SAE 541: Systems Engineering Theory & Practice

Class Session: Wednesdays, 3:30 pm – 6:40 pm, Location ~~Ronald Tutor Hall (RTH) Room 105~~ Online

Class Section: 32341D (DEN/Off-campus) and 32311R (On Campus)

Contact Information:

Instructor: Kenneth Cureton	Teaching Assistant: Edwin Ordoukhanian
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Course Description
Systems engineering is an essential part of achieving success for system products, services, and processes in important domains such as Aerospace & Defense, Transportation, Medical, and Energy Management. As such systems become increasingly complicated and complex, fundamental concepts and rigor become increasingly important throughout the system life cycle: from concept evaluation through retirement. This class provides both theoretical and practical knowledge needed for conceptualizing, designing, supporting, and evaluating today's and tomorrow's systems.

Course Learning Objectives:

- Introduce students to Systems Engineering support of design processes, architecture concepts, operations concepts, systems integration, and life-cycle support concepts
- Explore means for performing trade studies and evaluating risk
- Introduce system Verification, Validation, Quality, Test, Specialty Engineering, Security, and Mission Assurance concepts
- Familiarize students with various standard Systems Engineering Handbooks and Guides and related International Standards Organization (ISO) documents
- Discuss representative systems that highlight course concepts

Prerequisite(s): None

Readings:

- Representative (INCOSE, DoD, NASA, and FAA) Systems Engineering Handbooks, Guides, and ISO Standards posted on the DEN/D2L system as downloadable PDF files.
- No textbooks are required for purchase in this class.

Class Assignments:

- All deliverables for the course must be submitted via the DEN/D2L system.

Homework Assignments:

For ten homework assignments, you'll analyze a hypothetical new system, described in the first lecture. You are to analyze that proposed new system using the tools, techniques and concepts presented in each lecture and the assigned readings for that lecture. The homework analyses are assigned at the end of most lectures, and homework will be due before class the following lecture. The homework assignments are required but *not* graded. They are reviewed, and you will receive comments regarding your answers.

Midterm Exam

The Midterm Exam will cover lecture topics presented in Lectures 1 through 6. The exam will be an individual effort, take-home exam with open book and notes. The exam will be downloadable from the DEN starting on Wednesday June 23rd, 2021 at 6:40 PM Pacific Time. Responses must be submitted to the DEN before 3:30 PM Pacific Time on Wednesday June 30^{th,} 2021.

FORMAT: Microsoft WORD (.DOC or .DOCX) or equivalent (no PDF files, please).

GRADING: The Midterm will be graded on a scale of zero-to-50. I'll grade and comment on Midterm Exams as soon as possible after the due date. All late or missing submissions will receive a score of zero. Collaboration on the Midterm is forbidden. Violators will receive an automatic score of zero.

Final Paper:

You will combine and integrate your homework assignments to form a final paper, due at the end of the semester, in place of a final examination.

GOAL: Demonstrate that you understand and can properly apply the concepts presented in the class through the accomplishment of structured Systems Engineering analyses of the assigned hypothetical new system and produce a document that is suitable for presentation as a Research Paper at a professional conference.

FORMAT: Microsoft WORD (.DOC or .DOCX) or equivalent, or Adobe Acrobat (.PDF) format. More specific guidance regarding format, structure, and content will be provided.

LENGTH: Experience to date shows that the average is somewhere around 12 pages, single-spaced, in 10 or 12-point type. Papers are NOT graded by their weight! Take as long as it takes to present a well-organized analysis in terms of the course concepts. N.B. very few papers of size less than 10 pages have been worthy of a good grade in this class.

SOURCES: You must properly reference <u>all</u> sources. We use the turnitin.com service to look for matches with existing books, magazine and newspaper articles, journals, prior student papers, and all Internet sources. Published works (such as books, scholarly articles, and journal publications) are strongly preferred. If you obtain information via interviews, then a list of sources and contacts is essential, listing what sources you used and anyone you interviewed. Be sure to provide the URLs of any Internet sources used in your research. If you directly quote text from a source (including class lectures and reference materials),then you <u>must</u> properly designate quoted material "in quotation marks" or in italics and give a citation for each quotation via a footnote or a numbered reference or in-text (author-date) notation. The amount of quoted text relative to the total text in your paper should be kept to a minimum—if excessive; this will detract from your paper's grade.

WARNING: Failure to properly designate copy-and-pasted text will be considered as a violation of academic integrity (see University Policy Statements at the end of this syllabus). This includes quotations from <u>your</u> prior papers (e.g. from SAE 549 or other classes!) You can build on your own work from other classes, and from other author's works, as long as you properly cite those references. You must not directly copy text from those sources—even your own—unless properly marked and cited as a quotation. Instead, you must *add value* by citing then restating such work in your own words plus your own enhancements, such that the combination has enhanced relevance to this class. You can directly copy graphics, tables, or figures if you give a citation for each copied item. Although there is no limitation on the relative number of copied items, your own artwork—however crude yet clearly legible and illustrative—is always acceptable.

LIMITS: I cannot accept a request to limit access to your final paper. Although I do not plan to disseminate your work without your permission, I cannot guarantee that other people (including non-US citizens) will not view or handle your submitted materials. Thus, you must not use classified, proprietary or company limited-distribution materials in your coursework. If your employer requires review and approval for your submitted materials (e.g. Public Affairs Office or Export Compliance Review) then you must obtain such approval within the deadlines listed in this syllabus. As the approval practices in many companies may be time consuming, the best practice is not to use company material at all.

DELIVERY: Please submit on-line via DEN Assignments no later than the scheduled final exam date (TUESDAY August 10th, 2021, Midnight Pacific Time).

GRADING: The final paper will be graded on a scale of zero-to-50. All late or missing submissions will receive a score of zero. Collaboration on the final paper is also forbidden. Violators will receive an automatic score of zero.

N.B. very few papers are worthy of an "A" grade in this class unless they are of suitable quality for presentation at a Systems Engineering conference or inclusion in a Systems Engineering journal or other publication. Also, if English grammar, spelling and syntax are not your strong points, then I strongly suggest that you obtain help in editing your text. Your grade depends on the clarity of presentation.

Grades:

Your class grade is based on the take-home midterm exam (50% of your class grade), and the final paper due at the end of the semester in place of a final exam (50% of your class grade).

Your class grade is computed as follows:

The Take-Home Midterm score (a maximum of 50 points) is summed with the Final Paper score (a maximum of 50 points). The grand total of points is divided by 25 (to scale your total to a range of four-to-zero):

CLASS SCORE = (MIDTERM EXAM SCORE + FINAL PAPER SCORE) / 25

This class score is converted into a letter grade for the class:

A   4.0 to above 3.7
A-   3.7 to above 3.3
B+   3.3 to above 3.0
B   3.0 to above 2.7
B-   2.7 to above 2.3
C+   2.3 to above 2.0
C   2.0 to above 1.7
C-   1.7 to above 1.5
D+   1.5 to above 1.0
D   1.0 to above 0.7
D-   0.7 to above 0.5
F   0.5 or below.

This letter grade is reported to USC as your class grade.

I must turn in the class grades shortly after the end of the Semester (after Final Exams Week), so I'll inform you via e-mail regarding your final paper grade (as well as your overall grade) no later than two weeks after the paper is due.

Schedule of Class Sessions:

The exact schedule and topics are subject to change. Changes will be announced in class.

Date	Planned topics
5/19	**Lecture #1: Introduction to Systems Engineering Concepts / Value of SE** *Personal Introduction assigned; Homework #1 assigned*
5/26	**Lecture #2: Systems Engineering Processes Overview & Life Cycles** *Personal Introduction due; Homework #1 due; Homework #2 assigned*
6/2	**Lecture #3: Mission & Business Analysis / Stakeholders, Needs, Scope, and CONOPS** *Homework #2 due; Homework #3 assigned*
6/9	**Lecture #4: Requirements Analysis and Development** *Homework #3 due; Homework #4 assigned*
6/16	**Lecture #5: Functional Analysis and Allocation** *Homework #4 due; Homework #5 assigned*
6/23	**Lecture #6: Architecture Definition / Design Definition** *Take-Home Midterm Exam assigned (Lecture #1-6 content); Homework #5 due*
6/30	**Lecture #7: Trade study and Risk Analysis** *Take-Home Midterm Exam Due; Homework #6 assigned*
7/7	**Lecture #8: Systems Analysis and Control** *Homework #6 due; Homework #7 assigned*
7/14	**Lecture #9: Implementation, Integration, & Transition, Interface Analysis** *Homework #7 due; Homework #8 assigned*
7/21	**Lecture #10: Verification, Validation, Quality, Test** *Homework #8 due; Homework #9 assigned*
7/28	**Lecture #11: Specialty Engineering, Security, Mission Assurance** *Homework #9 due; Homework #10 assigned*
8/4	**Lecture #12: Operation, Maintenance, Disposal** *Homework #10 due*
8/10	(Tuesday) No Lecture ***Final Paper Due (Combined/Integrated from 10 Homework assignments)***

Statement on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Counseling and Mental Health - (213) 740-9355 – 24/7 on call
studenthealth.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.
National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.
Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press "0" after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298
equity.usc.edu, titleix.usc.edu
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity |Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs - (213) 740-0776
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention - (213) 821-4710
campussupport.usc.edu
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC - (213) 740-2101
diversity.usc.edu
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu
Non-emergency assistance or information.