SAE 547 SYLLABUS

Course ID and Title: **SAE 547: Model-Based Systems Architecting and Engineering**

Prerequisites: None.

Semester and Day/Time: Fall 2022, Friday, 5:00 – 7:40 pm PT, OHE 120

Instructors:
Dr. Mark McKelvin
Office Hours: By Appointment Only
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Course Website: courses.uscden.net

Introduction/Catalog Description

This course introduces Model-based Systems Engineering (MBSE) theory, principles, and methods for modeling and analysis of engineered systems. The course will introduce students to the application of MBSE for architecting engineered systems. Concepts that are introduced in this course will be illustrated with practical examples.

Course Goals and Learning Objectives

The primary goal of the Model-Based Systems Engineering (MBSE) course is to teach the student the fundamentals of MBSE with application to practical problems in systems engineering. The course will emphasize principles, methods, and practices that are software tool agnostic, however, to reinforce concepts in the course, software tools are expected to be used for homework assignments and the final course project. Previous experience with popular enterprise architecture tools that are based on the Unified Modeling Language are not required. However, students are expected to be able to install and use open-source tools such as Papyrus and Capella for homework assignments and the final project. The instructor will introduce the basic use of any software tool that is specifically chosen to complete assignments and the project. It is left to the discretion of the instructor if other software tools may be used by the students.

The class explores several key issues including:

1. What is a system model and how does it help the systems engineering process?
2. How is model-based systems engineering different from traditional systems engineering? What are some of the popular MBSE methodologies?
3. What are the fundamental tenets of MBSE?
4. What is the role of ontologies in MBSE?
5. How are models used to define and capture system requirements and behaviors?
6. What are the types of questions that models can answer?

7. How to practically determine the completeness of models?

8. How do system models relate to each other and to practical system design issues?

9. How is modeling incorporated into the systems engineering process? How does it change the SE process?

10. How does modeling support ancillary analyses such as verification and validation?

11. How can MBSE be extended to address quality attributes such as resilience? For example, how can resilience be modeled and measured within a MBSE framework?

12. What are some examples of real-world system models?

Required Reading: Reading materials and lectures will be posted on the D2L website weekly.

Optional Reading and References:

- *SysML Distilled: A Brief Guide to the Systems Modeling Language*, Lenny Delligatti
- *A Practical Guide to SysML: The Systems Modeling Language* by Sanford Friedenthal, Alan Moore, and Rick Steiner, Second Edition
- *System Design, Modeling, and Simulation using Ptolemy II*, URL: https://ptolemy.berkeley.edu/books/Systems/
- *Model-Based System and Architecture Engineering with the Arcadia Method*, Jean-Luc Voirin, 2018. Accessed via USC Library as online book, URL: https://www-sciencedirect-com.libproxy1.usc.edu/book/9781785481697/model-based-system-and-architecture-engineering-with-the-arcadia-method

Getting Help:

- You are encouraged to email the instructor at any time if you have questions or would like to discuss issues, concerns, practical applications, or research topics. The usual turnaround time for emails is 24 hours. Please send a reminder if you do not receive a response within that timeframe.
- You are encouraged to utilize D2L discussion boards to discuss topics and get help from your classmates, however, please submit your own work and do not plagiarize one another's work.

Course Highlights:

In this course, you will have homework assignments, two midterm exams (take-home), and a class project. These activities are to provide a valuable learning experience by demonstrating your knowledge, comprehension, application, analysis, synthesis, and evaluation of the subject material. You will be expected to apply systems thinking and utilize the systems engineering process during the course. More detail regarding the class project will be provided after the first midterm. This course emphasizes creative thinking and practical approaches to problem solving with models.

Assignment Submission:

All assignments for this class will be submitted through the D2L drop box, unless otherwise noted by the instructor. Before submitting, please check that the submission is legible and adheres to any instructor submission requirements, such as file format.

Course Grading: USC Grading Policies shall be followed. The course activity breakdown is as follows:

Homework Assignments	10%
Midterm 1	30%
Midterm 2	30%
Course Project	30%

Unless otherwise noted by the instructor, homework and midterms are due at 5:00 pm Pacific Time on the due date. The class project is due 12/03 at 5:00 Pacific Time. Please consult the instructors at least 24 hours before an assignment is due if there are special circumstances that prevents you from submitting the assignment on time. Emergencies will be handled on a case-by-case basis.

Late assignments will not be accepted without prior approval.

Academic Integrity Statement:

The School of Engineering adheres to the University's policies and procedures governing academic integrity as described in USC Campus. Students are expected to be aware of and to observe the academic integrity standards described in USC Campus, and to expect those standards to be enforced in this course.

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 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.

Classroom Courtesies:

Standard classroom courtesies are expected from students attending the lectures on campus. Cell phone use and conversations among students are not allowed. These practices are distracting to the on-going lecture. These courtesies also extend to D2L students who should mute their phones during lecture.

Plagiarism:

University policies on plagiarism are in effect. For any assignment including the final project, material may not be directly extracted from web sites or other sources, including internal company documents unless properly cited. Quotations within quotation marks are expected and references cited. Papers will be submitted to turnitin.com.

Office of Equity and Diversity (OED): (213) 740-5086

The university is firmly committed to complying with all applicable laws and governmental regulations at the federal, state and local levels which prohibit discrimination, or which mandate that special consideration be given, on the basis of race, religion, national origin, gender, age, Vietnam veteran status, disability, sexual orientation, or any other characteristic which may from time to time be specified in such laws and regulations. Students may contact the instructor or OED regarding issues of discrimination or harassment.

Class Schedule:

The class material will be covered in the following order, **changes may occur to accommodate guest lectures or at the discretion of the instructor.** If the schedule changes, students will be notified prior to changes in the planned schedule below.

Date	Lecture	Planned Topics
08/26	1	Class Overview and an Introduction to Systems Engineering Concepts **Homework #1: Assigned**
09/02	2	Introduction to Model-Based Systems Engineering (MBSE) **Homework #1: Due** **Homework #2: Assigned**
09/09	3	Languages, Ontologies, and Metamodels **Homework #2: Due** **Homework #3: Assigned**
09/16	4	Overview of the Systems Modeling Language (SysML) **Homework #3: Due** **Homework #4: Assigned**

Date	Lecture	Planned Topics
09/23	5	Models in Requirements Engineering **Homework #4: Due** **Take-Home Midterm #1: Assigned**
09/30	6	Models of Computation **Take-Home Midterm #1: Due** **Homework #5: Assigned**
10/07	7	Models for Systems Architecture **Homework #5: Due**
10/14		**No Class (Fall Recess)**
10/21	8	Model-Based Verification and Validation **Homework #6: Assigned**
10/28	9	Engineered Resilience and Cyber-secure System Modeling **Homework #6: Due** **Take-Home Midterm #2: Assigned**
11/04	10	Special Topic: Digital Engineering **Take-Home Midterm #2: Due** **Class Project: Assigned**
11/11	11	**No Class (Veteran's Day)**
11/18	12	Special Topic or Guest Lecture
11/25		**No Class (Thanksgiving Holiday)**
12/02	13	Course Review (Last Day of Classes) **Class Project: Due**