ENGINEERING, PHD

Program Description

The PhD in Engineering program prepares students to enter professional work or seek professorial positions in the engineering disciplines represented by the undergraduate engineering programs at TAMU-CC. Students can elect one of the four concentrations: Civil and Environmental Engineering, Electrical and Advanced Manufacturing Engineering, Industrial and Process Engineering, and Mechanical and Energy Engineering. Upon completion of the degree, the graduate will have a solid education in the fundamentals of engineering and have an opportunity to explore AI/machine learning for solving engineering problems; will have conducted impactful research; and will have developed the skills necessary allowing for continuing career advancement.

The PhD program is designed to operate in conjunction with the MS degree program in engineering at TAMU-CC. High-achieving and highly motivated undergraduate students at TAMU-CC may elect to take a predetermined number of graduate credits toward their undergraduate degree. Those students may be admitted to the accelerated BS/MS degree program at TAMU-CC. If they elect to pursue a degree of PhD in Engineering at TAMU-CC, they will be at an accelerated rate toward completion of their degree study.

Exceptional and high achieving students with a BS in Engineering degree maybe directly admitted to the PhD in Engineering program.

Program Goal: Prepare students to pursue careers in industry, academia, and government by offering a state-of-the-art curriculum and advanced knowledge and opportunities to conduct impactful research.

Student Learning Outcomes

Upon completion of the PhD in Engineering degree, graduates will be able to demonstrate the ability to

1. identify, formulate, and solve complex engineering problems;
2. conduct impactful research on topics related to the disciplines of engineering or related fields, independently or with minimal direction.
3. make original contributions to the chosen field of study.

For Additional Information

Website:
https://www.tamucc.edu/engineering/departments/engineering/index.php (https://www.tamucc.edu/engineering/departments/engineering/)

Campus Address:
Robert Furgason Engineering Building, Room 222
Phone: (361) 825-5849

Mailing Address:
Department of Engineering, Unit 5797
College of Engineering and Computer Science
Texas A&M University-Corpus Christi
6300 Ocean Drive
Corpus Christi, Texas 78412-5825

Admission Requirements

- In addition to meeting all University requirements, students seeking admission to the program for the Doctor of Philosophy in Engineering must submit the following in their applications:
  - An application and application fee
  - Transcripts from regionally accredited institutions (international students will be required to submit relevant international transcripts, with translations through approved translation services, if not in English)
  - An essay (500-1000 words) discussing why the student wishes to obtain a Ph.D. in engineering degree and the student's areas of interest
  - International students must show English language proficiency through either TOEFL or IELTS exam and submit additional documents as required.
- A student entering the program is expected to have adequate preparation in engineering and mathematics through their undergraduate degree. The PhD in Engineering has four concentration areas: civil and environmental engineering, electrical and advanced manufacturing engineering, industrial and process safety engineering, and mechanical and energy engineering. For civil and environmental engineering, this preparation must include successful completion of undergraduate coursework in structural engineering, materials, geotechnical engineering, and hydraulics / hydrology. For electrical and advanced manufacturing engineering, this preparation must include successful completion of undergraduate course work in circuits and networks, electronics, signal processing, controls, and microprocessors. For industrial and process safety engineering, this preparation must include successful completion of undergraduate coursework in human factors, operations research, simulations, manufacturing processes, and logistics. For mechanical and energy engineering, this preparation must include successful completion of undergraduate coursework in dynamics, materials science, strength of materials and solid mechanics, thermodynamics, fluid mechanics, and heat transfer. In addition to these, in the area of mathematics, all students must have successfully completed course work in calculus through multivariable calculus, differential equations, and at least one additional mathematics course such as linear algebra, numerical analysis, or applied probability and statistics.
- Students who have not successfully completed the above courses may be required to take undergraduate leveling courses in any missing subjects. All leveling courses must be completed with a grade of "B" or better.
- Students seeking admission to the PhD in Engineering program must identify a faculty member willing to serve as their graduate faculty advisor. Applicants may review the research interests of faculty members at engineering.tamucc.edu. Applicants should contact faculty members via e-mail and determine if a particular faculty member is willing to serve as their faculty advisor. Applicants will not be admitted to the program without a graduate advisor.

Program Requirements

The Ph.D. degree requires a minimum of 81 semester credit hours beyond a baccalaureate degree, and a minimum of 48 semester credit hours for a student who has completed a master's degree. A student in this program must pass the Qualifying Exam according to the departmental guidelines for the exam.

There are three areas from which students must complete the required number of semester credit hours: Engineering Graduate Cores I and II,

Engineering Elective Courses, and Research Courses. The three areas and the requirements from each area are listed below.

Engineering Graduate Cores I & II

Students without an MS degree must complete 12 hours of Engineering Graduate Core I and 12 hours from one of the four Core II concentration areas. Students with an MS in Engineering degree will take 12 hours from one of the Core II concentration areas.

Engineering Graduate Core I - Courses

Code	Title	Hours
ENGR 5401	Engineering Mathematics and Analysis	4
ENGR 5302	Numerical Methods for Engineers	3
ENGR 5305	Experimental Methods and Design in Engineering	3
ENGR 5101	Engineering Research Seminar I	1
ENGR 5102	Engineering Research Seminar II	1
Total Hours		**12**

Engineering Graduate Core II - Courses

Core II. a Civil & Environmental Engineering (12 hours)

Code	Title	Hours
ENGR 6302	Engineering Mathematics and Analysis II	3
CEEN 6323	Advanced Sustainable Infrastructure Engineering	3
CEEN 6324	Advanced Dynamics and Control of Civil Engineering Structures	3
CEEN 6334	Environmental Transport Processes	3
Total Hours		**12**

Core II. b Electrical & Advanced Manufacturing Engineering (12 hours)

Code	Title	Hours
ENGR 6302	Engineering Mathematics and Analysis II	3
EEEN 6315	Advanced Control Systems	3
EEEN 6323	Nanoscience and Nanotechnology	3
EEEN 6333	Random Signal Processes	3
Total Hours		**12**

Core II. c Industrial & Process Engineering (12 hours)

Code	Title	Hours
ENGR 6302	Engineering Mathematics and Analysis II	3
IEEN 6314	Advanced Systems Engineering	3
IEEN 6323	Human Factors Engineering for Vehicular Designs	3
IEEN 6334	Engineering Decision Theory	3
Total Hours		**12**

Core II. d Mechanical & Energy Engineering (12 hours)

Code	Title	Hours
ENGR 6302	Engineering Mathematics and Analysis II	3
MEEN 6315	Advanced Control Systems	3
MEEN 6322	Advanced Fluid Mechanics	3
MEEN 6332	Advanced Heat Transfer	3
Total Hours		**12**

Engineering Elective Courses

Students without an MS in Engineering degree must take 33 hours engineering graduate courses including 9 or more hours from Engineering 6000-level courses. Students with an MS in Engineering degree must take 12 hours engineering graduate courses including 9 or more hours from Engineering 6000-level courses.

Civil & Environmental Engineering

Code	Title	Hours
CEEN 6322	Optimization	3
CEEN 6341	Transportation Engineering	3
CEEN 6351	Geotechnical Engineering	3

Electrical & Advanced Manufacturing Engineering

Code	Title	Hours
EEEN 6314	Robotics and Autonomous Systems	3
EEEN 6322	Embedded Systems	3
EEEN 6332	Machine Vision and Image Processing	3

Industrial & Process Safety Engineering

Code	Title	Hours
IEEN 6313	Optimization	3
IEEN 6322	Ergonomics and Safety Engineering	3
IEEN 6333	Manufacturing Process Engineering	3

Mechanical & Energy Engineering

Code	Title	Hours
MEEN 6314	Robotics and Autonomous Systems	3
MEEN 6315	Advanced Control Systems	3
MEEN 6323	Computational Fluid Dynamics I	3
MEEN 6324	Turbulent Flow	3

Additional Electives (may be taken in addition to or in lieu of elective courses listed above)

Code	Title	Hours
ENGR 6390	Special Topics	3
ENGR 6396	Directed Independent Study	3

Other 6000-level courses in Sciences, Mathematics, or Statistics as Approved in Degree Plan

Research Courses

Students must take a minimum of 24 hours engineering research courses listed below.

Code	Title	Hours
ENGR 6311	Research	1-12
ENGR 6312	Dissertation Research	1-12
ENGR 6313	Dissertation	3-12
Total Hours		**24**

Courses

Engineering Courses

ENGR 6302 Engineering Mathematics and Analysis II
3 Semester Credit Hours (3 Lecture Hours)
Analytic methods and engineering problem solving; linear algebra; vectors and tensors; vector differential calculus; vector integral calculus and integral theorems; numerics for ODEs and PDEs; AI for engineering problem solving.
Prerequisite: ENGR 5401.

ENGR 6311 Research
1-9 Semester Credit Hours
course for students in Ph. D. in Engineering program. Open to Engineering Ph. D. students who have not yet passed the qualifying exam and with consent of their graduate advisor. The course is graded with an S or U, and may be repeated.

ENGR 6312 Dissertation Research
1-9 Semester Credit Hours
Research related to PhD dissertation. Open only to degree candidates having passed the qualifying exam in Engineering with consent of their graduate advisor. The course is graded with an S or U, and may be repeated.

ENGR 6313 Dissertation
3-9 Semester Credit Hours
Open only to degree candidates in Engineering with consent of their graduate advisor. Students should enroll in this course during their last semester of the Ph. D. in Engineering program. To successfully complete this course the student must pass the dissertation defense as well as have a final copy of the dissertation signed by the full graduate committee and approved for binding and distribution. A grade of Credit/No Credit will be assigned for the class with the possibility to assign the grade of IP or In Progress. If a grade of IP is assigned, the course must be repeated the following semester(s) until the course is passed.
Prerequisite: ENGR 6312.

ENGR 6390 Special Topics
3 Semester Credit Hours (3 Lecture Hours)
Study of advanced topics in engineering. May be repeated. Topics vary by semester and offering. Varies. Offered on demand.

ENGR 6396 Directed Independent Study
3 Semester Credit Hours
One-on-one study of advanced topics in engineering directed by individual faculty member. May be repeated for credit once. Topics vary by faculty member. Requires a formal proposal of study to be completed in advance of registration which must be approved by the supervising faculty member, department chair, and associate dean of the College of Engineering. Varies.

Civil Engineering Course

CEEN 6322 Optimization
3 Semester Credit Hours (3 Lecture Hours)
This course focuses on problem formulation, software technologies and analytical methods for optimization serving as an introduction to a wide variety of optimization problems and techniques including dynamic programming, network flows, integer programming, heuristic approaches, Markov chains, game theory, and decision analysis. This course provides tools to formulate engineering problems as the optimization of some function under some set of constraints. As such operations research is a quantitative discipline that deals with the application of advanced analytical methods to help make better decisions. This course employs techniques from other mathematical sciences, such as mathematical modeling, statistical analysis, and mathematical optimization and provides optimal or near-optimal solutions to complex decision-making problems. (Cross-listed with IEEN 6313 Optimization.)
Prerequisite: ENGR 5302.

CEEN 6323 Advanced Sustainable Infrastructure Engineering
3 Semester Credit Hours (3 Lecture Hours)
This course aims at providing students with simple scientific techniques for the optimum design of materials to improve its performance while minimizing cost and environmental impacts. The course aims at providing students with metrics of sustainability, principles of design for the environment, methods for pollution prevention, and use of mass and energy balances in the design of sustainable systems. In addition, concepts of Life-Cycle Assessment (LCA) and cost analysis are introduced to students. The concepts of carbon footprint and embodied energy of construction materials will be introduced to the students. The course will include new technologies, materials, and design processes for sustainable infrastructure; energy management and renewable energy and efficiency in structures; and connections between societal needs and infrastructure development.
Prerequisite: CEEN 5321 and 5331.

CEEN 6324 Advanced Dynamics and Control of Civil Engineering Structures
3 Semester Credit Hours (3 Lecture Hours)
Review of basic structural dynamics and response of structures to time-varying loadings; standard and special models of structures; controllability and observability; actuator and sensor placement; modal actuators and sensors; system identification; controllers; structural health monitoring; smart materials, sensors, and actuators.

CEEN 6334 Environmental Transport Processes
3 Semester Credit Hours (3 Lecture Hours)
This course will present the fundamental processes that control the transport of constituent substances in fluids and their implications for a variety of applications in environmental systems. Basic physical conservation principles will be introduced and initially applied to understand the behavior of important classes of environmental flows. Fundamental hydrodynamic transport processes will be analyzed under various boundary and initial conditions. The inter-relationship of hydrodynamic transport with biological and biogeochemical processes will be discussed.
Prerequisite: CEEN 4312.

CEEN 6341 Transportation Engineering
3 Semester Credit Hours (3 Lecture Hours)
Planning, design, staging, construction, test, and maintenance of the public works and facilities for air, water, rail, and highway transit systems. Introduction to concepts from traffic engineering including traffic flow theory and capacity and quality of traffic flow.

CEEN 6351 Geotechnical Engineering
3 Semester Credit Hours (3 Lecture Hours)
Soil dynamics, ground improvement, soil and foundation systems; problems of dynamic soil-structure interaction. Elasticity and plasticity models; stress-strain relations for soils; failure criteria. Site preparation and improvement; flexible retaining structures, pile foundations, and other foundational structures such as caissons, pile foundations, and drilled shafts.

Electrical Engineering Courses

EEEN 6314 Robotics and Autonomous Systems
3 Semester Credit Hours (3 Lecture Hours)
Robots and Autonomous Systems are projected to benefit our society as new technologies are being developed. This course involves an introduction and survey of contemporary robotic mechanisms or systems, and field applications. This course includes the understanding of basic principles of robotics such as embedded systems in automated systems, manipulator kinematics and design, and principles of unmanned ground, aquatic, surface, and aerial vehicles. The student will be introduced to the Robotic Operating System (ROS) environment and its application in modern robotics. Also, there will be a survey in multi-agent modeling and its application on multi-robot systems. Other topics to be discussed are path-planning for navigation, task allocation and decision making, machine learning and artificial intelligence technologies with the complement of multi-sensor data fusion that can currently enable certain levels of autonomy in robots. (Cross-listed with MEEN 6314 Robotics and Autonomous Systems.)
Prerequisite: EEEN 5311 or MEEN 5311.

EEEN 6315 Advanced Control Systems
3 Semester Credit Hours (3 Lecture Hours)
This course provides an in-depth exploration of modern control techniques, with a strong focus on nonlinear systems, robust control, and adaptive control. Students will learn stability analysis, Lyapunov methods, feedback linearization, robust control techniques, and adaptive controllers. The course will also include practical implementations using MATLAB/Simulink. (Cross-listed with MEEN 6315 Advanced Control Systems.)
Prerequisite: EEEN 5311 or MEEN 5311.

EEEN 6322 Embedded Systems
3 Semester Credit Hours (3 Lecture Hours)
This course covers the study and operation of embedded computer systems which include a microcomputer with mechanical, chemical, and electrical devices attached to it. Such systems are programmed for a specific purpose and package up as a complete system. The class is enabled by the utilization of the TI MSP432 ARM Cortex-M based microcontroller. The class is mainly focused on the programming and implementation of C based programs (with some assembly language as necessary) with the microcontroller. Topics covered in this course are Introduction to Computing, C for Embedded Systems, Input/output Programming, LCD and Keyboard interfacing, UART Serial Port Programming, Timer Programming, Interrupt and Exception Programming, ADC, DAC, and Sensor Interfacing, SPI Protocol and DAC interfacing, I2C Protocol and RTC Interfacing, and several Motors/Actuators interfacing.
Prerequisite: EEEN 3418.

EEEN 6323 Nanoscience and Nanotechnology
3 Semester Credit Hours (3 Lecture Hours)
Nanoscale science and nanotechnology is by nature an interdisciplinary topic which covers electrical engineering, materials science, and fields outside of engineering such as chemistry and biology. This course will introduce some of the fundamental principles behind nanotechnology and nanomaterials, as well as applications of nanotechnology. The role of solid-state physics and chemistry in nanotech will be emphasized, and the topic of sensors made using nanofabrication instruments to characterize phenomena at the nanoscale will be addressed. Nanoscale tools such as surface probe and atomic force microscopy, nanolithography, and special topics such as molecular electronics will also be covered.

EEEN 6332 Machine Vision and Image Processing
3 Semester Credit Hours (3 Lecture Hours)
This course covers machine vision systems, system components, design criteria including lighting and camera specifications, as well as testing and measurements with such systems. In addition, fundamentals of image processing are introduced. Topics include image processing and analysis of color and gray scale images in spatial and frequency domain. Topics also include other transform domains, filtering, segmentation, object detection, recognition, tracking, and introduction to machine learning for image segmentation.
Prerequisite: EEEN 5331.

EEEN 6333 Random Signal Processes
3 Semester Credit Hours (3 Lecture Hours)
This course extends in the study of random processes as a natural extension of random variables when dealing with signals. This will enable students to study signals as random rather than deterministic. This topic is essential into the study of non-ideal characteristics of signals and the development of noise mitigation techniques. Topics covered in this class are survey of probability fundamentals, Random Variables, Statistical Averages, Wide-Sense Stationary and Multiple Random Processes, Random Processes and Linear Systems, Power Spectral Density of Stationary Processes and a Sum Process, Gaussian Processes, White Processes and Filtered Noise Processes.
Prerequisite: EEEN 5331.

Industrial Engineering Courses

IEEN 6313 Optimization
3 Semester Credit Hours (3 Lecture Hours)
This course focuses on problem formulation, software technologies and analytical methods for optimization serving as an introduction to a wide variety of optimization problems and techniques including dynamic programming, network flows, integer programming, heuristic approaches, Markov chains, game theory, and decision analysis. This course provides tools to formulate engineering problems as the optimization of some function under some set of constraints. As such operations research is a quantitative discipline that deals with the application of advanced analytical methods to help make better decisions. This course employs techniques from other mathematical sciences, such as mathematical modeling, statistical analysis, and mathematical optimization and provides optimal or near-optimal solutions to complex decision-making problems. (Cross-listed with CEEN 6322 Optimization.)
Prerequisite: ENGR 5302.

IEEN 6314 Advanced Systems Engineering
3 Semester Credit Hours (3 Lecture Hours)
This doctoral-level course provides an in-depth exploration of the principles and practices of Systems Engineering (SE) with an emphasis on complex, multidisciplinary systems. The course integrates advanced mathematical modeling, optimization techniques, and systems thinking to solve real-world engineering problems. Topics will include systems architecture, design, integration, verification, and validation, as well as risk management, lifecycle analysis, and sustainability in system development.
Prerequisite: IEEN 3324.

IEEN 6322 Ergonomics and Safety Engineering
3 Semester Credit Hours (3 Lecture Hours)
This course covers occupational safety in the manufacturing environment and the use of ergonomic principles to recognize, evaluate, and control workplace conditions that cause or contribute to employee safety and productivity issues. Topics cover Occupational Safety and Health Administration (OSHA) safety guidelines including electrical, chemical, and hazardous material safety. Ergonomic considerations to include repetitive motion, plant layout, and machine design and industrial safety awareness, accident cost and prevention, and workman's compensation issues are discussed.
Prerequisite: IEEN 5321.

IEEN 6323 Human Factors Engineering for Vehicular Designs
3 Semester Credit Hours (3 Lecture Hours)
This course explores advanced concepts in human-centered design and ergonomics as applied to vehicular systems. This course emphasizes the integration of human capabilities and limitations—cognitive, physical, and perceptual—into the design of vehicles to enhance safety, usability, and performance. Topics include driver-vehicle interaction, human error and reliability, user interface design, autonomous vehicle systems, and the application of simulation and experimental methods in evaluating human performance. Students will engage with current research, case studies, and design challenges to develop innovative, data-driven solutions for complex vehicular environments.

IEEN 6333 Manufacturing Process Engineering
3 Semester Credit Hours (3 Lecture Hours)
Theory and application of the design of modern manufacturing facilities. Facility location and layout; materials handling practice and systems, manufacturing systems layout, and warehouse operations. Automated systems. Total process analysis; optimization and economics of manufacturing systems.
Prerequisite: IEEN 5321.

IEEN 6334 Engineering Decision Theory
3 Semester Credit Hours (3 Lecture Hours)
This course introduces stochastic decision-making methods for complex engineering systems. Topics include decision analysis, Markov chains, Markov decision processes, and queueing theory. Emphasis is placed on modeling uncertainty, evaluating system performance, and optimizing decision policies. Applications in industrial engineering are highlighted through real-world case studies and mathematical modeling.
Prerequisite: MATH 3342 and IEEN 3302.

Mechanical Engineering Courses

MEEN 6314 Robotics and Autonomous Systems
3 Semester Credit Hours (3 Lecture Hours)
Robots and Autonomous Systems are projected to benefit our society as new technologies are being developed. This course involves an introduction and survey of contemporary robotic mechanisms or systems, and field applications. This course includes the understanding of basic principles of robotics such as embedded systems in automated systems, manipulator kinematics and design, and principles of unmanned ground, aquatic, surface, and aerial vehicles. The student will be introduced to the Robotic Operating System (ROS) environment and its application in modern robotics. Also, there will be a survey in multi-agent modeling and its application on multi-robot systems. Other topics to be discussed are path-planning for navigation, task allocation and decision making, machine learning and artificial intelligence technologies with the complement of multi-sensor data fusion that can currently enable certain levels of autonomy in robots. (Cross-listed with EEEN 6314 Robotics and Autonomous Systems.)
Prerequisite: MEEN 5311 or EEEN 5311.

MEEN 6315 Advanced Control Systems
3 Semester Credit Hours (3 Lecture Hours)
This course provides an in-depth exploration of modern control techniques, with a strong focus on nonlinear systems, robust control, and adaptive control. Students will learn stability analysis, Lyapunov methods, feedback linearization, robust control techniques, and adaptive controllers. The course will also include practical implementations using MATLAB/Simulink. (Cross-listed with EEEN 6315 Advanced Control Systems)
Prerequisite: MEEN 5311 or EEEN 5311.

MEEN 6322 Advanced Fluid Mechanics
3 Semester Credit Hours (3 Lecture Hours)
Equations of motion for compressible fluid flow; nozzle flows; shocks and expansions; flows with heat addition and friction; unsteady one-dimensional flows; method of characteristics for one-dimensional unsteady and two-dimensional steady flows; flows about two-dimensional and axisymmetric bodies.
Prerequisite: MEEN 5321.

MEEN 6323 Computational Fluid Dynamics I
3 Semester Credit Hours (3 Lecture Hours)
Classification of partial differential equations. Finite-difference and finite-volume discretization techniques and solution methods for linear and non-linear, steady and unsteady problems; accuracy, convergence, and stability. Multigrid methods, validation techniques. Current computational techniques and solution methods.
Prerequisite: ENGR 5302 or MEEN 5321.

MEEN 6324 Turbulent Flow
3 Semester Credit Hours (3 Lecture Hours)
Transition from laminar flow; turbulent wall-bounded flows, jets, and wakes. The nature of turbulent flow; Reynolds averaging and correlated variables; mixing length and integral scales; law of the wall and wake law; the Kolmogorov structure of turbulence, the energy cascade, diffusion; energy, mass, and momentum exchange; structure of turbulent flows; fundamentals of modeling turbulent flows.
Prerequisite: MEEN 5321.

MEEN 6332 Advanced Heat Transfer
3 Semester Credit Hours (3 Lecture Hours)
An advanced treatment of conduction, convection, and radiation heat transfer from a Reynolds transport theorem perspective. Topics include: three dimensional steady-state and transient conduction, phase change; forced and free convection; internal and external flows; black body radiation; radiative exchange between nongray surfaces; radiative transfer equation; numerical modeling and simulation of heat transfer phenomena; term project.
Prerequisite: MEEN 5331.