrary Loan (ILL) system. If you are a resident of one of the local counties (e.g., Fairfax, Loudon, etc.), you may also use your local county library (including ILL).

Your 2-minute preview in Class 4 will follow the single-slide template provided.

You will complete a 3-5 page (single-spaced) review of the book, with the following: a) summary of book; b) theses and main points; c) specific lessons regarding engineering systems and complexity related to politics, organization and economics and society. You will also submit and present in class a 10-15 minute presentation (template is provided, as well as an example titled "Model Book Review Report").

**Capstone Team Project**: This integrates all of the course themes into a single, capstone project. Students will form into teams of 3-5 individuals. You should self-select into teams, otherwise I will assign you to a team. Your team will select (or be assigned) one of the topics under discussion in class, e.g., the environment as a complex system, or another relevant topic that I approve.

Each team will research a current systems engineering system, project or concept within that topic area, as related to culture, politics, organization and economics. You may choose the project or choose from one of the projects I suggest. Your team will use proper academic sources for your research (books, journal/newspaper articles, etc.).
Your teams will form and select topics by Class 4. In Class 6 your teams will submit to me a proposal describing the project and outlining the specific issues to be covered. This proposal will include details of the team structure and clearly outline who does what. In Class 7 your teams will present to the class a short (2-minute) brief outlining your proposal, using the template provided. In Class 9 your teams will present to the class a short (5-minute) mid-project review of the project, using the template provided.

Your teams will prepare and present to the class a 20-minute brief (using PowerPoint, video or other media), following the provided guidelines. You will then have a 10-minute question / answer session. Your teams will submit the presentations to me and make the class presentations during Class 13 (and 14 if needed). If required, teams will deliver final versions of the presentation, with edits, during Exam Week.

**Class Schedule – Fall 2017**

| Date | Class Number | Topics |
|---|---|---|
| **August 31** | 1 | Course Introduction; Introduction to Systems Engineering |
| **Sept 7** | 2 | Origins of Complex Systems Engineering |
| **Sept 14** | **No Class** | |
| **Sept 21** | 3 | Military Systems and Society |
| **Sept 28** | 4 | Transportation as a Complex System |
| **Week of Oct 2-6 (DL)** | 5 | Computers and Communications |
| **Oct 12** | 6 | Energy as a Complex System |
| **Oct 19** | 7 | The Environment as a Complex System |
| **Oct 26** | 8 | The Organization as a Complex System |
| **Nov 2** | 9 | Health Care as a Complex System |
| **Nov 9** | 10 | The Household as a Complex System |
| **Nov 16** | 11 | Safety of Complex Systems |

| Date | Class Number | Topics |
|---|---|---|
| **Nov 23** | **No Class -- Thanksgiving** | |
| **Nov 30** | 12 | Complexity and Decision-making under Uncertainty |
| **Dec 7** | 13 | Capstone Team Presentations |
| **Dec 14** | Exam week | Deliver final project reports (if required) |

***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 University home page; GMU-TV; and local radio and television stations. If there is any doubt as to the status of the class, contact me. If I need to cancel a particular class, I will contact the students at the earliest possible opportunity.

*Emergency Preparedness*: In the event of an emergency, we will follow GMU procedures. You may want to register with Mason Alert.

*Privacy*: Students must use their MasonLIVE email account to receive important University information, including messages related to this class.

*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*".

Three fundamental and rather simple principles to follow 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 me 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) investing 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*** to determine the accommodations you need; and 2) speak with me to discuss your 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 when I am giving a lecture. You can't do that while surfing or texting or tweeting. It becomes very obvious to both me and to your classmates that you aren't engaged and it distracts everyone. More importantly, you are not learning! **Close your laptops and put your tablets and smartphones away**. 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.

***NOTE: This information is subject to change with advance notification to the class***.