SAE 599: Engineered Resilient Systems & System-of-Systems
Spring 2016

Class Day and Time: Monday, 6:40-9:20 PM
Location: OHE 120

Instructor: Professor Azad M. Madni
Office: RRB 201
Office Hours: By Appointment Only
Contact Info: azad.madni@usc.edu
Office Phone: (213) 740-9211

Teaching Assistant: Edwin Ordoukhanian
Office: TBD
Office Hours: By Appointment Only
Contact Info: ordoukha@usc.edu
Phone: 818-720-2682

COURSE DESCRIPTION
Resilience Engineering has become an important subject in systems engineering, as systems continue to grow in size, scale, and complexity. This course provides Systems Architects and Engineers with key definitions, concepts and formal methods for the design and analysis of resilient systems and system-of-systems (SoS).

LEARNING OBJECTIVES
- To provide students with clear definition of resilience in various domains.
- To introduce students to key concepts associated with resilience engineering
- To provide students with modeling, analysis and design approaches for engineered resilient systems
- To introduce the students to new architectures and mechanics associated with engineering resilient system
- To improve the students’ ability to generate a professional-level research paper, suitable for presentation at a systems engineering conference or publication in a professional journal.

Prerequisite(s): None; however, SAE 549 Systems Architecting is recommended
Recommended Preparation: 2 years of Systems Engineering desirable, but not necessary

FINAL GRADE
Your grade will be based on a Mid-term Exam, and a Final Term Paper. Midterm will account for 40% and the Final Term Paper will account for the remaining 60% of the final grade. There will be extra credit assignments during the semester.

MIDTERM EXAM
The mid-term will consist of multiple questions that require short answers. It will test the students’ knowledge about the fundamentals of resilience engineering. This will be a take home, open book
exam on topics covered in lectures up to that point. It will be assigned on **March 7 at 6:30 PM** and it will be due **March 8 at 11:59PM**.

**FINAL TERM PAPER**

**TOPIC:** Select a complex system or system-of-systems (e.g. UAV swarm, autonomous vehicle network) and analyze it in terms of resilience concepts presented in the class. Your analysis should be quantitative where possible. Also provide qualitative discussions based on the modeling and analysis methods presented in this course.

The paper quality should be commensurate with the quality expected in peer-reviewed conference publications. Target conferences include CSER, INCOSE IS, IEEE SMC International Conference, IEEE Systems Conference, AIAA Infotech@Aerospace, and AIAA Science and Technology Conference.

The student is expected to propose a topic, and get it approved by the instructor and/or TA:
- It can be something that the student has been personally involved in, or something that is of interest to the student.
- It should address a system where the need for resilience is well-recognized, and the measures of effectiveness are available
- The choice of the domain is up to the student

**APPROVAL:** You must submit a one-page abstract regarding your proposed topic for approval. Please submit on-line via D2L Assignments no later than February 16 2016 by 6:30PM.

**FORMAT:** Microsoft WORD (.DOC) or Adobe Acrobat (.PDF) format for abstracts and research papers. 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.

**LENGTH:** The term paper should be between **10-12 pages, single-spaced, in 12-point type**. This includes all references, figures and tables.

**DELIVERY:** Please submit on-line via Desire to Learn Assignments no later than **April 25 2016 by 11:59 PM**.

**SOURCES:** You must properly reference all sources. We will use the turnitin.com service to look for matches with existing books, magazine and newspaper articles, journals, prior student papers, and all Internet sources. If you directly quote text from a source, you must 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 your 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 (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 amount of copied items, your own artwork—however crude yet clearly legible and illustrative—is always acceptable.

LATENESS: Term papers are due on April 25 2016 by 6:30 PM. No late papers will be accepted after the due date and time, and the student will receive an automatic F grade for final paper.

LIMITS: I cannot accept a request to limit access to your abstract or research papers. 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.

Additional Information:
- Please feel free to discuss the structuring of your research plan at the end of the class.
- If English grammar, spelling and syntax are not your strong points, I strongly suggest that you obtain help in editing your text. Your grade depends on the clarity of writing.
# Course Schedule: A Weekly Breakdown

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<thead>
<tr>
<th>2016</th>
<th>Topics</th>
<th>Assigned Readings</th>
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<tbody>
<tr>
<td>Jan 18</td>
<td>No Class. University Holiday</td>
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<tr>
<td>Feb 1</td>
<td>Guest Lecture</td>
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<tr>
<td>Feb 15</td>
<td>No Class University Holiday</td>
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<tr>
<td>Mar 7</td>
<td>Midterm. No class. Assign at 6:30 PM Due March 8 by 11:59 PM</td>
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<td>Mar 14</td>
<td>No Class. Spring Break.</td>
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<td>Mar 21</td>
<td>Guest Lecture</td>
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<tr>
<td>Apr 4</td>
<td>Guest Lecture</td>
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<tr>
<td>Apr 11</td>
<td>Guest Lecture</td>
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STATEMENT FOR STUDENTS WITH DISABILITIES
Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. Website and contact information for DSP: http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.

STATEMENT ON ACADEMIC INTEGRITY
USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one’s own academic work from misuse by others as well as to avoid using another’s work as one’s own. All students are expected to understand and abide by these principles. SCampus, the Student Guidebook, (www.usc.edu/scampus or http://scampus.usc.edu) contains the University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A.

EMERGENCY PREPAREDNESS/COURSE CONTINUITY IN A CRISIS
In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies.