

Systems Engineering

Department Information

Systems Engineering Program Staff		(251) 460-7993
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Systems Engineering Program website
<https://www.southalabama.edu/colleges/engineering/phd-se>

Doctor Of Philosophy (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 (With Master's Degree)

In addition to meeting Graduate School requirements, the requirements for admission with a Master's degree to the Ph.D. Program 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.
3. A M.S. degree in a discipline related to engineering (e.g. civil, computer, chemical, electrical, industrial, mechanical engineering, etc.).
4. A B.S. degree in a discipline related to engineering (e.g. civil, computer, chemical, electrical, industrial, mechanical engineering, etc.) (The Ph.D. Admission committee reserves the right to review the coursework at the B.S. level before making any admission decision.)
5. A grade point average of 3.0 or greater (on a scale of 4.0) on all graduate coursework.
6. Applicants whose highest degree is a graduate degree from an accredited institution of higher education will not be required to provide GRE scores.
7. 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.
8. Official transcripts from all colleges and universities attended by the applicant.

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), three letters of reference regarding the

applicant's ability to succeed in the Ph.D. in Systems Engineering, the applicant's statement of purpose, and TOEFL or IELTS or iTEP or Pearson PTE Academic score (for International applicants), applicant's work history, program enrollment and funding availability if required by applicant.

Admission may be granted by the Systems Engineering Program Director in special cases where a holistic evaluation shows that the applicant's credentials and work experience are appropriate.

Requirements For Admission (With Bachelor's Degree)

In addition to meeting Graduate School requirements, the requirements for acceptance without a Master's degree are as follows:

1. A Bachelor's degree in a discipline related to engineering (e.g. civil, computer, chemical, electrical, industrial, mechanical engineering, etc.). Other STEM Bachelor's degrees MAY be considered if the degree led to working in an Engineering field and the applicant has gained experience. (Factors such as length of time and experience gained will be considered at the admission committee's discretion. The Ph.D. admission committee reserves the right to review the coursework at the B.S. level before making any admission decision.)
2. A grade point average of 3.0 or greater (on a scale of 4.0) on all undergraduate coursework.
3. A grade of 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.
4. Official transcripts from all colleges and universities attended.
5. A minimum score of 151 in the Verbal portion and a minimum score of 151 in the Quantitative portion of the Graduate Record Examination (GRE) (see further details below).
6. 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.

Applicants for the Ph.D. program must submit officially certified scores on the Graduate Record Exam (GRE). This requirement is waived for students who received an engineering B.S. degree from the University of South Alabama. (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 a minimum of five years of engineering work experience, may request that the GRE requirement be waived.

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), three letters of reference regarding the applicant's ability to succeed in the Ph.D. degree in Systems Engineering, the applicant's statement of purpose, TOEFL or IELTS or iTEP or Pearson PTE Academic scores (for International applicants), applicant's work history, program enrollment and funding availability if required by applicant.

Admission may be granted by the Systems Engineering Program Director in special cases where a holistic evaluation shows that the applicant's credentials and work experience are appropriate.

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. Program admission and MS degree requirements, as well as plan of study options (thesis, project, and coursework only), are described under the College of Engineering section of this Bulletin. 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 admission criteria for the College of Engineering (see Admission to Graduate Programs):

Regular Admission

1. A grade-point average of 3.0 or greater (on a scale of 4.0) on all undergraduate coursework.
2. A minimum score of 146 in the Verbal portion and a minimum score of 151 in the Quantitative portion of the Graduate Record Examination (GRE) (see further details below).
3. 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.

Provisional Admission

1. A minimum grade-point average of 2.5 or greater (on a scale of 4.0) on all undergraduate coursework.
2. A minimum score of 138 in the Verbal portion and a minimum score of 141 in the Quantitative portion of the Graduate Record Examination (GRE) (see further details below).
3. 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.

Applicants for the MSSE program must submit officially certified scores on the Graduate Record Exam (GRE). This requirement is waived for students who received an engineering BS degree from the University of South Alabama. (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 a minimum of five years of engineering work experience, may request that the GRE requirement be waived.

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), and TOEFL or IELTS or iTEP or Pearson PTE Academic score (for International applicants), applicant's work history, program enrollment and funding availability if required by applicant.

Admission may be granted by the Systems Engineering Program Director in special cases where a holistic evaluation shows that the applicant's credentials and work experience are appropriate.

Areas Of Study

Systems Engineering (MS)
 Systems Engineering (Ph.D.)
 Systems Engineering Certificate Program

Courses

Engineering (EG) (EG)

EG 101 Intro to Engineering & Design 2 cr

A course for first time engineering students that assists with maximizing the student's potential to achieve academic success and to adjust responsibly to the individual and interpersonal challenges presented by college life. Introduction to engineering fundamentals through reading, homework assignments, laboratory investigations, guest lecturers and group discussions on the engineering profession.

Pre-requisite: (MA 113 Minimum Grade of D or MA 172 Minimum Grade of D) or (MA 125 Minimum Grade of C or MA 132 Minimum Grade of D). MA 113 and MA 125 can be taken concurrently with this course.

EG 201 Intro to Engr & Prob Solving 0 cr

A course for first-time transfer students that helps maximize the student's potential to achieve academic success and to address the transition from community college to four-year college. Introduction to engineering fundamentals and problem solving techniques through reading, homework assignments, laboratory investigations, guest lecturers and group discussions on the engineering profession.
Pre-requisite: MA 126 Minimum Grade of C.

EG 220 Electrical Circuits 3 cr

Ohm's and Kirchhoff's laws. Network theorems- superposition, source transformation, Thevenin's and Norton's Theorems. RLC circuits. Sinusoids and phasors and their applications in RLC circuits. RMS values of voltages and currents. Operational amplifiers. Average power and power factor in AC circuits.
Pre-requisite: MA 126 Minimum Grade of C and PH 202 Minimum Grade of C.

EG 231 Intro to Ethics and Economics 3 cr

Introduction to ethics and the use of codes of ethics in developing an ethical profession. Application of engineering economic principles to engineering problems.
Pre-requisite: MA 126 Minimum Grade of C.

EG 270 Engineering Thermodynamics 3 cr

First and second law of thermodynamics with applications.
Pre-requisite: (MA 126 Minimum Grade of C and PH 201 Minimum Grade of C).

EG 283 Statics 3 cr

Use of vector algebra to analyze two and three dimensional forces, moments, and couples. Use of free body diagrams to analyze rigid bodies, beams, trusses, and frames in equilibrium. Calculation of the area and mass moments of inertia, and friction forces.
Pre-requisite: (MA 126 Minimum Grade of C and PH 201 Minimum Grade of C).

EG 284 Dynamics 3 cr

Kinematics and kinetics of particles and rigid bodies. Work/energy and momentum methods.
Pre-requisite: EG 283 Minimum Grade of C and MA 126 Minimum Grade of C.

EG 290 Sp Top - 1 TO 5 cr

Subjects of special interest in engineering. Requires permission of instructor.

EG 315 Mechanics of Materials 3 cr

An introduction to the mechanics of deformable bodies. Analysis of stress and strain. Emphasis on axial, torsional and bending loads. Deflections, deformations, and column stability.
Pre-requisite: EG 283 Minimum Grade of C and (MA 227 Minimum Grade of C and PH 201 Minimum Grade of C).

EG 360 Fluid Mechanics 3 cr

Study of the properties of fluids including fluid statics, kinematics; integral and differential equations of mass, momentum and energy conservation principles; dimensional analysis; flow in ducts; boundary layer flows; and compressible flow.
Pre-requisite: MA 238 Minimum Grade of D and EG 284 Minimum Grade of C.

EG 390 Special Topics- 1 TO 3 cr

This course covers topics of current interest in Engineering.

EG 450 Intro to Systems Engineering 3 cr

This course will explore the history of systems engineering, the problems that contributed to the need for systems thinking, and the systems engineering lifecycle as defined by ISO/IEC/IEEE 15288 Systems and Software Engineering -- System Life Cycle Processes. This course will include a significant reading list and a systems engineering exercise that will run for the duration of the course.

EG 490 Special Topics 1 TO 3 cr

This course covers topics of current interest in Engineering.

EG 494 DIS In Engineering 1 TO 3 cr

Directed study, under the guidance of a faculty advisor of a topic from the field of Engineering not offered in a regularly scheduled course.

EG 590 Sp Top - 1 TO 3 cr

Subjects of special interest in engineering for engineering graduate students. Requires permission of instructor.

EG 620 Biomedical Engineering I 4 cr

Fundamental concepts of medical instrumentation, biomedical imaging and biological systems modeling as used in biomedical engineering. Course is cross-listed with IDL 620. Fee.

EG 621 Biomedical Engineering II 4 cr

Fundamental concepts of transport phenomena, cellular and tissue mechanics, and materials as used in biomedical engineering. Course is cross-listed with IDL 621. Fee.

Systems Engineering (SE) (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.
Pre-requisite: SE 500 Minimum Grade of B. SE 500 can be taken concurrently with this course.

- 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 TO 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. Pre-requisite: SY 598 Minimum Grade of B.
- 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. Fee.
- 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. Fee.
- 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. Fee.
Pre-requisite: 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. Fee.
Pre-requisite: 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. Fee.
- 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.
Pre-requisite: 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 from 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 690 Special Topics in SE 3 cr

Topics of current interest in Systems Engineering. Fee.

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 TO 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

LIPPERT, KARI J.
Assistant Professor
BS, University of Toledo
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DSC, University of South Alabama