SYSTEMS ENGINEERING, MS

Banner Code: VS-MS-SYST

Academic Advising

2100 Nguyen Engineering Building
Fairfax Campus

Phone: 703-993-1670
Email: seor@gmu.edu
Website: https://seor.gmu.edu/

Mason's educational and research program in systems engineering addresses a broad range of issues relevant to the design, implementation, analysis and management of systems. Concentration areas include; Advanced Transportation Systems; Architecture-Based Systems Integration; Command, Control, Communications, Computing, and Intelligence; Financial Systems Engineering; Systems Engineering and Data Analytics; Systems Engineering of Software-Intensive Systems; and Systems Management. Research activities include both fundamental and applied research. Mason's graduate program in Systems Engineering recognizes the importance of balancing an education in quantitative models and engineering tools with a proper understanding of the systems "perspective."

The program prepares students for a professional career in conceptualization, architecture, design, development, and management of large complex engineered systems. The program emphasizes both analytical and practical aspects of engineering complex systems. Students are expected to demonstrate proficiency in several quantitative modeling disciplines. Students are also expected to master issues relevant to practical aspects of systems architecture, design, and management.

Admissions & Policies

Admissions
Foundation and Admission Requirements

Applicants should have a baccalaureate degree from an accredited institution in engineering, mathematics, computer science, physical sciences, economics, or a related field. They also should have completed courses in calculus (MATH 113 Analytic Geometry and Calculus I (Mason Core), MATH 114 Analytic Geometry and Calculus II, and MATH 213 Analytic Geometry and Calculus III), matrix algebra (MATH 203 Linear Algebra), differential equations (MATH 214 Elementary Differential Equations), applied probability (STAT 346 Probability for Engineers), and a scientific programming language (CS 112 Introduction to Computer Programming (Mason Core)).

Other requirements are as follows:

- Evidence of satisfactory educational achievement in at least one of the following forms: a GPA of at least 3.00 as an undergraduate or an acceptable GPA in graduate courses. International students must also achieve satisfactory scores on the GRE. Nonnative English speakers must have achieved a satisfactory score on the TOEFL exam.
- Two letters of recommendation submitted by former professors or supervisors

- A goals statement and resume
- Working background in engineering mathematics and computer systems. Students with minor deficiencies in preparation may apply for admission to the program, but they will be required to take one or more foundation courses. The department offers SYST 500 Quantitative Foundations for Systems Engineering as an intensive review of undergraduate engineering mathematics, including matrix algebra, transforms, differential equations, probability, and statistics.

Students who have not completed a basic engineering undergraduate mathematics sequence will be required to complete courses in engineering calculus and matrix algebra prior to acceptance. On acceptance, students will be required to take a foundation qualification test a week or two before school starts, unless waived by the department chair or graduate coordinator. Students who fail the test will be required to take SYST 500 Quantitative Foundations for Systems Engineering or other foundation courses. A sample test is available from the department.

Familiarity with analytical modeling software, such as spreadsheets or math packages, is also expected. Students should acquaint themselves with these software packages before beginning classes.

Policies
Advising & Plan of Study
Each student is assigned a faculty advisor with whom to work to complete an approved plan of study. This plan of study must include five core courses, three required courses in a concentration area, one elective, and a capstone systems engineering project (3 credits) for a total of 10 courses (30 credits for graduation). A thesis option that replaces the 3-credit capstone course with a 6-credit thesis (for a total of 33 credits for graduation) is available in some situations. Matriculation requirements for candidates needing additional work in mathematics or engineering also may be included in the plan of study.

Requirements

Degree Requirements
Total credits: 30-33

All Systems Engineering MS students must complete 5 core courses, 3 concentration courses, an elective, and a project or thesis.

Core Courses

Students must complete the following five courses:		15
SYST 505	Systems Engineering Principles [1]	
SYST 510	Systems Definition and Cost Modeling	
SYST 520	System Engineering Design	
SYST 530	Systems Engineering Management I	
SYST 611	System Methodology and Modeling	
Total Credits		15

[1]   Students who have work experience in systems engineering should consult with their advisor on replacing SYST 505 Systems Engineering Principles with a higher-level SYST course.

Concentrations

Students may construct 12 credit concentration areas by choosing electives from among special groupings. Students may also devise their own grouping of electives subject to prior approval of their advisor.

Concentration in Advanced Transportation Systems (ATS)

The air transportation system is among the most complex networked systems. This concentration is designed to provide students with the skills to address the next generation of challenges of the air transportation system. Topics addressed include congestion and safety of the national air space, economic and human factors, impact of technology innovation, and public policy. The program emphasizes design, modeling, and analysis to support decision making for government and the aviation industry.

SYST 560	Introduction to Air Traffic Control	3
SYST 660	Air Transportation Systems Modeling	3
One from the following:		3
ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	
OR 531	Analytics and Decision Analysis	
OR 541	Operations Research: Deterministic Models	
OR 542	Operations Research: Stochastic Models	
OR 568	Applied Predictive Analytics	
or SYST 568	Applied Predictive Analytics	
SYST 563	Evidence-Based Systems Engineering	
SYST 573	Decision and Risk Analysis	
SYST 620	Discrete Event Systems	
SYST 664	Bayesian Inference and Decision Theory	
One free elective, chosen under advisement:		3
Total Credits		12

Concentration in Architecture-Based Systems Integration (ABSI)

There is much interest today in the engineering of systems that comprise other component systems, where each of the component systems serves organizational and human purposes. These systems families are often categorized as systems of systems, federations of systems, or coalitions of systems. The design of architectures is a major ingredient in the design of systems families. Furthermore, it provides the conceptual basis for achieving system integration. This concentration covers the formulation of the system integration problem, definition of architecture frameworks, use of structured analysis and object-oriented methodologies for the design of architectures, modeling and simulation for the evaluation of architectures, and approaches to integration. Both defense and industrial applications are considered.

With careful planning, students who complete this concentration might be able to complete the Architecture-Based Systems Integration Graduate Certificate simultaneously with their MS.

SYST 618	Model-based Systems Engineering	3
SYST 620	Discrete Event Systems	3
SYST 621	Systems Architecture Design	3
One free elective, chosen under advisement:		3
Total Credits		12

Concentration in Command, Control, Communications, Computing, and Intelligence (C4I)

C4I systems are concerned with gathering, retrieving, analyzing, and disseminating time-sensitive information to achieve mission-critical objectives. These systems support military operations across the spectrum of conflict, intelligence operations, transportation monitoring, emergency response, drug interdiction, and law enforcement, among others. C4I systems include the equipment, people, and procedures necessary to accomplish the mission. The equipment may include a variety of sensors, communications systems, and information processing and decision-support systems.

This concentration focuses on the analysis, design, development, and management of C4I systems. Topics addressed include C4I architectures and software, communications, decision support, modeling and simulation, and sensor data fusion.

With careful planning, students who complete this concentration might be able to complete the Command, Control, Communications, Computing, and Intelligence Graduate Certificate simultaneously with their MS.

OR 542	Operations Research: Stochastic Models	3
or ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	
SYST 680	Principles of Command, Control, Communications, Computing, and Intelligence (C4I)	3
or ECE 670	Principles of C4I	
SYST 584	Heterogeneous Data Fusion	3
One free elective, chosen under advisement:		3
Total Credits		12

Concentration in Energy Systems (NRGS)

With the rising economic and environmental costs to power homes, businesses and the transportation systems that move people and goods from place to place, innovative solutions are required to meet the world's expanding energy needs. Students completing the energy systems concentration will build upon a foundation in systems engineering design by incorporating physical principles of thermal fluid energy transfer into system models. Students will develop the tools to model and analyze generation, transmission, and utilization systems in steady and dynamic operation. Students will optimize these systems by considering physical principles, economics, local policy and security concerns. Graduates will be able to apply their expertise to work with: traditional power generation facilities; renewable energy integration; national, local, and smart grids; mechanical and electrical energy storage systems; utilization of energy in building and transportation systems.

ME 521	Energy Transfer	3
ME 531	Energy Transmission	3
ME 541	Power Generation	3
One free elective, chosen under advisement:		3
Total Credits		12

Concentration in Financial Systems Engineering (FNSE)

Financial engineering is a cross-disciplinary field which relies on mathematical finance, numerical methods, and computer simulations to make trading, hedging, and investment decisions, as well as facilitating the risk management of those decisions. While mathematics is indispensable in financial engineering, the concentration will try best to

focus on the concepts and ideas of finance, while limiting the math within a scope acceptable to most students in engineering.

SYST 538	Analytics for Financial Engineering and Econometrics	3
SYST 588	Financial Systems Engineering I: Introduction to Options, Futures, and Derivatives	3
SYST 688	Financial Systems Engineering II: Derivative Products and Risk Management	3
One free elective, chosen under advisement:		3
Total Credits		12

Concentration in Systems Engineering and Data Analytics (SEDA)

Systems engineers must address a broad range of issues relevant to the design, implementation, analysis, and management of systems. This concentration provides methodological tools that can be applied to the systems engineering process. Areas of focus include decision support systems, distributed intelligent systems, knowledge-based planning systems, network systems, probabilistic reasoning systems, sensor fusion systems, and optimization methods.

OR 531	Analytics and Decision Analysis	3
SYST 568	Applied Predictive Analytics	3
SYST 573	Decision and Risk Analysis	3
One free elective, chosen under advisement:		3
Total Credits		12

Concentration in Systems Engineering of Software-Intensive Systems (SESI)

This concentration addresses the software component of the systems engineering life cycle. It specifically covers the allocation of system requirements to software. Practitioners are concerned with the theoretical and practical aspects of technology, cost, and the social effect of computer systems that are reliable, maintainable, secure, efficient, and cost effective. The program emphasizes the integration of hardware, software, and firmware, and the management of these complex computer systems over their life cycle through systems engineering methods, tools, and processes.

With careful planning, students who complete this concentration might be able to complete the Engineering Resilient Enterprise Systems Graduate Certificate simultaneously with their MS.

SYST 542	Decision Support Systems Engineering	3
SYST 618	Model-based Systems Engineering	3
One from the following:		3
ECE 528	Introduction to Random Processes in Electrical and Computer Engineering	
OR 531	Analytics and Decision Analysis	
OR 541	Operations Research: Deterministic Models	
OR 542	Operations Research: Stochastic Models	
OR 568	Applied Predictive Analytics	
or SYST 568	Applied Predictive Analytics	
SYST 563	Evidence-Based Systems Engineering	
SYST 573	Decision and Risk Analysis	
SYST 620	Discrete Event Systems	

SYST 664	Bayesian Inference and Decision Theory	
One free elective, chosen under advisement:		3
Total Credits		12

Concentration in Systems Management (SMG)

The management aspect of systems engineering involves tracking and control of system development through the major phases of the system lifecycle, identifying and resolving problems to minimize their effect on cost, schedule, or performance, and iteratively improving product and process. This concentration emphasizes the theory and practice of systems management and prepares students for careers in managment.

SYST 514	Systems Thinking	3
SYST 618	Model-based Systems Engineering	3
SYST 630	Systems Engineering Management II	3
One free elective, chosen under advisement:		3
Total Credits		12

Project or Thesis

Students must complete a capstone project (3 credit hours) or thesis (6 credit hours) under the direction of a Systems Engineering faculty member.

Under the project option, the student completes three credit hours of SYST 699 Masters Project. Students in these courses work in teams on an approved applied project. A project report is submitted at the end of the semester, and a final project presentation is made to the entire faculty of the SEOR Department.

The thesis option requires approval by the department chair and approval is only given in rare circumstances. Under the thesis option, the student completes six credit hours of SYST 799 Master's Thesis. The master's thesis should reflect a significant independent research effort. The work is conducted under the guidance of a faculty thesis advisor, and the final written thesis and oral defense are approved by a three-member faculty committee and submitted to the library. The thesis work is expected to be completed while taking six semester hours of SYST 799 Master's Thesis. Although a student is required to maintain continuous enrollment by registering for SYST 799 Master's Thesis each semester until the thesis is completed, only six hours will be applied to the degree.

Select one from the following:		3-6
SYST 699	Masters Project (3 credits)	
SYST 799	Master's Thesis (6 credits)	
Total Credits		3-6

Accelerated Master's

BS (selected)/Systems Engineering, Accelerated MS

Overview

Highly-qualified students in selected BS programs (see below) have the option of obtaining an accelerated Systems Engineering, MS.

For more detailed information, see AP.6.7 Bachelor's/Accelerated Master's Degrees. For policies governing all graduate degrees, see AP.6 Graduate Policies.

Admission Requirements

Mason undergraduate students majoring in civil and infrastructure engineering, computer engineering, computer science, electrical engineering, or systems engineering may apply to this option if they have earned 90 undergraduate credits with an overall GPA of at least 3.30 and completed all MATH and PHYS requirements. Criteria for admission are identical to criteria for admission to the Systems Engineering, MS program.

Accelerated Option Requirements

Up to two courses (6 credits) of approved master's level courses taken as part of the undergraduate degree may be applied to the graduate degree. These two courses may be chosen from the graduate courses in the following table.

For BS candidates, these graduate courses replace the corresponding undergraduate courses listed. The undergraduate version of these courses may not be applied toward the MS degree.

Undergraduate	Graduate	
SYST 420	SYST 521	Credit may not be received for both courses.
SYST 473	SYST 573	Credit may not be received for both courses.
OR 441	OR 541	Credit may not be received for both courses.
OR 442	OR 542	Credit may not be received for both courses.

Any other 500-level course may be applied to both the undergraduate and graduate degrees with approval of the advisor and SEOR department chair.

Degree Conferral

Students must apply the semester before they expect to complete the BS requirements to have the BS degree conferred. In addition, at the beginning of the student's final undergraduate semester, students must complete a Bachelor's/Accelerated Master's Transition form that is submitted to the Office of the University Registrar and the VSE Graduate Admissions Office. At the completion of MS requirements, a master's degree is conferred.