**SAE PROGRAM COURSES AND INSTRUCTORS**

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| **SAE 549 Systems Architecting** | | |
| A person wearing a suit and tie  Description generated with very high confidence | A person wearing a suit and tie  Description generated with very high confidence | This course, which is the first course in the SAE program, introduces students to the key concepts and heuristics employed in developing systems architectures for aerospace, defense, automotive and manufacturing systems. It focuses on both conceptual and acceptance phases. The course emphasizes both synthetic (i.e., integrative) and analytic methods in problem formulation and problem-solving. Students learn to formulate the right problem (resist oversimplification to fit a known technique) and see the “big picture” in terms of program & system scope (not individual subsystems). Students are introduced to architectural frameworks, trade-off analysis, role of ontology engineering in systems architecting, systems thinking, use of heuristics in systems architecting, and architecture-aware human-system integration concepts. Modeling, simulation, and prototyping concepts are presented in the context of systems architecting. Real-world case studies are presented, with specific emphasis on the role of system architects and their relationship to systems engineers and other members of the project teams. Concepts from transdisciplinary systems engineering are presented along with how they can enhance systems architecting. |
| Dr. Azad M. Madni | Guest Lecturer, Gen.(ret) Ellen Pawlikowski |

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| **SAE 543 Case Studies in Systems Engineering and Management** | | |
| A person wearing a suit and tie  Description generated with very high confidence | A person wearing a suit and tie  Description generated with very high confidence | The course provides real-world case studies from DoD and NASA programs, as well as commercial programs. It employs a structured methodology for representing cases and conducting case studies. The individual cases cover program objectives, key decision-makers, assumptions, key decisions, expected and actual outcomes, and what-if changes in architectural decisions, assumptions and technologies to explore how the outcomes might have been different. Students will be exposed to the interdisciplinary aspects of systems architecting and engineering program. Industry Speakers will present examples of case studies from various initiatives. |
| Gen. Ellen M. Pawlikowski | Dr. Azad M. Madni, Guest Lectures |

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| **SAE 547 Model-Based Systems Architecting and Engineering** | | | |
| A person wearing a suit and tie  Description generated with very high confidence | https://16yvut3lcf341mbymkpwo7zt-wpengine.netdna-ssl.com/wp-content/uploads/2017/04/faculty_seivers-150x150.jpg | https://16yvut3lcf341mbymkpwo7zt-wpengine.netdna-ssl.com/wp-content/uploads/2017/04/faculty_mckelvin-150x150.jpg | This course provides a deep understanding of Model-Based approaches in systems architecture and engineering. Students will be exposed to modeling system requirements, structure, behavior, and parametric relationships. The course covers the mapping of models to hardware description languages and presents code generation concepts at the hardware level. Students are introduced to key concepts such as ontologies and metamodels and how they can be exploited in MBSE. Students learn to model systems using software and modeling language such as SySML. Students are taught methods to assess whether an organization is prepared to undertake a transformation to MBSE, as well as how to perform economic analysis to determine the potential benefits (or not) of MBSE for an organization. |
| Dr. Azad M. Madni | Dr. Michael Sievers | Dr. Mark McKelvin |

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| **SAE 560 Economic Considerations for Systems Engineering** | |
| https://16yvut3lcf341mbymkpwo7zt-wpengine.netdna-ssl.com/wp-content/uploads/2017/04/faculty_hihn-150x150.jpg | This course is intended to give systems architects and engineers key insight into the impact of economic factors on their programs and help them in the use of tools to gain an in-depth understanding of these factors. The fundamental terms involved in quantitative analysis of cash flow are covered. Insight into cost estimation techniques are also shared. The relationship of software and its cost implications are also presented. Building on the work that has been done in software cost modeling, the course examines how these methods can be applied to systems engineering. This course is intended to give students a strong foundation in time value of money, interest rate concepts, and practical aspects of economic justification of projects in an organization. A key goal of the course is to improve students’ ability to create and understand parametric cost models, and learn to perform risk analysis and trade studies using models. |
| Dr. Jairus Hihn |

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| **SAE 541 Systems Engineering Theory and Practice** | | |
| A person smiling for the camera  Description generated with very high confidence | A person wearing a suit and tie smiling at the camera  Description generated with very high confidence | This course will acquaint the student with both the theory and practice of the discipline of systems engineering. It will teach the systems engineering design approach which is concerned with how to devise a system solution, which meets customer/stakeholder objectives optimally within available resources. The course will discuss solving open-ended problems, employing creativity, formulating of problem and need statements and requirements, management of complex systems requirements. It will teach students how to examine alternative solutions, employ concurrent engineering design, and take into account a variety of factors such as economic (business case), safety, reliability, aesthetics, environment, ethics, social impact, production, and operations. It is the intent of this course to give the student a strong foundation in the fundamentals of system engineering, and at the same time, to introduce them to innovative systems approach to problem solving and team leadership. |
| Dr. Robert Minnichelli | |  |  | | --- | --- | |  | Mr. James Hines | |

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| **SAE 548 Systems/System-of-Systems Integration and Communication** | | |
| A person wearing a suit and tie  Description generated with very high confidence | https://16yvut3lcf341mbymkpwo7zt-wpengine.netdna-ssl.com/wp-content/uploads/2017/04/faculty_seivers-150x150.jpg | With the increasing scale and complexity of systems and the need for systems to perform their own missions as well as participate in a larger system-of-systems to perform more complex missions, systems integration and system-of-systems integration have become key areas of emphasis for aerospace, defense, telecommunications, transportation, and emergency services. The terms “system integration” and “SoS integration” can mean many things to many people. With this in mind, this course emphasizes the importance of stakeholder concerns and integration contexts before discussing theories, methods, processes and tools. The course presents key perspectives and challenges of SI and SoSI and presents case studies and examples from several aerospace and government programs to reinforce the principles. The course discusses key integration challenges such as legacy integration, human-system integration, and SoS integration. The course discusses interoperability in suitable depth and presents the pros and cons of interoperability. The course also covers Verification and Validation methods ranging from inspection, simulation-based analysis, demonstration, and test. Students will be exposed to both theory and real-world case studies as well as findings from the recent literature. |
| Dr. Azad M. Madni | Dr. Michael W. Sievers |

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| **SAE 542 Advanced Topics in Systems Engineering** | |
| https://16yvut3lcf341mbymkpwo7zt-wpengine.netdna-ssl.com/wp-content/uploads/2018/10/Dr-Phan-Color-e1540487167535-150x150.jpg | The course focused on probability theory and its applications in system testing and performance evaluation, test design, assessment of test accuracy, and fidelity. It also covers reliability, maintainability, and quantitative decision models in systems engineering. This course provides principles and methods of Constraint theory to manage and de-conflict complex requirements. Complexity Theory is covered with applications to software-intensive and complex systems. Upon successful completion of this course, a student should be able to demonstrate analytical skills in applying quantitative methodologies in critical consideration and performance of various systems engineering activities. |
| Dr. Phan Phan |

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| **SAE 550 Systems Architecting and the Political Process** | |
| https://16yvut3lcf341mbymkpwo7zt-wpengine.netdna-ssl.com/wp-content/uploads/2017/04/faculty_cureton1.jpg | The design and development of major engineering systems are invariably influenced political processes in governments. These processes often determine the approval and funding of programs. System architects tend to be trained in techniques to deal with cost, schedule, and performance challenges, but rarely if ever in understanding the role of government politics on their programs and projects. This class teaches students in methods to mitigate political risk and successfully navigate political processes that directly or indirectly affect engineering decisions. Real-world case studies are used to communicate the impact of political processes, analyze them to reveal potential risks on systems architecting, and teach political risk mitigation techniques. Students will learn the various ways that political processes influence the architectures of government systems. Students will learn about the U.S. Federal Government acquisition processes (Administrative and Congressional) and typical funding and approval procedures employed on major government-funded systems programs. The students will learn how to to anticipate the impacts of political decisions through application of risk analysis and heuristics. |
| Mr. Kenneth L. Cureton |

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| **SAE 546: Engineered Resilient Systems and System-of-Systems** | | |
| A person wearing a suit and tie  Description generated with very high confidence | https://16yvut3lcf341mbymkpwo7zt-wpengine.netdna-ssl.com/wp-content/uploads/2017/04/faculty_seivers-150x150.jpg | The course presents the different definitions and interpretations of resilience and provides examples from various domains. It presents practical formal methods for the design and analysis of resilient systems and system-of-systems (SoS). These include deterministic models, probabilistic models, and hybrid models. It presents various disruption types, and risks as a function of system scale and complexity. Architectural implications and management strategies for resilient SoS are also discussed in this class. Guest lectures by industry practitioners supplement theory with real-world practical examples. Illustrative examples covered in guest lectures include UAV swarm operations and self-driving vehicle networks. |
| Dr. Azad M. Madni | Dr. Michael W. Sievers |

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| **SAE 515: Sustainable Infrastructure Systems** | |
| No Profile picture | While open to many different interpretations, “sustainability” generally implies the optimization of economic, environmental, and social factors when developing complex infrastructure systems. SAE 515 shows students how to create dynamic infrastructure models, how to include economic, environmental, and social attributes, and how to assess behavior under disruptive perturbations. Students will use these skills to evaluate an infrastructure system of their choice. |
| Dr. Edward W Maby |

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| **SAE 551: Lean Operations** | |
| Image result for Mr. Ted Mayeshiba | Study of various aspects of integrated manufacturing and service enterprises including management, design and production functions, interfaces, and related resources and information systems. This course introduces the role of lean thinking in the manufacturing or service (operations) enterprise and its connections with society, economy, and environment. The course will address both theoretical and applied aspects of the topic. Alternative views of lean operations will also be introduced. Ultimately, assessment of learning is provided through the application of learned principles to a process with which the student is familiar and submits as an end of term project. In pursuit of this goal, to the extent possible, the course will use a collaborative learning approach; meaning participation in class is critical to everyone's learning experience. The instructor then functions more as a facilitator to accomplish this goal. |
| Mr. Ted Mayeshiba |

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| **SAE 599: Foundations of Cyber-Physical Human Systems** | | |
| A person wearing a suit and tie  Description generated with very high confidence | https://16yvut3lcf341mbymkpwo7zt-wpengine.netdna-ssl.com/wp-content/uploads/2017/04/faculty_seivers-150x150.jpg | Cyber-physical systems (CPS), and more generally, cyber-physical-human systems (CPHS) are becoming increasingly ubiquitous with the advent of autonomous vehicles, smart buildings, and smart devices in general. CPHS comprise physical components, software that interacts with and controls their behavior, and humans who perform in the role of an operator or agent within the system. This course presents the fundamentals and recent advances in CPS and CPHS, including modeling challenges, formal modeling methods, and formal verification and testing techniques. Student teams get to apply a technique of their choosing to a system of their choosing in the class project pursuant to instructor approval. |
| Dr. Azad M. Madni | Dr. Michael W. Sievers |