SIE 454A/554A: The Systems Engineering Process
Fall 2017
M&W 3-4:15
AME S212

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Prerequisite: Advanced standing in the College of Engineering; or
SIE 250 Introduction to Systems and Industrial Engineering

Course Description
Processes and tools for engineering large-scale, complex systems: architecture, requirements, risk management, evaluation criteria, concept exploration, decision making, tradeoff studies, life-cycle models, decomposition, system coupling, test, verification, validation, system modeling, business process re-engineering, sensitivity analysis, teamwork, process maturity and documentation.

Course Objectives
This course is aimed at developing your capability of systems thinking by introducing classical and advanced systems engineering theory, methods, and tools. After taking this course, you should be able to:

- Apply systems engineering methodologies & tools to the design of large, complex systems from eliciting customer requirements through disposal
- Apply systems engineering methodologies & tools to a real project for a real customer
- Judge the applicability of any proposed process, strategy, or methodology for systems engineering using the fundamental concepts from disciplines such as probability, economics, and cognitive science

- Understand system engineers' role and responsibilities and their role within organizations
- Understand the dynamics of teams and their role in successful projects
- Recognize the value and limitations of modeling and simulation
- Apply problem solving skills to a variety of puzzles that are representative of real-world challenges
- Communicate effectively with team members and customers through both oral and written means

Required Course Texts

1. Readings based on "Blanchard, B. S. and Fabrycky, W. J., *Systems Engineering and Analysis* (5th Edition), Prentice Hall, 2010." Note: do not purchase the complete book, a custom course reader has been created with selected chapters from the book. It can be purchased at the UA Bookstore or via http://uabookstores.arizona.edu/.
2. DeMarco, T. and Lister, T., *Peopleware: Productive Projects and Teams* (3rd Edition), Addison-Wesley Professional, 2013.

Supplemental Resources

Air Force Institute of Technology Systems Engineering Case Studies,
http://www.afit.edu/cs/cases.cfm
INCOSE Systems Engineering Handbook

Homework assignments

There are ten homework assignments, you are responsible for completing all of them. The ten homework assignments are worth 20% of your grade. Assignments must be 2-3 pages in length (single spaced) and must be submitted electronically via the D2L website before each class meeting. Penalties will be applied for late submissions.

Midterm Exam

An exam will be administered approximately two-thirds of the way through the semester to assess progress on learning objectives. Rather than testing memorization, the focus will be on the application of concepts from the first half of the class. Questions for the midterm will be a combination of multiple choice and essay questions generated from student inputs and instructor-generated questions.

Final Project

The best way to learn systems engineering is to apply it to a real situation. You will be expected to find an existing effort where you can apply one or more concepts learned in the class. Deliverables include a project proposal, status report, and final project report. Specific content will be negotiated on a case by case basis. Arrangements may be made for team projects but the content will be commensurate with expected person-effort.

Basis of grade

Component	Weight	Notes
Homework	20%	10 assignments @ 2% each
Midterm	40%	Around the end of October
Final project	40%*	Towards the end of the semester

*Final project grade is comprised of Deliverable #1 (2.5%) + Deliverable #2 (2.5%) + Final written report (35%).

Accessibility and Accommodations
Our goal in this classroom is that learning experiences be as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, please let me know immediately so that we can discuss options. You are also welcome to contact Disability Resources (520-621-3268) to establish reasonable accommodations. For additional information on Disability Resources and reasonable accommodations, please visit http://drc.arizona.edu/.

If you have reasonable accommodations, please plan to meet with me by appointment or during office hours to discuss accommodations and how my course requirements and activities may impact your ability to fully participate.

Please be aware that the accessible table and chairs in this room should remain available for students who find that standard classroom seating is not usable.

Inclusive Excellence is a fundamental part of the University of Arizona's strategic plan and culture. As part of this initiative, the institution embraces and practices diversity and inclusiveness. These values are expected, respected and welcomed in this course.

Threatening Behavior Policy
The UA Threatening Behavior by Students Policy prohibits threats of physical harm to any member of the University community, including to one's self. See: http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students.

Code of Academic Integrity
Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See: http://deanofstudents.arizona.edu/academic-integrity/students/academic-integrity

The University Libraries have some excellent tips for avoiding plagiarism available at: http://www.library.arizona.edu/help/tutorials/plagiarism/index.html

Selling class notes and/or other course materials to other students or to a third party for resale is not permitted without the instructor's express written consent. Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA email to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student email addresses. This conduct may also constitute copyright infringement.

UA Nondiscrimination and Anti-harassment Policy
The University is committed to creating and maintaining an environment free of discrimination, http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Our classroom is a place where everyone is encouraged to express well-formed opinions and their reasons for those opinions. We also want to create a tolerant and open environment where such opinions can be expressed without resorting to bullying or discrimination of others.

Subject to Change Statement
Information contained in the course syllabus, other than the grade and absence policy, may be subject to change with advance notice, as deemed appropriate by the instructor.

SIE 454/554 Course Schedule Fall 2017

Class	Day	Date	Topics	Homework Due	Readings
1	Monday	Aug 21	***COURSE OVERVIEW*** (Lecture 0) Course Overview Pixar Story What is Systems Engineering?		Syllabus review Last year's midterm exam
2	Wednesday	Aug 23	***SYSTEMS THEORIES*** *(Lecture 1)* What is a System? Different Views/Descriptions Systems Process Standards SE Societies	**HW #1**: 1 slide powerpoint introduction	Blanchard & Fabricky Module 1 Systems Science & Engineering
3	Monday	Aug 28	***SYSTEMS THINKING*** *(Lecture 2)* System Design Characteristics		
4	Wednesday	Aug 30	***Science of Baseball*** ***Guest Lecture:*** *Prof. Terry Bahill*	**HW #2**: Questions Module 1 (CH 1): 1, 2, 5, 6, 7, 8, 14, 17, 26, 30, 32 Module 2 (CH 2): 3,10, 13, 17, 20, 25* (* you may choose from one of the following three journals- *Systems Engineering, IEEE Systems, or Information Knowledge & Systems Management*	Blanchard & Fabricky Module 2 Bringing Systems Into Being
N/A	Monday	Sept 4	Labor Day		
5	Wednesday	Sept 6	***SYSTEM DESIGN*** *(Lecture 3)* Problem Identification/Definition Systems Processes System Development Execution Defining/Documenting the System		
6	Monday	Sept 11	***CONCEPTUAL DESIGN*** *(Lecture 4)* State the Problem Define the ConOps Requirements Development	**HW #3**: Mod. 3 (CH 3) Questions 4, 5, 15, 18, 23	Blanchard & Fabricky Module 3 Conceptual Systems Design
7	Wednesday	Sept 13	***FUNCTIONAL DESIGN*** *(Lecture 5)* System Functions Writing Requirements Types of Requirements	**HW #4**: Mod. 4 (CH 4) Questions 1, 9, 19	Blanchard & Fabricky Module 4 Preliminary System Design
8	Monday	Sept 18	**CONCEPT SELECTION/TRADE SPACE** TRLs (Lecture 6) Trade Study Pugh Method	**Deliverable 1:** Project Proposal	
9	Wednesday	Sept 20	***DETAIL DESIGN*** *(Lecture 7)* *Functional Block Diagram* *Design Constraints* *SE in Modular Upgrades*	**HW #5:** Mod. 5 CH 5) Questions 1, 7, 8, 15, 21	Blanchard & Fabricky Module 5 Detail Design & Development
10	Monday	Sept 25	**SYSTEM DESIGN EXAMPLE** Drinking Fountain		
11	Wednesday	Sept 27	**REQUIREMENT FLOWDOWN** (Lecture 8) Subsystem requirements development		
12	Monday	Oct 2	**LESSONS & CASE STUDY** (Lecture 9) Why Systems Fail Case Study Discussion **Guest Lecture:** Stan Weintraub		
13	Wednesday	Oct 4	**RISK** (Lecture 10) Risk assessment/quantification/mitigation		
14	Monday	Oct 9	**VERIF. & VALID.** (Lecture 11) Use cases Test strategies Test planning & execution	**HW #6:** Mod. 6 (CH 6) Questions 2, 9, 14, 20	Blanchard & Fabricky Module 6 System Test, Evaluation and Validation
15	Wednesday	Oct 11	**Systems Integration & Interfaces**		

16	Monday	Oct 16	**DECISION MAKING** (Lecture 12) Utility Functions Risk Aversion Perspective	**HW #7**: Mod. 7 (CH 7) Questions 4, 11, 16, 17	Blanchard & Fabrycky Module 7 Alternatives and Models in Decision Making
17	Wednesday	Oct 18	**SYSTEM ATTRIBUTES (Ilities)** Reliability & Maintainability Human systems integration		
18	Monday	Oct 23	**LIFE-CYCLE COSTING** Design to cost Activity based costing Parametric cost estimation	**HW #8**: Mod. 8 (CH 8) Questions 2, 8, 13 Mod. 9 Questions 1, 2, 3	Blanchard & Fabrycky Module 8 Models for Economic Evaluation Module 9 Design for Affordability (Life-Cycle Costing)
19	Wednesday	Oct 25	**REUSABILITY & COTS** Reuse principles Reuse frameworks Commercial off the shelf evaluation	**HW #9**: Proposed Midterm Questions (due Fri 10/27)	Wang, G., Valerdi, R. and Fortune, J. "Reuse in Systems Engineering." **IEEE** Systems Journal, 4(3): 376-384, 2010
20	Monday	Oct 30	**ENGINEERING TEAMS I** Productivity Parkinson's Law		Demarco & Lister Ch. 1-9
21	Wednesday	Nov 1	**ENGINEERING TEAMS II** Extactor Workspaces Turnover	**Midterm** (avail. 10/30- due 11/3)	Demarco & Lister Ch. 10-17
22	Monday	Nov 6	**ENGINEERING TEAMS III** High-performing teams Groupthink, madness of crowds **Guest Lecture:** Lt Gen (ret) Barry Knutson		Demarco & Lister Ch. 18-26
23	Wednesday	Nov 8	**ARCHITECTURES AND ARCHITECTING** The architecting paradigm Views & Methods **Guest Lecture:** Sharon O'Neal, *Architecting System Security*		Rechtin, E., Systems Architecting: Creating & Building Complex Systems, Prentice-Hall, 1991.
24	Monday	Nov 13	**ENGINEERING TEAMS IV** (De) Motivational posters Delays in process improvement		Demarco & Lister Ch. 27-34
25	Wednesday	Nov 15	**PROCESS IMPROVEMENT** Lean, six sigma, theory of constraints Capability maturity models	**Deliverable #2**: To be defined based on negotiated scope of final project	
26	Monday	Nov 20	**PLANNING AND ORGANIZATION** Systems engineering management plan Statement of Work	**HW #10**: Mod. 10 (CH 17)	Blanchard & Fabrycky Module 10 Systems Engineering Planning and Organization
27	Wednesday	Nov 22	**PROGRAM MANAGEMENT** The iron triangle Earned value PERT charts Fire Fighting **Guest Lecture:** Don Newman		Blanchard & Fabrycky Module 11 (CH 18 & 19) Program Management, Control, and Evaluation Repenning, N., P. Goncalves, and L. Black (2001), Past the Tipping Point: The Persistence of Fire Fighting in Product Development, California Management Review, 43, 1: 44-63.
28	Monday	Nov 27	**SOFT SKILLS** (lecture 13??) Communicating Effectively Ethics		
		Nov 29, Dec 4 & 6			
	Finals week	Dec 8-14		**Final project report**	