SYLLABUS

SAE 549: Systems Architecting **Summer 2025**

Class Session: Tuesday 6:30 pm – 9:40 pm

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

Contact Information:

Instructor: Dr. Edwin Ordoukhanian
Office hours: Virtual, By Appointment Only
Office location: OHE 500
Office phone: --
E-mail: ordoukha@usc.edu

Kindly use online discussion boards (available on D2L) if you have any questions on course materials, mid-term, or final paper. The turnaround time to answer questions is 24 hours. The use of email should be limited to emergency situations.

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, human behavior modeling) relevant to complex systems architecting.
- To introduce the students to key concepts associated with trade-off analysis which are 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 Text:
  - Maier, M., & Rechtin, E. (2009). The art of systems architecting (3rd ed.). Boca Raton, FL: CRC Press ISBN: 978-1-4200-7913-5
  - Bahill, T. A., Madni, A.M., *"Trade-off Decisions in Systems Desig*n" Springer, 2017.
  - Madni, A.M. *Transdisciplinary Systems Engineering: Exploiting Convergence in a Hyper-connected World*, Springer, 2018

Grade

Your grade will be based on one midterm exam (*will account for 50% of your final grade*) and a final term paper *(which will account for the remaining 50% of your final grade).* The exam will be administered online through Brightspace.

Exam

- The exam will consist of multiple questions that will test students' knowledge about the fundamentals of systems architecting, complex systems, and systems thinking. The exam will be on all the subjects covered in previous lectures and assigned readings. This will be online timed exam (3 hours and 10 minutes).
- Exam will be available online **During July 15 Week**.

- **Collaboration on the exam is forbidden**. Violators will receive an automatic F for the course.

Term Paper:

The term paper should address the following:

Describe and analyze the architecture of a selected system as a case study. Your analysis should discuss how the architecting process led to the architecture. The architecting process should address the heuristics used, key tradeoffs, questions posed, people involved, options generated, and decisions made, the outcomes and implications for the future.

Details about the structure of abstract and term paper will be discussed in class.

LENGTH: The term paper should be between 8-10 pages (including references, figures, and tables), single-spaced, in 11-point type. The term paper is due on or before **Final Class Session (August 12) by 11:59pm**.

DELIVERY: The term paper must be submitted through the Desire to Learn (D2L) system. Links for submitting final paper will be available on D2L (http://courses.uscden.net).

LATENESS: Term papers are due on **Final Class Session (August 12) by 11:59pm.** ***No late papers will be accepted after the due date and time, and the student will receive an automatic F grade for final paper.***

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.

2025	Lecture Topics	Readings
May 27	SAE Program, Course Overview and Intro to Systems Architecting	• Chapters 1,3,12 Maier & Rechtin, 2009 • Chapter 6 from Madni 2018
June 3	System Architecture and Architectural Frameworks	• Chapter 6 from Madni 2018 • Chapter 11 from Maier & Rechtin 2009 *Student Bio Due*
June 10	Architecture Tradeoff Analysis and Ontology Enabled Systems Architecting	• Madni, A.M., Ross, A. "Exploring Concept Trade-offs," Chapter 10 in "Trade-off Analytics," Eds Parnell G., Wiley 2016 • Chapter 5 of Bahill & Madni 2017
June 17	Role of Heuristics in Systems Architecting	• Chapter 2 of Maier & Rechtin 1991 • Section 2.4 of Bahill & Madni 2016
June 24	Human-System Integration: Implications for Systems Architecting	• Chapter 7 from Madni 2018 • Madni, Azad M. "Integrating humans with software and systems: Technical challenges and a research agenda." Systems Engineering 13.3 (2010): 232-245. • Madni, Azad M. "Integrating humans with and within complex systems." CrossTalk 5 (2011).
July 1	Special Topic - Guest Lecture	- *Term paper Abstract Due*
July 8	Transdisciplinary Engineering *(Used by Permission from Dr. Madni's groundbreaking work)*	• Madni, A.M. Transdisciplinary Systems Engineering: Exploiting Convergence in a Hyperconnected World, Springer 2018
July 15	Special Topic - Guest Lecture	
July 22	Ontology-Enabled Hardware-Software Testbed for Unmanned Systems	• Ordoukhanian, E. and Madni, A.M. Ontology-Enabled Hardware-Software Testbed for Engineering Adaptive Systems, In Madni, A.M. er al., (Eds.) Recent Trends and Advances in Model Based Systems Engineering, Springer, 2022 • Madni, Azad M. "MBSE Testbed for Rapid, Cost-Effective Prototyping and Evaluation of System Modeling Approaches." Applied Sciences 11.5 (2021): 2321.
July 29	MBSE Overview	• Madni, Azad M., and Michael Sievers. "Model-based systems engineering: Motivation, current status, and research opportunities." Systems Engineering 21.3 (2018): 172-190.
August 5	Role of Digital Twin Technology in SA/SE *(Used by Permission from Dr. Madni's groundbreaking work)*	• Madni, A.M., Madni, C.C., and Lucero, D.S. Leveraging Digital Twin Technology in Model-Based Systems Engineering, MDPI Systems, special issue on "Model-Based Systems Engineering," 7(1), 7, 2019.
August 12	Course Review	• Chapter 10 Madni 2018 • Chapter 14 from Maier & Rechtin 2009 *Final Papers Due*

Assigned Readings List

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

- Madni, A.M., Ross, A. “Exploring Concept Trade-offs,” Chapter 10 in “Trade-off Analytics,” Eds Parnell G., Wiley 2016
- Madni, Azad M. "Integrating humans with software and systems: Technical challenges and a research agenda." Systems Engineering 13.3 (2010): 232-245.
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- Madni, A.M. Transdisciplinary Systems Engineering: Exploiting Convergence in a Hyperconnected World, Springer 2018
- Ordoukhanian, E. and Madni, A.M. Ontology-Enabled Hardware-Software Testbed for Engineering Adaptive Systems, In Madni, A.M. er al., (Eds.) Recent Trends and Advances in Model Based Systems Engineering, Springer, 2022
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