

SYSTEMS ENGINEERING AND OPERATIONS RESEARCH, PHD

Banner Code: EC-PHD-SEOR

Academic Advising

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This doctoral program offers a unique integration of systems engineering and operations research. This integration gives students a strong analytical and computational capability combined with an overarching systems perspective that is well-grounded in application. No other department in the nation offers a PhD degree program that covers systems engineering and operations research in this integrated manner. The program prepares students for leadership positions in research and development in government, industry, and academia.

Admissions & Policies

Admissions

All general Mason and specific College of Engineering and Computing admissions requirements apply. Candidates for the PhD program typically must hold an MS degree from an accredited institution of higher education in systems engineering, operations research or related areas in engineering, mathematics, and computer science with a minimum graduate GPA of 3.50 and a minimum undergraduate GPA of 3.00. In addition, well-qualified candidates holding a BS degree in these areas may apply directly to the PhD program.

All applicants should have a strong background in engineering mathematics, which includes three semesters of calculus, differential equations, linear algebra, and probability. In addition, students entering the doctoral program must have a sound working knowledge in computing.

The admission process involves submitting the application for admission, undergraduate and graduate transcripts from previous colleges and universities attended, three letters of reference, a résumé, and a statement that includes a self-assessment of past background and articulation of career goals and aspirations. Translations of international credentials must be provided if they are not in English; in some cases, applicants will be required to have documents evaluated by an external agency. A satisfactory score on the TOEFL examination is required for non-native English speakers. GRE test results are recommended but not required. All of an applicant's background is examined before an admission decision is made.

Policies

For policies governing all graduate programs, see AP.6 Graduate Policies (<https://catalog.gmu.edu/policies/academic/graduate-policies/>).

Program Requirements

The program includes: course requirements; a qualifying exam that tests fundamental concepts in systems engineering and operations research; a comprehensive exam that tests the research competency of the student; dissertation proposal defense; dissertation research; and dissertation pre-defense and defense. All general Mason and specific College of Engineering and Computing requirements apply to this program.

PhD dissertations are extremely time intensive, and successful completion requires full time focus. It is expected that students who have reached candidacy (that is, successfully presented their dissertation proposal) will spend full time on their research for at least one academic year and will attend the majority of the SEOR departmental seminars throughout that period.

Transfer of Credit

The doctoral program is a 72 credit hour program; however, students entering with a master's degree in a related discipline may be given up to 24 transfer credits, AP.6.5 (<https://catalog.gmu.edu/policies/academic/graduate-policies/#ap-6-5>). Transfer credit requires the approval of the program director or designee and the dean or designee of the school. They determine whether the credits are eligible for transfer, applicable to the degree program and the number of credits to be transferred.

The 72 hours of required doctoral-level credits typically consist of 48 credits of coursework and 24 credits of dissertation research. Students who receive a transfer of credit will complete a minimum of 48 credits as outlined in Degree Requirements.

All decisions concerning the student's course requirements and plan of study must be approved by the dissertation committee chair, as well as by the department's doctoral coordinator.

Requirements

Degree Requirements

Total credits: 72

Doctoral Coursework

A GPA of 3.50 is required, and no grade of C is allowed in doctoral coursework. Students lacking prerequisites for their courses or lacking the coursework to complete the qualifying exams or their dissertation may need to take additional courses.

Code	Title	Credits
OR 568	Applied Predictive Analytics	3
or SYST 568	Applied Predictive Analytics	
SYST 763	Research Methods in Systems Engineering and Information Technology	3
or OR 763	Research Methods in Systems Engineering and Information Technology	

Select 12 credits of 700-level SEOR approved courses; students in the ME concentration may include credits from 700-level ME approved courses (<https://catalog.gmu.edu/courses/seor/>)^{1,2} 12

Select 6 credits in SYST or OR courses numbered 600 or higher; students in the ME concentration may include credits from 600-level ME approved courses (https://catalog.gmu.edu/courses/seor/) ^{2,3}	6
SYST Courses (https://catalog.gmu.edu/courses/syst/)	
OR Courses (https://catalog.gmu.edu/courses/or/)	
SEOR 800 Systems Engineering and Operations Research Colloquium I ⁴	0
or ME 500 Mechanical Engineering Seminar	
Total Credits	24

¹ A list of approved courses is available from the SEOR department. Approved courses for the concentration in Mechanical Engineering are available from the ME department.

² No more than 3 credits are allowed for a directed reading course. All courses and course substitutions must be approved by the student's dissertation committee chair and the SEOR doctoral coordinator.

³ Excluding SYST 699 and OR 699.

⁴ Students must register for the 0-credit SEOR 800 three times before being able to take SEOR 997. Students in the Mechanical Engineering concentration may take ME 500 in place of SEOR 800.

Additional Coursework Requirements

Students entering without a master's degree are required to complete an additional 24 credits of Master's level courses, including the following:

Code	Title	Credits
SYST 505	Systems Engineering Principles	3
SYST 520	System Engineering Design	3
OR 541	Operations Research: Deterministic Optimization	3
OR 542	Operations Research: Stochastic Models	3
Select 12 additional credits from one of two alternatives (systems engineering or operations research) ¹		12
Total Credits		24

¹ Consult the SEOR Department for the list of allowable courses.

Students in the Mechanical Engineering concentration who enter without a masters are required to complete an additional 24 credits of Master's level courses, including the following:

Code	Title	Credits
Three courses from the following list:		9
SYST 505	Systems Engineering Principles	
SYST 520	System Engineering Design	
OR 541	Operations Research: Deterministic Optimization	
OR 542	Operations Research: Stochastic Models	
One course from the Mechanical Engineering (ME) Specialized Coursework list ¹		3
Select 12 additional credits from systems engineering, operations research, and mechanical engineering ²		12
Total Credits		24

¹ See the "Specialized Coursework" section of the INFT, PhD (<https://catalog.gmu.edu/colleges-schools/engineering-computing/information-technology-phd/#requirements-text>) program. Students should reference the Mechanical Engineering (ME) list of courses for this requirement.

² Consult the SEOR Department and ME Department for the list of allowable courses.

Note

With appropriate selection of courses, students may obtain the MS degree in systems engineering or operations research by completing 6 additional credits, including 3 approved credits from the advanced emphasis courses (which may also apply towards the PhD degree advanced emphasis requirements) and 3 credits of either SYST 699 Masters Project or OR 699 Masters Project. Consult the SEOR Department for further detail. Credits taken in the courses SYST 699 or OR 699 may not be applied towards the PhD degree program requirements.

Qualifying Exams

The exams are primarily for testing the students' familiarity with fundamental concepts. Each student must take the following four exams within two years of enrolling in the program:

- Systems Engineering Principles
- Systems Engineering Design
- Deterministic Models
- Stochastic Models

Students in the Mechanical Engineering concentration must take three of the four exams (systems engineering principles, systems engineering design, deterministic models, and stochastic models) plus one ME qualifying exam corresponding to a Fundamental Knowledge course.

A student who passes three of the four exams in the first attempt must retake and pass the failed exam within one year. A student who passes fewer than three exams in the first attempt must retake and pass an entire set of four exams within one year. After two unsuccessful attempts, a student is terminated from the PhD program.

Systems Engineering and Operations Research Colloquium II

Code	Title	Credits
SEOR 997	Systems Engineering and Operations Research Colloquium II ¹	3

¹ SEOR 997 must be taken after coursework is completed, after three semesters of SEOR 800 are completed, and along with SEOR 998. Students should also have a dissertation advisor and a dissertation topic prior to registering. The colloquium presentation in SEOR 997 must be given at least one month prior to the proposal defense.

Dissertation Research

Code	Title	Credits
Select 21 credits from the following:		21
SEOR 998	Doctoral Dissertation Proposal	

SEOR 999 Doctoral Dissertation (must complete a minimum of 12 credits)

Total Credits

21

Doctoral Supervisory Committee

Students should identify a potential dissertation director and approach them to see if they are willing to work together, and identify a doctoral supervisory committee as soon as possible. It is recommended that the committee be formed by the end of the second or third semester of study.

The dissertation director must be a member of the SEOR graduate faculty or a member of the Mason graduate faculty with approval from the SEOR department chair. The doctoral supervisory committee must include at least three members from the SEOR department-approved graduate faculty, and at least one non-SEOR member from the Mason graduate faculty. The composition of the doctoral supervisory committee is to be approved by the doctoral coordinator. At least four members of the committee must be members of the Mason graduate faculty.

For students in the Mechanical Engineering concentration, the dissertation director must be a member of the Mechanical Engineering graduate faculty. The doctoral supervisory committee (including the dissertation director) must include at least four members of the Mason graduate faculty. The committee must include at least one member from ME graduate faculty and at least one member from the SEOR graduate faculty. At least three committee members must be from either the ME graduate faculty or the SEOR graduate faculty. The composition of the doctoral supervisory committee is to be approved by the doctoral coordinator.

Comprehensive Exam

The comprehensive exam is taken after the student has satisfactorily completed all the advanced emphasis coursework requirements in the approved plan of study filed by the student. The examiners will include the supervisory committee plus any outside examiners considered appropriate. However, the supervisory committee determines whether the student passes or not. The comprehensive exam consists of a written examination of 8 hours in length and an oral examination. The committee will determine if the student has a mastery of the advanced emphasis coursework. If a student fails the comprehensive exam, the student may request a re-examination within 60 days of receiving notice of the exam result. The request should be made in writing to the doctoral coordinator. If the student fails the re-examination or does not request a re-examination within 60 days, the student may be terminated from the PhD program. In such a case, with recommendation of the supervisory committee and approval of the SEOR Chair, the student may apply his/her coursework towards a master's degree.

Dissertation Proposal

After passing the comprehensive exam, each doctoral student prepares a written dissertation proposal, which is presented to the doctoral supervisory committee. After successfully completing SEOR 997 Systems Engineering and Operations Research Colloquium II, this requirement, and with the dissertation supervisory committee's recommendation, the student is formally admitted as a candidate for the PhD degree.

Dissertation Defense

When the central portions of the research have been completed to the point where the student is able to describe the original contributions of the dissertation effort, a candidate submits the written dissertation to

the supervisory committee and schedules an oral predefense with the committee. The predefense is attended by the supervisory committee. The supervisory committee must approve the work or the student must schedule a second predefense.

Once the committee believes the student is ready, a final public oral defense may be scheduled no sooner than one month after the conclusion of the predefense, with an announcement posted for at least two weeks. The defense must be attended by the supervisory committee and the department's doctoral coordinator, unless an exception has been approved in advance by the doctoral coordinator. Following a satisfactory evaluation of the oral defense of the dissertation by the supervisory committee, the student must prepare, with supervision from the dissertation director, a final publishable dissertation that represents a definitive contribution to knowledge in systems engineering and operations research. This document must meet format guidelines specified by the Guide for Preparing Graduate Theses, Dissertations, and Projects. If the student fails to successfully defend the dissertation, the student may request a second defense, following the same procedures as for the initial defense. There is no time limit for this request, other than the general time limits for the doctoral degree. An additional predefense is not required, but the student is strongly advised to consult with the committee before scheduling a second defense. If the student fails on the second attempt to defend the dissertation, the student will be terminated from the PhD program.

Concentration in Mechanical Engineering (ME) (Optional)

This concentration is suitable for students who wish to pursue doctoral research in areas related to mechanical engineering with a foundation in systems engineering and operations research. The concentration has modified requirements for coursework, qualifying exams, and the doctoral supervisory committee, as described in the relevant sections.

Students whose primary research interests are in systems engineering and operations research should follow the standard program requirements for the PhD/SEOR without enrolling in this concentration.