

# SYSTEMS ENGINEERING

## Systems Engineering Program Information

(251) 341-4735

Systems Engineering Program website

<https://www.southalabama.edu/colleges/engineering/phd-se> (<https://www.southalabama.edu/colleges/engineering/phd-se/>)

### Systems Engineering Program Faculty

| Title               | Name          |
|---------------------|---------------|
| Program Coordinator | Sean Walker   |
| Assistant Professor | Kari Lippert  |
| Assistant Professor | Bhushan Lohar |

## Master of Science in Systems Engineering (MS)

The program for the Master of Science in Systems Engineering (MSSE) focuses on holistic views of systems. As the complexity of everything increases, it is important for engineers to recognize that everything can be viewed as a system. The MSSE takes a total system lifecycle view – from cradle to grave. The program provides an ideal mix of theory and a practical experience-based approach to systems engineering. It is suitable for both working engineers looking for a broader view of engineering as well as for full-time students wishing to find out more about systems. Courses include the system lifecycle, project engineering, systems thinking and software systems engineering. At USA, we emphasize a model-based systems engineering approach (MBSE) in many of our courses. Graduates will have acquired the background needed to move into any industry that understands and values early concept development, the importance of solid systems requirements, systems integration, and verification and validation. Most graduate courses in Systems Engineering are offered in late afternoon or early evening, in a blended classroom/webcast format, to accommodate remote and practicing engineers.

### Requirements for Admission to MSSE Program

The following requirements are additional to the requirements of the Graduate School. Final admission decisions are made based upon an evaluation of the applicant's complete file which consists of all official academic transcripts, undergraduate grade-point average, Graduate Record Exam (GRE) scores (when required), English language test score (for international applicants), work history, program enrollment, and funding availability if required by the applicant. Admission may be granted by the Systems Engineering Program Director in special cases where holistic evaluation shows that the applicant's credentials and work experience are appropriate. GRE scores are not required for regular admission, but students may be required to present GRE scores to be eligible for some assistantships or fellowships.

### Regular Admission to MSSE Program

1. A minimum grade-point average of 3.0 or greater (on a scale of 4.0) on all undergraduate coursework leading to the award of a Bachelor's degree in a discipline related to engineering (e.g. civil, computer, chemical, electrical, industrial, mechanical engineering; other related STEM majors may be considered on a case-by-case basis).

2. Grade B or higher for all graduate courses to be considered as transfer credits from previous institutions attended. Only graduate credits that have not been applied to another degree can be considered for transfer.
3. Official transcripts from all colleges and universities attended by the applicant.
4. For international students whose native language is not English, a minimum score of 79 on the Internet-based TOEFL, or a minimum score of 213 on the computer-based TOEFL, or a minimum score of band 6.5 on the IELTS test, or a minimum overall score of 58 on the Pearson PTE Academic Test, or a minimum Duolingo score of 100.

### Provisional Admission to MSSE Program

1. A grade-point average of 2.5 or greater (on a scale of 4.0) on all undergraduate coursework leading to the award of a Bachelor's degree in a discipline related to engineering (e.g. civil, computer, chemical, electrical, industrial, mechanical engineering; other related STEM majors may be considered on a case-by-case basis).
2. Officially certified minimum score of 146 in the Verbal portion and a minimum score of 151 in the Quantitative portion of the Graduate Record Examination (GRE). This requirement is waived for students who received an engineering BS degree from the University of South Alabama (but those students may be required, however, to present GRE scores to be eligible for some assistantships or fellowships.) Applicants holding a current P.E. license, or holding a Bachelor's degree in an engineering discipline (e.g., civil, computer, chemical, electrical, industrial, or mechanical engineering), or having a minimum of five years of engineering work experience, may request that this GRE requirement be waived. Strong GRE scores may improve chances of acceptance for candidates who do not have a strong GPA or English language scores.
3. All other requirements for Regular Admission to the MSSE program (see above), except that the grade-point average required is reduced as above.

## Doctor of Philosophy in Systems Engineering (Ph.D.)

The Doctor of Philosophy (Ph.D.) in Systems Engineering offers students a holistic approach to the design and understanding of complex systems. NASA defines systems engineering as "a holistic, integrative discipline, wherein the contributions of structural engineers, electrical engineers, mechanism designers, power engineers, human factors engineers, and many more disciplines are evaluated and balanced, one against another, to produce a coherent whole that is not dominated by the perspective of a single discipline." At USA, we emphasize a model-based systems engineering approach (MBSE) in many of our courses. The main objectives of the Ph.D. program are to

1. provide our graduates with the ability to approach all systems (engineered, environmental, coastal, biological, social/organizational, etc.) with the ability to understand the entire system lifecycle in a manner that meets the needs of industry, and
2. prepare our graduates for leadership positions requiring applied research along with critical and creative thinking.

This program is appropriate for students who want to pursue research-based careers in industry, government, or academia. The program requires coursework across multiple engineering disciplines, and specific, validated systems research resulting in a publicly defended doctoral thesis.

## Requirements for Admission to Systems Engineering Ph.D. Program

GRE scores are not required for regular admission. However, a strong GRE score may improve chances of acceptance for candidates who do not have a strong GPA or English language scores. Students may be required to present GRE scores to be eligible for some assistantships or fellowships.

Final admission decisions are made based upon an evaluation of the applicant's complete file which consists of all official academic transcripts, undergraduate grade-point average, GRE scores (when required), letters of recommendation, the applicant's statement of purpose, English language test score (for international applicants), work history, program enrollment, and funding availability if required by the applicant. Admission may be granted by the Systems Engineering Program Director in special cases where holistic evaluation shows that the applicant's credentials and work experience are appropriate. The Ph.D. Admission Committee reserves the right to review coursework at the Bachelor's degree level before making any admission decision.

## Requirements for Regular Admission (already holding Master's degree) to Ph.D. Program

In addition to meeting Graduate School requirements, the requirements for **Regular Admission** into the Systems Engineering Ph.D. program when already holding a Master's degree are as follows:

1. A written Statement of Purpose outlining the applicant's professional goals and commitment to completing the degree requirements.
2. Three letters of recommendation, from individuals familiar with the student's academic and technical abilities, describing the applicant's ability to succeed in the Ph.D. degree in Systems Engineering.
3. A Master's degree in a discipline related to engineering (e.g. civil, computer, chemical, electrical, industrial, mechanical engineering; other related STEM majors may be considered on a case-by-case basis).
4. All other requirements for Regular Admission to the Systems Engineering MS program (see above), except that the grade point average requirement of 3.0 or greater (on a scale of 4.0) applies instead to all graduate (not undergraduate) coursework, and other STEM Bachelor's degrees may be considered depending on relevant factors such as time spent working and gaining experience in an Engineering field or environment. GRE scores are not required.

## Requirements for Regular Admission (not already holding Master's degree) to Ph.D. Program

As above for Regular Admission (already holding Master's degree), except that the requirement to hold a Master's degree does not apply, and the grade point average of 3.0 or greater (on a scale of 4.0) is required on all undergraduate (not graduate) coursework.

## Requirements for Provisional Admission to Ph.D. Program

1. A written Statement of Purpose and the letters of recommendation as specified above for Regular Admission (already holding a Master's degree).
2. All other requirements for Provisional Admission to the Systems Engineering MS program (see above).

## Academic Dismissal

The Dean of the Graduate School has authority to dismiss graduate students from the Graduate School for any of the following reasons:

1. Any term in which a graduate student drops below a 3.0 Program GPA, the student is placed on probationary status and has a period of two terms to attain a 3.0 Program GPA or be dismissed.
2. Having two unsuccessful attempts to pass the Qualifying Exam or Proposal Defense.
3. Receiving a course F grade that has not been improved by repeating the course.
4. Having an average GPA less than 3.0 (grade B average) after earning 10 or more credits.
5. Receiving three or more C grades.

A student who has been academically dismissed is eligible to reapply to the Graduate School subject to the approval of the Director of Graduate Studies of the specific new program and the Dean of the Graduate School. This is not intended to include the program from which the student has been dismissed. Once placed on dismissal status, a student must meet with his/her advisor and complete a Remediation Action Plan (RAP). This plan must be submitted to the Registrar before the student is allowed to take additional courses.

## Non-Academic Dismissal

A student dismissed from the Ph.D. program as the result of an academic misconduct penalty will be automatically dismissed from the Graduate School and the University of South Alabama and will not be eligible to apply for readmission.

## Degrees, Programs, or Concentrations

- Systems Engineering (MS) (<http://bulletin.southalabama.edu/programs-az/engineering/systems-engineering/systems-engineering-ms/>)
- Systems Engineering (Ph.D.) (<http://bulletin.southalabama.edu/programs-az/engineering/systems-engineering/systems-engineering-phd/>)
- Systems Engineering Certificate Program (<http://bulletin.southalabama.edu/programs-az/engineering/systems-engineering/systems-engineering-certificate-program/>)

## Courses

### Engineering (EG)

### Systems Engineering (SE)

#### SE 500 Engr Probability & Statistics 3 cr

Probability and statistical concepts; discrete, continuous, and joint distributions; point and interval estimation; hypothesis testing; regression and correlation analysis; analysis of variance.

#### SE 501 Engineering Optimization 3 cr

Model construction, linear programming, network models, dynamic models, stochastic models, queuing theory, and decision theory.

**Prerequisite:** SE 500 (may be taken concurrently) Minimum Grade of B

#### SE 590 Special Topics in SE 3 cr

Topics of current interest in Systems Engineering. Fee

**SE 592 Directed Study in SE 3 cr**

Directed study, under the guidance of a faculty advisor, of a topic from the field of Systems Engineering not offered in a regularly scheduled course. Requires Instructor's permission.

**SE 594 Projects in SE 3 cr**

An investigation of an original problem in Systems Engineering, under the guidance of a faculty advisor. Approval of the project prospectus by the student's advisory committee and consent of the Director of Engineering Graduate Studies.

**SE 599 Thesis 1-6 cr**

An investigation of an original problem in Systems Engineering under the guidance of the student's major professor. Approval of the dissertation prospectus by the student's Advisory Committee, the Graduate School, and consent of the Director of Engineering Graduate Studies.

**SE 601 Systems Eng Fundamentals 3 cr**

Fundamentals of systems engineering, structure of complex systems, system development process, systems engineering management and documentation, needs analysis, requirements development, engineering design and development, integration and test, change management, process improvement.

**SE 602 Risk and Failure Analysis 3 cr**

Risk Analysis needs, risk analysis methods, performance requirement analysis, trade studies, failure analysis needs, failure analysis tracking, and failure analysis methods. Pre-requisites: Requires a background in calculus-based statistics and permission of instructor.

**SE 603 Integration, Test & Evaluation 3 cr**

Interface control documents, design reviews, requirements management, allocation of test methods to requirements, test plans, test procedures, test execution, and failure tracking and resolution.

**Prerequisite:** SE 601 Minimum Grade of C

**SE 604 Software Systems Engineering 3 cr**

Software development methodologies, software development tools, change management, software concept development, software requirements development and allocation, coding and unit test, program technical interfaces, software engineering management.

**Prerequisite:** SE 601 Minimum Grade of C

**SE 605 Project Engineering 3 cr**

Management of system design, development and risk, work breakdown, structure, systems engineering management plan, design reviews, budget and schedule analyses, negotiation and conflict resolution, contracts, customer interactions, team selection, failure resolution.

**SE 606 Systems Architecture 3 cr**

The systems architecture is that foundational structure of a system, capturing the core capability and structure of the system. This course will cover principles of systems architecting, system architecture drivers, relationship of systems architecture to system requirements, common tools and techniques to include design structure matrices, IDEF0, SysML, and simulation.

**Prerequisite:** SE 601 Minimum Grade of C

**SE 607 Systems Simulation 3 cr**

This course rigorously examines system modeling and simulation methodologies, emphasizing statistical analysis and discrete-event simulation via simulation software.

**SE 608 Reliability Engineering 3 cr**

This course rigorously examines reliability and maintainability methodologies, emphasizing mathematical constructs, design concepts, and data analysis employed to quantify reliability, availability, and maintainability measures for operational readiness, support system design, and system effectiveness.

**SE 609 Engineering Research Methods 3 cr**

This course is a fast tracked course examining quantitative and qualitative methods for conducting meaningful inquiry and research. Topics include research ethics, intent, design, methodologies, techniques, formatting, data management, analysis, publication, and presentation utilizing common statistical approaches.

**SE 610 Systems Thinking 3 cr**

The act of systems thinking is taking a step back from the details considered during engineering design, and looking at the whole picture. This class exposes the student to a conceptual framework to allow them to properly define complex systems and enterprises drawing from synthesizing techniques from systems science, soft systems methodologies, and systems engineering. The class demonstrates the ability to leverage the simultaneity of perspectives, the role of paradox, and the centrality of soft issues in resolving complexity.

**SE 611 Socio-Technical Systems 3 cr**

Socio-Technical systems are those systems which contain and/or are strongly influenced by human, social and institutional elements. Because of those influences, they quickly become dependent on community partnerships, infrastructure constraints, and government-aspects that are not traditionally part of the engineering equation. This course considers the systems engineering approach as it relates to the challenges of socio-technical systems.

**SE 612 Production System Engineering 3 cr**

This course rigorously examines principles, design, models and techniques for operational planning and analysis of production and distribution systems emphasizing quantitative methods.

**SE 613 Decision Analysis 3 cr**

This course will give the engineering student the analysis techniques used to assess single participant multiple criteria and multiple participant multiple criteria decisions. As decisions occur throughout the lifecycle of a system, the variety of engineering decision techniques introduced can be applied to a myriad of decisions.

**SE 614 Sys Lifecycle Cost Analysis 3 cr**

Systems engineering considers the entire lifecycle of a system. Therefore, it makes sense to consider the entire cost of the product or system form cradle to grave. This course presents methods, processes, and tools needed to conduct cost analysis, estimation, and management of complex systems.

**SE 615 Engineering Management 3 cr**

Engineering management is an integral part of any engineered system. Topics to be covered include team project vision, mission, goals, organization, tools, management and leadership, managing technical issues, coordination and control. This course is relevant to any engineering or technical discipline.

**SE 616 Requirements Engineering 3 cr**

Systems requirements are the foundation of all engineered systems. They form the basis for what the customer wants, what the engineer produces, and what the system accomplishes. There must be synergy between those three perspectives. This course addresses the process of identifying systems requirements before the system exists, writing effective and concise requirements, writing testable requirements, and the management of those requirements as the system is engineered.

**SE 621 Digital Twin Foundations 3 cr**

The realm of designing and defining digital twins will belong to the systems engineer of the future. The Unity game engine is a gateway to mastering development of high-caliber digital twins and creating unparalleled virtual prototypes. Students will be prepared to take the Unity Associate Game Developer Certification. Prior programming experience useful, but not required.

**SE 622 Systems Engineering Internship 1-3 cr**

The Systems Engineering Internship provides students with the opportunity to work up in an engineering role. In this course students will learn to apply their knowledge of Systems Engineering to practical engineering problems in the workplace.

**SE 690 Special Topics in SE 3 cr**

Topics of current interest in Systems Engineering.

**SE 692 Directed Studies 3 cr**

Directed study, under the guidance of a faculty advisor, of a topic from the field of Systems Engineering not offered in a regularly scheduled course. Prerequisite: Instructor's permission.

**SE 699 Dissertation 1-6 cr**

An investigation of an original problem in Systems Engineering under the guidance of the student's major professor. Prerequisite: Approval of the dissertation prospectus by the student's Advisory Committee, the Graduate School, and consent of the Director of Engineering Graduate Studies.

## Faculty

**Faculty Name**

LIPPERT, KARI JOANN  
(klippert@southalabama.edu)

**Faculty Department**

General Engineering

**Faculty Position**

Assistant Professor

**Degrees Held**

BS, University of Toledo  
MS, Johns Hopkins University  
DSC, University of South Alabama