Class Sessions:

Day:	**Monday**
Time:	**3:30 pm – 6:10 pm**
Room:	**OHE 120 (Webcasted Course)**
Class Number:	**32319D (DEN/Off-campus) and 32349D (On Campus)**

Contact Information:

Instructor:	**Dr. Azad Madni**
Office hours:	**By Appointment Only**
Office location:	**RRB 201**
Office phone:	**(213)-740-9211**
E-mail:	**azad.madni@usc.edu**

TA:	**Edwin Ordoukhanian**
Office hours:	**By Appointment Only**
Office location:	
Office phone:	**(818)-720-2682**
E-mail:	**ordoukha@usc.edu**

Course website	**http://www.courses.uscden.net (Desire to Learn, login required)**

Course Learning Objectives:

- To improve students' ability to think critically, ask the right questions, and apply the right methods when architecting various types of systems.
- To improve students' understanding of the role of system architects and their relationship to systems engineers and transdisciplinary systems engineering.
- To introduce the students to new, advanced multidisciplinary topics (e.g., systems thinking, systems modeling, psychological principles in systems architecting, biologically-inspired architectures, agent-based modeling, human capabilities and limitations) relevant to complex systems architecting.
- To introduce the students to key concepts in performing trade-off analysis which is important to both systems architecting and engineering.

SYLLABUS

Readings:

Required Text: Rechtin, E. (1991). *Systems architecting: Creating and building complex systems*. Englewood Cliffs, NJ: Prentice Hall. ISBN: 0-13-880345-5. This text is out of print, but is available in the USC Bookstore as the "Course Reader" for SAE 549.

Second Reader for SAE 549, Fall 2010 "Selected Readings"
These readings were culled from papers by Dr. Madni and others.

Madni, A.M. "Generating Novel Options During Systems Architecting: Psychological Principles, Systems Thinking, and Computer-Based Aiding," pages 1-9, *Systems Engineering*, Volume 16, Number 4 2013.(Google Scholar)

Recommended Reading: Maier, M., & Rechtin, E. (2009). *The art of systems architecting* (3rd ed.). Boca Raton, FL:CRC Press ISBN: 978-1-4200-7913-5

Nadler, G., & Chandon, W. (2004). *Smart questions: Learn to ask the right questions for powerful results* (1st ed.). San Francisco, CA:Josey-Bass ISBN: 978-0787971373

Senge, P., (1994). *The fifth discipline* (revised ed.). Currency ISBN: 0-3855-1725-4

Notes: Weekly class notes/charts will be provided. They will be posted on the Desire to Learn (courses.uscden.net)

IF YOU WANT HELP

Our phone numbers and e-mail addresses are listed at the top of this syllabus.

We encourage you to e-mail us if you have any questions about the term paper and difficulties with understanding course materials. The usual turnaround time for emails is 24 hours. If you don't hear from us within that timeframe, please send us a reminder

Always include the TA in any email sent to the instructor. Questions pertaining to homework, due dates, mid-term, and final term paper should be addressed to the TA directly.

GRADE

Your grade will be based on 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 throughout the semester.

MIDTERM EXAM

The mid-term will consist of multiple questions requiring short answers. It will test the students' knowledge about the fundamentals of systems architecting, critical thinking, and systems thinking. This will be a take home, open book exam on all the subjects covered in previous lectures. It will be assigned on **Monday March 7 at 3:30 PM** and it will be due **March 8 by 11:59 PM**.

FINAL TERM PAPER GUIDELINES

TERM PAPER:

The term paper should address the following problem:
Describe and analyze the architecture of a selected system in terms of any or all of the class concepts presented in lectures. Your analysis should discuss how the architecting process led to the architecture. The architecting process should address, to the extent possible, the key tradeoffs, the steps taken, the questions asked, the people involved, the options generated, the decisions made, and the techniques used. The analysis of the system should also include a quantitative and qualitative evaluation of the characteristics, benefits, and limitations of the selected system as a result of the aforementioned activities.

The paper should be of sufficient quality for potential submission to a reputable IEEE/INCOSE/IIE/AIAA conference, with the eventual goal of submitting it to a journal.

The student gets to propose the topic, subject to the instructor and TA's approval:
- 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 architecting/development process is well-documented, and the measures of effectiveness, are available in the public domain.

APPROVAL: Submit two page extended abstract on the topic for approval, and is due on **Feb 16, 2016 by 3:30 PM**. *Follow the term paper guideline available on course website.*

LENGTH: The term paper should be between **10-12 pages (excluding references and appendices), single-spaced, in 12-point type**. The term paper is due on or before **April 25, 2016 at 11:59 PM**.

DELIVERY: The term paper proposal, and main paper should be submitted through Turnitin. Links for submitting the assignments will be available under "Assignment" section of Desire to Learn system (http://courses.uscden.net).

GRADING: Each term paper will be graded on the letter scale: A, A-, B+, B, B-, etc. Your paper grade will require writing a paper that would be instructive or of general interest to systems architects, including those who may not be necessarily interested in the particular system you analyze.

LATENESS: Term papers are due on **April 25, 2016 at 11:59 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.**

ADDITIONAL INFORMATION

- Policies and procedures for submitting homework and exams (via DEN for all students) are available on the GAPP website (http://gapp.usc.edu/graduate-programs/den/getting-started/policies-procedures). *Students are responsible for understanding and following these policies and procedures*.

- There have been previous attempts of students to copy someone else's text into their papers or homework. *Never copy text in to your file without marking it with a citation. Never attempt to copy text into your file and then "edit it into your own words."* All the text that you turn in that comes from somewhere else must be marked as quotation. All the ideas that you turn in that come from someone else must be cited. The default punishment for plagiarism by a graduate student is failing the course, and expulsion is possible.

- 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 presentation.

UNIVERSITY LEVEL ISSUES

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. The phone number for DSP is (213) 740-0776.

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, contains the Student Conduct Code in Section 13.00, while the recommended sanctions are located in Appendix A: https://scampus.usc.edu/university-student-conduct-code/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.

Schedule of Class Sessions: The exact schedule is likely to change, based on availability of guest lecturers. Dates of readings may change to align with other schedule adjustments. Changes will be announced.

2016	Session number: Planned topics	Readings
Jan 11	1: Introduction to the SAE Program, the course, the instructor, and the systems architecting	1. "Preface" of Rechtin, 1991
Jan 18	2: No Class. University Holiday	
Jan 25	3: System Architecture: Key Perspectives and Concepts	1. Madni, A.M. "Generating Novel Options During Systems Architecting: Psychological Principles, Systems Thinking, and Computer-Based Aiding," pages 1-9, *Systems Engineering*, Volume 16, Number 4 2013.(Google Scholar)
Feb 1	4: Guest Lecture:	
Feb 8	5: Systems Thinking	1. Madni, A.M. "Generating Novel Options During Systems Architecting: Psychological Principles, Systems Thinking, and Computer-Based Aiding," pages 1-9, Systems Engineering, Volume 16, Number 4 2013.(Google Scholar)
Feb 15	6: No Class. University Holiday.	***Extended Abstract Due By February 16, 3:30 PM.***
Feb 22	7: Architecture Trade-off Analysis	1. Madni, A.M, "Madni, A.M., "Systems Engineering Trade-off Analysis: Challenges and Promising Themes", ISERC 2015, Nashville Ordoukhanian, E, Madni, A.M., "System Trade-offs in Multi-UAV Network", AIAA Space 2015, August 31-Sep 2, 2015, Pasadena, CA *(Google Scholar)*
Feb 29	8:Guest Lecture	
Mar 7	9: Midterm. No class. Assign at 3:30 PM. Due March 8 by 11:59 PM.	
Mar 14	10: No Class. Spring Break.	
Mar 21	11: Heuristics	
Mar 28	12: Guest Lecture	

2016	Session number: Planned topics	Readings
Apr 4	13: Systems Architect and Complex Systems	1. Ch 1 and 2 from Rechtin, 1991. "Selected Readings": 2. Raymond, Arthur E., (1951) "The Well-Tempered Aircraft" 3. Simon, H. A. 1962. The Architecture of Complexity. *Proceedings of the American Philosophical Society*, 106(6): 467-482. 4. Simon, H. A. 1976. How Complex are Complex Systems? PSA: *Proceedings of the Biennial Meeting of the Philosophy of Science Association,* 1976: 507-522.
Apr 11	14: Human-System Integration: Implications for Systems Architecting	1. Madni, A.M. "Integrating Humans With and Within Complex Systems: Challenges and Opportunities," (Invited Paper) *CrossTalk, The Journal of Defense Software Engineering*, May/June 2011, "People Solutions." (Google Scholar) "Selected Readings": 1. Madni, A. M. 2010. Integrating Humans With Systems and Software: Technical Challenges and Research Agenda. *Systems Engineering*, 13(3): 21.
Apr 18	15: Guest Lecture	
Apr 25	16: Course Overview	1. Madni, A.M. and Sievers, M. Systems Integration: Key Perspectives, Experiences, and Challenges, 2013 2. Madni, A.M., and Sievers, M. "System of Systems Integration: Key Considerations and Challenges." *Systems Engineering* (2013). ***Final Term Paper Due by 11:59 PM***