**SAE 547 SYLLABUS**

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

**Prerequisites:** None

**Semester and Day/Time:** Fall 2017, Tuesday, 6:40 pm-9:20 pm

RTH 105

**Instructors:** Dr. Michael Sievers
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**Teaching Assistant:** TBD

Phone:

Office Hours:

Email:

**Course Website:** courses.uscden.net

**Introduction/Catalog Description**

Introduction to model-based systems engineering (MBSE) theory, methods, principles, and tools. Concepts are illustrated with real-world systems examples.

**Course Goals and Learning Objectives**

The primary goal of the Model-Based Systems Engineering (MBSE) course is to teach the student MBSE fundamentals with application to real-world problems. The class explores a several key MBSE issues including:

1. What is a system model and how does it help the SE 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 can humans be accounted for in MBSE? What needs to happen?
8. How to practically determine the completeness of models?
9. How do system models relate to each other and to practical system design issues?
10. How is modeling incorporated into the systems engineering process? How does it change the SE process?
11. How does modeling support ancillary analyses such as verification and validation?
12. 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?
13. What are some examples of real world system models?

**Readings**

Required Reading: Reading materials will be posted on the D2L website:

**Optional Reading**: *A Practical Guide to SysML: The Systems Modeling Language* by Sanford Friedenthal, Alan Moore, and Rick Steiner, Second Edition

*SysML for Systems Engineering*, John Holt and Simon Perry, *The Institution of Engineering Technology (IET)*

 Weekly lectures will be posted on the D2L page.

**Getting Help**

* Our office hours are by appointment only
* We encourage you to email us at any time to discuss research problems, questions, etc. The usual turnaround time for emails is 24 hours. If you don’t hear from us within that timeframe, you may send us a reminder.

**Course Highlights:**

1. Homework assignments
2. (2) Midterm exams
3. 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 midterm.

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

 Homework Assignments 10%

 Take-Home Midterm exam-1 30%

 Take-Home Midterm exam-2 30%

 SysML Project 30%

All assignments for this class will be submitted through the D2L dropbox unless otherwise noted by the instructor or teaching assistant. Please use Microsoft Word or Powerpoint for your submitted assignments. **Please DO NOT submit PDFs**.

**Unless otherwise noted by the instructor or teaching assistant, homework and midterms are due at 6:00 pm Pacific time on the day of the lecture (Tuesday) the following week that it is assigned**. **The class project is due 12/1 at 6:00 Pacific time**. **Please consult the instructors at least one day before an assignment is due if there are special circumstances that prevents you from submitting the assignment on time.**

**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 the final project paper, 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:** (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.

The class material will be covered in the following order, **changes may occur to accommodate guest lectures.**

| **Date** | **Lecture** | **Planned Topics** |
| --- | --- | --- |
| 08/22 | 1 | History and motivation |
| 08/29 | 2 | Overview of Class, expectations, gradingIntroduction to Systems Engineering and MBSE* History and Origin
* Motivation
* Systems and Systems Engineering
* MBSE overview
 |
| 09/05 | 3 | Ontologies, Semantics and Metamodels (Cont) |
| 09/12 | 4 | MBSE Processes and Methodologies* Process roadmap
* Introduction to methodologies
* Modeling examples and use
 |
| 09/19 | 5 | SysML Overview/Intro * SysML Pillars
* Model (Project) Organization, Packages
* Tool Overview
* SysML Pillar – Requirements
* SysML Pillar - Structure
	+ Block Definition Diagrams (BDD)
	+ Internal Block Diagrams (IBD)
* SysML Pillar - Behavior
	+ Use Cases
	+ State Machines
* SysML Pillar – Constraints and Parametrics
 |
| 09/26 | 6 | Requirements Engineering* Requirement typology
* Use cases and CONOPS
* Deriving requirements
* Specifications and capabilities
 |
| 10/03 | 7 | Models of Computation* Overview
* Finite State Machines
* Process Networks
* Data Flow Models
* Modeling Timed Systems

**Take-Home Midterm #1** |
| 10/10 | 8 | Models of Architecture* Architecture Patterns
* Architecture Frameworks
* Views and Viewpoints
 |
| 10/17 | 9 | Model-based V&V |
| 10/24 | 10 | Modeling Systems Integration |
| 10/31 | 11 |  Guest Lecture - TBA |
| 11/07 | 12 | Model Integration and Analysis with MagicDraw* Overview of MagicDraw
* Linking Models and Views
* Analyzing Models
* Document Generation
* Customization

In-Class Exercise**Take-home midterm #2** |
| 11/14 | 13 | Engineered Resilience and Modeling* Definitions
* Modeling approaches
* Issues
 |
| 11/21 | 14 | Modeling and Analysis for Cyber-secure Systems |
| 11/28 | 15 | Course Review, take home final project |