

SAE 547 SYLLABUS

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

Prerequisites: None.

Semester and Day/Time: Fall 2024, Friday 12:00 – 2:40 pm PST (OHE 100C and Virtual)

Instructors:

Dr. Mark McKelvin

Office Hours: By Appointment Only

mckelvin@usc.edu

Course Website: courses.uscden.net

Introduction/Catalog Description

This course introduces Model-based Systems Engineering (MBSE). The course addresses principles, practice, 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 and reinforced through hands-on exercises and a project using the Systems Modeling Language (SysML) standard.

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 and modeling languages such as the Systems Modeling Language (SysML), is not required. To give students a common basis for tool usage, it is expected that all students use the same set of tools specified by the instructor. The specific software tools planned for this course for assignments are IBM Rhapsody and Protégé. Other software tools may be used at the discretion of the instructor. For any tools the instructor specifies, a demonstration and instructions on the basic usage of the tool will be provided to the extent of enabling the students to complete the assignments.

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. How do system models relate to each other and to practical system design issues?
7. How is modeling incorporated into the systems engineering process? How does it change the SE process?
8. How does modeling support ancillary analyses such as verification and validation?
9. How can MBSE be extended to address quality attributes such as resilience?
10. What are some examples of real-world system models?

Required Reading: Lectures and additional reading materials will be posted to D2L.

Optional Reading and References:

- *SysML Distilled: A Brief Guide to the Systems Modeling Language*, Lenny Delligatti
- *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 by 5:00 pm Pacific Time on the due date. The class project is due 5:00 Pacific Time on the published due date. 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 earn full credit 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
8/30	1	Class Overview and an Introduction to Systems Engineering Concepts Homework #1: Assigned
09/06	2	Introduction to Model-Based Systems Engineering (MBSE) Homework #1: Due Homework #2: Assigned
09/13	3	Languages, Ontologies, and Metamodels Homework #2: Due Homework #3: Assigned
09/20	4	Overview of the Systems Modeling Language (SysML) Homework #3: Due Homework #4: Assigned
09/27	5	Models in Requirements Engineering Homework #4: Due Take-Home Midterm #1: Assigned

Date	Lecture	Planned Topics
10/04	6	Models of Computation Take-Home Midterm #1: Due Homework #5: Assigned
10/11		No Class (Fall Recess)
10/18	7	Models for Systems Architecture Homework #5: Due
10/25	8	Model-Based Verification and Validation Homework #6: Assigned
11/01	9	Engineered Resilience and Cyber-secure System Modeling Homework #6: Due Take-Home Midterm #2: Assigned
11/08	10	Project Overview Take-Home Midterm #2: Due Class Project: Assigned
11/15	11	Special Topic: Digital Engineering
11/22	12	Special Topic or Guest Lecture
11/29		No Class (Thanksgiving Holiday)
12/06	13	Course Review (Last Day of Classes) Class Project: Due