

## DRAFT SYLLABUS

**SAE 549: Systems Architecting**

**Spring 2017**

**Class Session:** Monday, 3:30 pm – 6:10 pm, OHE 120

**Class Section:** 32319D (DEN/Off-campus) and 32349R (On Campus)

### **Contact Information:**

Instructor: Prof. Azad M. Madni  
Office hours: By Appointment Only  
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We encourage you to e-mail us if you have any questions 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.

### **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.

### **Readings and Notes:**

- Weekly lecture notes will be posted on the Desire to Learn (<http://www.courses.uscden.net>)
- Required Reader:
  - Rechtin, E. (1991), Systems architecting: Creating and building complex systems. Englewood Cliffs, NJ: Prentice Hall. ISBN: 0-13-880345-5. *Note: This text is out of print, but is available in the USC Bookstore as the "Course Reader" for SAE 549.*
- Required Text:
  - Bahill, T. A., Madni, A.M., "Trade-off Decisions in Systems Design" Springer, 2017
- 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

### **Grade**

Your grade will be based on three exams. All exams will be administered online through Desire 2 learn. Each exam will account for 33.33% of your final grade.

### **Exams**

- The exams will consist of multiple questions that will test students' knowledge about the fundamentals of systems architecting, complex systems, and systems thinking. These exams will be on all the subjects

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covered in previous lectures and assigned readings. These will be timed exams (2 hours and 40 minutes) and will be conducted during class time. The first exam will be on **Monday February 27, 2017**. The second exam will be on **Monday April 10 2017**. The third exam will be on **Monday April 24, 2017**.

- You **are not allowed** to collaborate on the exams. The default punishment for unauthorized collaboration and cheating on the exams is F for the course.

### 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 GFS 120 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/>.

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**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.

2017	Lecture Topics	Readings
<b>Jan 9</b>	1. Intro to SAE Program, the course, the instructor, and systems architecting	1. "Preface" of Rechtin, 1991 2. Chapter 1,2, and 3 of Rechtin, 1991 <i>Submit student bio by 3:30 PM Friday Jan 13 2017</i>
<b>Jan 16</b>	University Holliday	
<b>Jan 23</b>	2. 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, <i>Systems Engineering</i> , Volume 16, Number 4 2013.(Google Scholar) 2. Chapter 15 from Rechtin 1991
<b>Jan 30</b>	3. Systems Thinking	1. Madni, A.M. "Generating Novel Options During Systems Architecting: Psychological Principles, Systems Thinking, and Computer-Based Aiding," pages 1-9, <i>Systems Engineering</i> , Volume 16, Number 4 2013.(Google Scholar)
<b>Feb 6</b>	Guest Lecture	
<b>Feb 13</b>	4. Architecture Trade-off Analysis	1. Madni, A.M., Ross, A. "Exploring Concept Trade-offs," Chapter 10 in "Trade-off Analytics," Eds Parnell G., Wiley 2016 2. Ordoukhanian, E, Madni, A.M., "System Trade-offs in Multi-UAV Network", AIAA Space 2015, August 31-Sep 2, 2015, Pasadena, CA ( <i>Google Scholar</i> )
<b>Feb 20</b>	University Holiday	
<b>Feb 27</b>	<b>Exam #1</b>	
<b>Mar 6</b>	5: Heuristics	1. Appendix A of Rechtin 1991
<b>Mar 13</b>	Spring Break	
<b>Mar 20</b>	6: Systems Architect and Complex Systems	1. Ch 1, 2, and 14 from Rechtin, 1991. 2. Simon, H. A. 1962. The Architecture of Complexity. <i>Proceedings of the American Philosophical Society</i> , 106(6): 467-482. 3. Simon, H. A. 1976. How Complex are Complex Systems? <i>PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association</i> , 1976: 507-522.
<b>Mar 27</b>	8. Guest Lecture	
<b>April 3</b>	7. Human-System Integration: Implications for Systems Architecting	1. Madni, A.M. "Integrating Humans With and Within Complex Systems: Challenges and Opportunities," (Invited Paper) <i>CrossTalk, The Journal of Defense Software Engineering</i> , May/June 2011, "People Solutions." (Google Scholar) 2. Madni, A. M. 2010. Integrating Humans With Systems and Software: Technical Challenges and Research Agenda. <i>Systems Engineering</i> , 13(3): 21. 3. Chapter 11 from Rechtin 1991
<b>April 10</b>	<b>11. Exam #2</b>	

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April 17	12. Course Review	<ol style="list-style-type: none"><li>1. Madni, A.M. and Sievers, M. Systems Integration: Key Perspectives, Experiences, and Challenges, 2013</li><li>2. Madni, A.M., and Sievers, M. "System of Systems Integration: Key Considerations and Challenges." <i>Systems Engineering</i> (2013). Chapter 16 from Reichtin 1991</li></ol>
April 24	<b>13. Exam #3</b>	

### Assigned Readings List

You can download these papers from Google Scholar or USC Libraries for free.

- 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
- Ordoukhanian, E, Madni, A.M., "System Trade-offs in Multi-UAV Network", AIAA Space 2015, August 31-Sep 2, 2015, Pasadena, CA
- Simon, H. A. 1976. How Complex are Complex Systems? PSA: Proceedings of the Biennial Meeting of the Philosophy of Science Association, 1976: 507-522.
- 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."
- Madni, A. M. 2010. Integrating Humans With Systems and Software: Technical Challenges and Research Agenda. *Systems Engineering*, 13(3): 21.
- Madni, Azad M. "Elegant systems design: Creative fusion of simplicity and power." *Systems Engineering* 15.3 (2012): 347-354.
- Madni, Azad M., et al. "Toward an Experiential Design Language: Augmenting Model-based Systems Engineering with Technical Storytelling in Virtual Worlds." *Procedia Computer Science* 28 (2014): 848-856.
- Madni, Azad M. "Expanding Stakeholder Participation in Up-front System Engineering through Storytelling in Virtual Worlds." *Systems Engineering* 18.1 (2015): 16-27.
- Madni, A.M. and Sievers, M. Systems Integration: Key Perspectives, Experiences, and Challenges, 2013
- Madni, A.M., and Sievers, M. "System of Systems Integration: Key Considerations and Challenges." *Systems Engineering* (2013).
- Simon, H. A. 1962. The Architecture of Complexity. *Proceedings of the American Philosophical Society*, 106(6): 467-482.
- Madni, A.M., Ross, A. "Exploring Concept Trade-offs," Chapter 10 in "Trade-off Analytics," Eds Parnell G., Wiley 2016