

Engineering, M.Eng.

COLLEGE OF ENGINEERING

Learn more about the Master of Engineering.

About the Program

The Master of Engineering (M.Eng.) degree program is designed for engineers who make their career in the engineering field and look to advance as either technical specialists and project supervisors or to move into management or sales positions. A strong skilled workforce is in very high demand as the skills gap widens in the field of engineering. Skilled engineers that can participate across disciplines are needed as industries evolve.

The M.Eng. degree allows engineering students to achieve the unique set of technical skills required by their specialty or the business skills needed for leadership that cannot be gained through undergraduate engineering education alone. Innovation in the delivery of graduate engineering education that allows for flexibility and customization is revolutionizing post-baccalaureate education for engineers by meeting the needs of the evolving industry and fostering the management skills engineers need to innovate and lead.

The M.Eng. degree enables students to select three graduate certificates of 9 credits each in specialized areas of engineering in accordance with their interests, combining the specialties to engage in a unique combination of cross-disciplinary training. To earn the degree, the three certificates are "stacked" along with an integrative capstone project proposed by the student. Graduates of the program emerge with technical expertise in their field as well as the leadership and business acumen required to advance in their organizations.

Time Limit for Degree Completion: 5 years

Campus Location: Online, with a mix of synchronous and asynchronous courses until all courses are asynchronous

Full-Time/Part-Time Status: The degree program can be completed on a full- or part-time basis.

Interdisciplinary Study: The degree program is inherently interdisciplinary in its design.

Non-Matriculated Student Policy: Students with an undergraduate GPA of 3.0 or higher may be allowed to take classes on a non-matriculated basis. Non-matriculated students may take a maximum of 9 credits. Any additional courses require the student to be matriculated in a program.

Financing Opportunities: For more information, contact the Department of Engineering, Technology and Management in the College of Engineering.

Admission Requirements and Deadlines

Application Deadline:

Fall: March 1

Spring: November 1; August 1 international

Applications are processed on a continual basis. Late applications may be considered for admission. Ordinarily, the applicant is informed of an admissions decision within 6 weeks of receipt of all supporting application documents.

APPLY ONLINE to this graduate program.

Letters of Reference:

Number Required: 3

From Whom: Recommendations should be professional references from supervisors and co-workers or academic references. References should be obtained from those who know the applicant well and who can attest to the applicant's ability to excel in the M.Eng. program.

Coursework Required for Admission Consideration: Two years' relevant work experience in a company is preferred, but exceptions can be made.

Bachelor's Degree in Discipline/Related Discipline: A baccalaureate degree in a STEM field is required, with a minimum GPA of 3.0 having been attained.

Statement of Goals: An essay on your professional plans and goals should be one to three pages in length. It should reflect your influences, values, aspirations, and interest in the M.Eng. program. The following questions may be addressed:

- What particular past experiences or previous exposure (academic, professional, etc.) prepared or motivated you to pursue the M.Eng. degree?
- How would you expect to change over the course of the program?
- What personal and professional values and skills do you hope to acquire through the academic content?

- How will obtaining the M.Eng. degree support your career objectives or potential career path(s)?
- Given the importance of teamwork and collaboration in business, what are the most significant strengths or contributions you bring to a team?

Standardized Test Scores:

GRE: Required. Scores must be no more than 5 years in advance of the application date. (See Graduate School Policy 02.23.12.) Applicants who request a waiver of the GRE should consult the Program Director concerning the mechanics and consequences of obtaining an exception.

Applicants who earned their baccalaureate degree from an institution where the language of instruction was other than English, with the exception of those who subsequently earned a master's degree at a U.S. institution, must report scores for a standardized test of English that meet these minimums:

- TOEFL iBT: 79
- IELTS Academic: 6.5
- PTE Academic: 53

Interview: Students applying to the M.Eng. program may be required to interview with the department chair or a designated faculty member.

Resume: Current resume required.

Program Requirements

General Program Requirements:

Number of Credits Required Beyond the Baccalaureate: 30

Required Courses:

Code	Title	Credit Hours
Specialization Courses		
Select three specializations from the following and complete 9 credits in each of the three areas:		27
Advanced Manufacturing and Robotics		
Select courses from the following that total 9 credits:		
MEE 5411	Introduction to Mobile Robotics	
MEE 5412	Modern Dynamics for Robotics	
MEE 5413	Robotic Manipulation	
MEE 5643	Manufacturing Engineering	
Automation in Manufacturing		
Cybersecurity		
ECE 5516	Introduction to Communication Networks	
ECE 5526	Engineering Principles of Computer Intrusion and Detection	
ECE 5826	Information Theory	
Engineering Project Management		
EMGT 5634	Project Management Overview and Project Management Essentials	
EMGT 5635	Financial Management for Technologists	
EMGT 5642	Project Management – Project Planning, Implementation and Case Study	
Agile Project Management		
Project Manager, Teams and Stakeholder Management		
Project Scheduling, Estimating and Resources		
New Product Development		
EMGT 5631	Design Thinking	
EMGT 5632	Idea to Invoice: Managing the New Product Development Process	
EMGT 5633	Management Principles for Innovators, Engineers and Technologists	
EMGT 5637	Marketing Technological Products and Services	
Capstone Course		
ENGR 9995	Project	3
Total Credit Hours		30

Culminating Event:

Capstone Course:

The integrative capstone project (ENGR 9995) is proposed by the student. The project should integrate the different skills learned for each of the three specialty areas to address an industry need. A faculty member is selected to serve as an advisor for the capstone project.

Contacts

Program Web Address:

<https://www.temple.edu/academics/degree-programs>

Department Information:

College of Engineering
 ATTN: Master of Engineering Program
 1947 N. 12th Street
 Philadelphia, PA 19122-6077
 gradengr@temple.edu
 215-204-7800

Submission Address for Application Materials:

<https://apply.temple.edu/Engineering/>

Department Contacts:

Admissions:

Colleen P. Baillie, Ed.D.
 colleenb@temple.edu
 215-204-7800

Program Director:

Tom Edwards
 tuc56565@temple.edu
 215-204-7794

Electrical Engineering Courses

ECE 5022. Engineering Analysis and Applications. 3 Credit Hours.

Vector space, basis, projection, null space, function space, L2 and space of continuous functions, Hilbert space, orthogonality, generalized Fourier series, linear transformation, adjoint transformation, eigenvalue problem, linear functional, Gateaux and Frechet differential, constrained optimization, infinite dimensional systems, complex analysis.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5033. Probability and Random Processes. 3 Credit Hours.

Sets and events, Random variables, Distribution and density functions, Functions of multiple random variables, Moments and conditional statistics, Information entropy, stochastic processes, wide-sense stationary process, ergodicity, correlation, and power spectrum of stationary processes. Applications to sampling theory and signal modulation and detection.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5110. Special Topics in Electrical and Computer Engineering. 3 Credit Hours.

Selected topics on current technologies in various research areas under electrical and computer engineering.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ECE 5116. Spacecraft Systems Engineering. 3 Credit Hours.

The concept of systems engineering is introduced using a satellite application. Systems engineering is a top-down approach to the design, implementation, testing, and deployment of large-scale systems to meet the needs of users. The topics will include systems engineering methodology, dynamics of spacecraft, and celestial mechanics. This course will also introduce the notion of invention and innovation, and how they are related to the intellectual property issues.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5314. Microelectronics. 3 Credit Hours.

Advanced study of electronic devices and their applications to linear, non-linear, and digital circuits; transistors, FET's, amplifiers, digital integrated circuits, and VLSI's; Software design emphasized. A term project will be assigned.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5324. VLSI System Design and Testing. 3 Credit Hours.

An introduction to a hierarchical design methodology of VLSI; study of basic logic elements and design methods in nMOS and CMOS; development of testable designs; the physics of MOS devices and fabrications processes; design rules and computation of circuit parameters from layout; system level design techniques; circuit structures with built-in self-test, design-for-test and self-checking features.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5314|Minimum Grade of C|May not be taken concurrently.

ECE 5344. Fundamentals of Bio-MEMS and Biomedical Microdevices. 3 Credit Hours.

The course introduces the basic concepts for design and principle of bio-micro-electro-mechanical systems (BioMEMS) and biomedical micro-integrated systems. Wireless communication in context to biomedical devices are described. Microelectronics process modules used in the design and fabrication of MEMS and micro-integrated systems are presented. Applications of these systems in a variety of sensors and transducers are considered. Recent advances in biomedical applications of MEMS are discussed in detail.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5412. Control System Analysis. 3 Credit Hours.

Review of control concepts and application; state space representation of dynamical systems; controllability, observability; time invariant and time varying systems, design of full state feedback and output feedback systems; eigenstructure assignment; the linear quadratic regulator; Kalman filter; estimation and filtering; robust control via eigenstructure design, Kharitonov theorem, application examples.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5432. Game Theory and Applications in Engineering. 3 Credit Hours.

The course covers the basic framework for strategic games and its various manifestations. Topics include matrix games, extensive form games, mixed strategies, repeated games, Bayesian games, and cooperative games. The course continues with various applications of game theory in engineering systems. The course also covers applications of game theory as a design tool for engineering multi-agent systems, i.e., systems that are comprised of a collection of programmable decision-making components.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5512. Intro Digital Comm. 3 Credit Hours.

Baseband pulse, digital, and passband communications systems; properties and bandwidth of signals and noise; detection of signals in noise; signal-to-noise ratio (SNR); distortionless transmission and intersymbol interference; pulse code modulation; amplitude, phase and frequency modulation and demodulation; simulation of communication systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5514. Digital Signal Processing Analysis. 3 Credit Hours.

Topics covered are: various types of digital signal processing (DSP) techniques such as convolution, correlation, and filtering, as well as Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) all pass and comb digital filters, the Discrete Fourier Transform, and the use of MATLAB as a tool for DSP software tasks. A term project will be assigned.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5516. Introduction to Communication Networks. 3 Credit Hours.

Introduction to Internet and TCP and IP protocols, telephone networks, Local Area Networks, packet switching, ATM, and other related topics.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5526. Engineering Principles of Computer Intrusion and Detection. 3 Credit Hours.

This course provides an introduction of computer intrusion and detection techniques. It gives theoretical and practical foundations necessary to continue further learning of computer security. We will study and analyze critical security vulnerabilities of software design and network and information systems. The learned skills are widely used by IT security analysts in industries. At the end of the class the students will be able to understand basic concepts of intrusion detection and traffic analysis from a practical point of view. This course will provide the tools and knowledge necessary to continue further learning in computer security and advance further in the profession.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5516|Minimum Grade of B-|May not be taken concurrently.

ECE 5528. Introduction to Cryptography and Information Security. 3 Credit Hours.

This course covers the theory and practice of computer communications security. Topics include symmetric encryption, public and private key cryptography, message digests, digital signatures, secure email, and various types of authentication methods. We will review various cryptographic primitives, algorithms, intrusion attacks, and security protocols.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5538. Hardware and Industrial Control System Security. 3 Credit Hours.

This course covers the theory and practice of hardware and control system security. Topics include digital system security, side channel attacks on cryptographic systems, industrial control system security, and intellectual property protection. We will review hardware implementation of cryptographic primitives, secure hardware design, and security protocols. Note: Credits of this course will not apply to MSEE and PhD (EE) degree programs unless preapproved.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5528|Minimum Grade of B-|May not be taken concurrently.

ECE 5541. Hardware Security Lab. 3 Credit Hours.

This laboratory includes a university version of wired (with internet protocol suite of packets and layers) and wireless (with IEEE802.11 layers) equipment and physical network along with open source network security software. Depending on the application, the lab provides students flexibility to fully analyze protocols and security vulnerability with respect to the network, Programmable Logic Controller (PLC), and power grid, etc. Students gain hands-on experience from role-playing both as a black-hat hacker by instigating attacks and a white-hat hacker by performing digital forensics and penetration tests. Note: Credits of this course will not apply to MSEE and PhD (EE) degree programs.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5548. Secure Computer Memory Architecture and Intrusion Prevention Methodologies. 3 Credit Hours.

This course covers physical computer memory organization and areas of vulnerability such as susceptibility to buffer overflow and Direct Memory Access (DMA) attacks. An overflow attack happens when the data written to a physical memory exceeds its allocated buffer size, which is in violation of memory safety rules. DMA happens when a data transfer is done via direct physical memory access, thus bypassing operating system's supervision. Such a "back door" access is intended to increase the hardware performance throughput but inadvertently creates a major hole in system security. This course analyzes physical memory design methodologies to prevent such intrusions. Note; Credits of this course will not apply to MSEE and PhD (EE) degree programs.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5558. Reverse Engineering. 3 Credit Hours.

This course covers methodologies, equipment and software tools used to extract information and build knowledge from sophisticated modern-era hardware and software systems for reverse engineering purposes. Some systems require invasive and destructive technique to get to the source of the information, while for others, non-invasive monitoring and fault injection are sufficient methods. Reverse engineering equipment and tools include but are not limited to debuggers, disassemblers, logic analyzers, oscilloscopes, and simulators. Note: Credits of this course will not apply to MSEE and PhD (EE) degree programs.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5562. Wireless Communications Engineering. 3 Credit Hours.

This course provides a comprehensive introduction of physical-layer wireless communications, including: Cellular concepts; Wireless channel modeling; Modulation techniques; Multiple access techniques; Channel coding and wireless system capacity; Receiver diversity; Transmit diversity and multiple-input multiple-output (MIMO) technology; Equalization; Orthogonal frequency division multiplexing (OFDM); Wireless systems and standards, and latest developments in wireless technologies.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5564. Cloud Computing Security. 3 Credit Hours.

This course first introduces students to the essentials of a cloud computing environment: technologies, infrastructure, platforms, and application software. Students then build a cloud computing system to monitor its vulnerability, build security measures, and attack it to further refine the security solution. OpenNebula Systems, an open source cloud computing management toolkit and a commercial cloud computing service, will be used for the exercises.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5566. Forensics for Cyber Physical Systems Security. 3 Credit Hours.

This course first introduces students to the construct of today's cyber physical system, which is an integration of software and hardware (cyber and physical), built upon an infrastructure of communications network. Cyber physical systems are an integral part of our daily lives that must deliver ultimate safety, security, and reliability, such as in automotive, medical, transportation, power, water, and nuclear energy systems. Therefore, an attack on any such system can be catastrophic. We will analyze hardware components and structure and study their vulnerability to exact forensic artifacts, and why it is important to have trust-worthy hardware, starting from secure integrated circuit design and manufacturing as a baseline. Tools will be used in investigation and forensic analysis. Advanced topics go beyond identification of the attack vector and region, and root causes by researching on self-monitoring, self-repair and self-healing hardware.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5568. Engineering Project Quality and Risk Management, and ISO Standards. 3 Credit Hours.

This course covers quality and risk management which are under the umbrella of project management, both go hand-in-hand to ensure best practices for engineering for products. Four components of quality management are quality planning, quality assurance, quality control and quality improvement. Also covered is ISO9001, quality management systems standards. Risk management includes enterprise risk management strategy, risk assessment, risk responses, risk communication and awareness training, and risk acceptance. Also covered is ISO 27001 and 2 on information security standards and best practices.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5572. Certificate Preparation - (ISC)2/CISSP-Information Systems Security. 3 Credit Hours.

The International Information Systems Security Certification Consortium (ISC)2 is a non-profit organization that specializes in information security certifications, which demonstrate certificate owners' competence in the subject matter. (ISC)2 is known as the "world's largest IT security organization" and among its certificates, Certified Information Systems Security Professional (CISSP) is the most widely valued. This course covers preparation for the CISSP-ISSEP certification, where ISSEP (Information System Security Engineering Professional) focuses on engineering aspects of the CISSP. The ISSEP exam focuses on four areas of information security: (1) Systems Security Engineering, (2) Certification and Accreditation (C&A) / Risk Management Framework (RMF), (3) Technical Management, and (4) United States Government Information Assurance Related Policies and Issuances. Note: Credits of this course will not apply to MSEE and PhD (EE) degree programs.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5574. Certificate Preparation - Cisco Networking Academy. 3 Credit Hours.

This course uses Cisco Networking Academy material to cover various Cisco Certified Network Security topics concentrating on network security principals, tools, and configurations, and includes a hands-on lab equipped with Cisco networking equipment. Note: Credits of this course will not apply to MSEE and PhD (EE) degree programs

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5575. Capstone Project. 3 Credit Hours.

A Capstone Project is a work-study project where a student with support from his/her sponsoring entity works on a current or emerging challenge on cybersecurity. Engineering Resilient Systems (ERS) is an example of a DoD sponsored Capstone Project. Through Capstone Project, a student will develop tools and procedures to produce a complete and robust product requirement, make efficient and effective engineering decisions, consider manufacturability of a system design, and establish a baseline resiliency including Tactics, Techniques, and Procedures (TTP) against threats. Note: Credits of this course will not apply to MSEE and PhD (EE) degree programs.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5600. Graduate Seminar. 0 Credit Hours.

Required seminar for graduate students in Electrical and Computer Engineering for scientific and professional development. Speakers for these seminars include prominent researchers from academic and professional backgrounds. Students will be graded on participation of at least 70% of the bi-weekly seminars during the semester.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ECE 5612. Advanced Processor Systems. 3 Credit Hours.

Hardware description language (Verilog) design of processor systems for digital signal processing and data communication. Projects will be assigned in simulation and synthesis of dataflow and processor architectures targeting field programmable gate arrays (FPGA).

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5622. Introduction to Computer Architecture. 3 Credit Hours.

Instruction set architectures, Register Transfer Level hardware description. Data-path design. Controller design. Caches and memory systems. Addressing. Microprogramming. Computer arithmetic. Survey of current computers and microprocessors. Projects will include Verilog/VHDL implementation of data-path components and testing them on FPGAs.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5712. Power Systems Engineering. 3 Credit Hours.

This course introduces the modern power systems and its changing landscape. The course covers the basics of power generation and transformers, and an introduction to power electronic devices, AC transmission and distribution, power flow, economic dispatch, transient and stability analysis, short circuit analysis, and HVDC systems, power system protection, power market deregulation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5714. Introduction to Intelligent Systems Engineering. 3 Credit Hours.

Introduction of the use of artificial intelligence techniques to develop intelligent systems. The course gives the student 1) an overview of what artificial intelligence is and its current state; 2) an overview of intelligent systems --what they are and their possible future role in society; 3) a practical and theoretical knowledge of expert systems, their development, implementation and maintenance and 4) an introduction to intelligent tutoring systems and to provide a perspective about the potential impact of these systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5716. Power System Economics. 3 Credit Hours.

This course aims at enriching course offerings for graduate students who would like to have a focus on electric energy. We will discuss major problems in power system economics, such as: optimization formulations and solutions; competition; bidding strategies; locational marginal prices; ancillary services; and investment decisions.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5712|Minimum Grade of C-|May not be taken concurrently.

ECE 5722. Power Electronic Devices and Systems. 3 Credit Hours.

This course introduces power electronic devices and circuits, and their applications in modern power systems. Topics include DC-DC converters in buck and boost topologies, and their modeling and feedback control; AC-DC rectification and control; DC-AC inverters, modeling, and voltage and frequency control; Three-phase inverters, and HVDC transmission. This course will use Matlab/Simulink simulation for student projects and homeworks.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5732. Electric Machines and Drives. 3 Credit Hours.

Fundamentals of electromechanical energy conversion, electric drives and systems. Transformers, DC machines, synchronous machines, induction motors, dq-transformation, vector control of induction motors, reluctance motors, single phase motors, brushless dc motor. Introduction to power electronics and their applications in power drives.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 5742. Power Converter Modeling and Control. 3 Credit Hours.

This course introduces modeling and control methodologies of modern power electronic systems and their applications. The course covers modeling of DC-DC, DC-AC, AC-DC and AC-DC-AC power electronic converters, conventional and advanced control diagram design of power converters, interactions among multiple converters in power electronics dominated systems. Also industrial and grid-level applications of these technologies will be discussed.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5722|Minimum Grade of B|May not be taken concurrently

OR ECE 4722|Minimum Grade of B|May not be taken concurrently.

ECE 5826. Information Theory. 3 Credit Hours.

Information Theory is a field that has been central to the development of modern communications and computing technologies. The goal of this course is to provide the student with a thorough understanding of the concepts of entropy and information, and how to apply these to real world problems such as speech recognition, language engineering, signal compression, and financial modeling. A secondary goal is to develop a mathematically rigorous understanding of methods for measuring and manipulating various measures of information in signals and systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 3522|Minimum Grade of B-|May not be taken concurrently.

ECE 5999. Research Experience in Electrical Engineering. 0 Credit Hours.

Research Experience provides graduate students laboratory experiences/research practices prior to undertaking independent, directed, master project, master's thesis, or dissertation research. This course allows graduate students the opportunity to learn the use of laboratory equipment, designing and carrying out an experiment(s), collecting preliminary data, field experiences, and participation in laboratory meeting, etc. with faculty which may lead to identifying a faculty mentor. The course will be graded Pass (P) or Fail (F). The Research Experience is a non-repeatable course. After the completion of ECE 5999 - Research Experience in ECE, students will need to be enrolled in independent study, directed research, master's research, master's thesis, dissertation proposal, or dissertation if they continue in an active research program.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 8110. Special Topics in Electrical and Computer Engineering. 3 Credit Hours.

Selected advanced topics in various major research areas under electrical and computer engineering.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ECE 8324. Mixed Signal VLSI Design. 3 Credit Hours.

Basic MOS device physics, single state amplifiers, frequency response, op amps, switched capacitor circuits, short-channel effects, amplifier design for wireless communication, low power static RAM architectures, layout and packaging.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5324|Minimum Grade of C|May not be taken concurrently.

ECE 8334. Nano Applications, MEMS & NEMS. 3 Credit Hours.

Nano challenges, quantum mechanics, nano materials, nanolithography, optics, carbon nanotubes, GaNa nanotechnology, MEMS and NEMS Architectures, Mathematical Model of MEMS and NEMS, Applications of Nanotechnology: Bio-Medical applications, Optical Devices, Sensors.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5324|Minimum Grade of C|May not be taken concurrently.

ECE 8412. Optimal and Robust Control. 3 Credit Hours.

Concept of optimality, calculus of variations, Euler-Lagrange equation, Pontryagin's minimum principle, Bellman's equation, Kalman filter, uncertainties in physical systems; structured and unstructured uncertainties; application of the Lyapunov method to robust control problems; robust optimal control; state space design for finite and infinite horizon problems; H-infinity design.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5412|Minimum Grade of C|May not be taken concurrently.

ECE 8414. Adaptive Control. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 8512. Signal Processing and Communication Theory. 3 Credit Hours.

Coherent and non-coherent detection of binary and M-ary signals in noise; waveform coding, linear block coding; convolutional, cyclic and turbo codes; error probability and bandwidth-efficiency plane in the design of digital communications systems; multipath and fading channels; simulation of communication systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(ECE 5512|Minimum Grade of C|May not be taken concurrently
AND ENGR 5033|Minimum Grade of C|May not be taken concurrently)

ECE 8514. Applications in Digital Signal Processing. 3 Credit Hours.

FIR and IIR digital filter design, finite word length effects, filter banks, multirate signal processing, spectral analysis (classical, modern, parametric and nonparametric techniques), adaptive filtering (Wiener filter theory) and speech production, analysis, and processing tools and speech coding. Computer experiments using MATLAB will be an integral part of the course.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5033|Minimum Grade of C|May not be taken concurrently.

ECE 8516. Design and Performance of Communication Networks. 3 Credit Hours.

An overview of the technologies, architectures and protocols used to build high-speed communication networks. Design and performance analysis techniques for computer communication networks. Topics will include: design and performance analysis of wired and wireless local networks, sensor networks, and Internet. Projects will include developing stochastic models, queuing analysis, and simulations.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 8524. Speech Signal Processing. 3 Credit Hours.

Spectral analysis of non-stationary signals, short-time Fourier transform, homomorphic filtering and filter bank, Speech compression, and synthesis techniques. Weiner filtering for speech enhancement.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 8514|Minimum Grade of C|May not be taken concurrently.

ECE 8525. Fundamentals of Speech Recognition. 3 Credit Hours.

This course introduces students to the theory and implementation of modern day speech recognition systems. We begin with a review of pattern recognition and machine learning, including topics such as Gaussian mixture models and Bayesian models. We then discuss the three main components of a speech recognition system: feature extraction, acoustic modeling and language modeling. We conclude the course with an overview of state of the art systems. Students will learn how to simulate and evaluate complex machine learning algorithms such as hidden Markov models and neural networks. Data-driven methodologies will be emphasized.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(ENGR 5022|Minimum Grade of B-|May not be taken concurrently)
AND (ENGR 5033|Minimum Grade of B-|May not be taken concurrently)

ECE 8526. Information Theory. 3 Credit Hours.

Information Theory is a field that has been central to the development of modern communications and computing technologies. The goal of this course is to provide the student with a thorough understanding of the concepts of entropy and information, and how to apply these to real world problems such as speech recognition, language engineering, signal compression, and financial modeling. A secondary goal is to develop a mathematically rigorous understanding of methods for measuring and manipulating various measures of information in signals and systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(ENGR 5022|Minimum Grade of B-|May not be taken concurrently)

AND (ENGR 5033|Minimum Grade of B-|May not be taken concurrently)

ECE 8527. Introduction to Machine Learning and Pattern Recognition. 3 Credit Hours.

Pattern recognition theory and practice is concerned with the design, analysis, and development of methods for the classification or description of patterns, objects, signals, and processes. At the heart of this discipline is our ability to infer the statistical behavior of data from limited data sets, and to assign data to classes based on generalized notions of distances in a probabilistic space. Many commercial applications of pattern recognition exist today, including voice recognition, fingerprint classification, and retinal scanners. Recent developments in statistical modeling using Bayesian techniques, neural networks, decision trees, fuzzy logic, and syntactic structures have accelerated the growth of pattern recognition applications. The objective of this course is to introduce fundamental methods of pattern recognition, both statistical and neural, with examples from several application areas.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(ENGR 5022|Minimum Grade of B-|May not be taken concurrently)

AND (ENGR 5033|Minimum Grade of B-|May not be taken concurrently)

ECE 8528. Advanced Topics in Statistical Modeling for Engineering Applications. 3 Credit Hours.

This course builds on a basic knowledge of machine learning and reviews recent advances in the field. It is a research-oriented course intended to complement a student's thesis or dissertation research. The course will focus on a selection of emerging machine learning algorithms and analyze contemporary publications on these techniques. The emphasis will be on algorithms suited to large, complex data sets. Both supervised and unsupervised learning methodologies will be discussed. Applications will be drawn from several signal processing disciplines including speech, image and bioengineering applications.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(ENGR 5022|Minimum Grade of B-|May not be taken concurrently)

AND (ENGR 5033|Minimum Grade of B-|May not be taken concurrently)

AND (ECE 8527|Minimum Grade of B-|May not be taken concurrently)

ECE 8529. Fundamentals of EEG Processing. 3 Credit Hours.

Electroencephalography (EEG) records electrical activity along the scalp, measuring spontaneous electrical activity of the brain. The signals measured along the scalp can be correlated with brain activity, which makes it a primary tool for diagnosis of brain-related illnesses. EEG specialists review these waveforms and develop a diagnosis. EEGs traditionally have been used to diagnose epilepsy and strokes. Other common clinical uses have been for diagnoses of coma, encephalopathies, brain death and sleep disorders. EEGs are increasingly being used to diagnose head-related trauma injuries and Alzheimer's disease. Hence, there is a growing need for expertise to interpret EEGs and, equally important, to understand how these conditions manifest themselves in the EEG signal. In this course we will discuss the techniques neurologists use to manually interpret EEGs. A vast archive of clinical EEG recordings will be studied. Since EEG signals are very low-level electrical signals, we will then discuss digital signal processing that is used to convert the raw electrical signals into visualizations that can be readily interpreted. We will also introduce machine learning techniques that are used to automatically interpret and transcribe these signals.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ECE 8622. Advanced Computer Architecture. 3 Credit Hours.

Advanced course in the design and analysis of computer architecture. Topics will include instruction level parallelism, digital signal processors, network processors and multi-microprocessors. Projects will focus on the design, design analysis and FPGA implementations of computing systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5322|Minimum Grade of C|May not be taken concurrently.

ECE 8712. Power Systems Operation and Control. 3 Credit Hours.

The emphasis of this course is on computational issues that arise in the analysis and solution of the large-scale operations and control problems in actual power systems. Topics include power flow analysis, contingency analysis, security analysis, load forecasting, economic dispatch, unit commitment, optimal power flow, state estimation, and bad data detection, etc. Additional topics for real time control of power system include substation automation, EMS system architecture, distribution management system (DMS), RTU's and PMU's, and situational awareness and visualization.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5712|Minimum Grade of B-|May not be taken concurrently.

ECE 8722. Applications of Advanced Power Electronics Technologies. 3 Credit Hours.

In this course, we will start from the basic components and operation principle of power electronic converters and their advanced applications in modern power systems. In particular, the following topics will be included: converter topologies used for grid applications, converter control approaches, AC and DC microgrids, converter interfaced energy storage systems, smart inverters in distribution automation, etc. Applications of power electronic devices and systems used in modern power systems will be presented.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 5722|Minimum Grade of B-|May not be taken concurrently.

ECE 8742. Power System Stability. 3 Credit Hours.

This course introduces advanced concepts on stability and control of power systems. State space concepts of stability and control of dynamic systems are reviewed. Mathematical models of synchronous and induction machines are developed using Park's transformation. The method is extended to modeling converters, inverters, multimachine power grid, and AC/DC microgrid. Power system stability concept is introduced starting with the swing equation and extended to the analysis of multimachine systems. Advanced control methods of induction motors using vector control are discussed. The course includes extensive Matlab simulation studies of power grid and its components.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(ECE 5412|Minimum Grade of B|May not be taken concurrently)

AND (ECE 5712|Minimum Grade of B|May not be taken concurrently)

ECE 9182. Independent Study I. 3 Credit Hours.

Special study in a particular aspect of engineering under the direct supervision of a graduate faculty member. May be taken once by MS/MSE students and once by Ph.D. students.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ECE 9282. Independent Study II. 3 Credit Hours.

Special study in a particular aspect of engineering under the direct supervision of a graduate faculty member. May be taken once by Ph.D. students.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ECE 9324. VLSI Physical Design. 3 Credit Hours.

This course provides a comprehensive background in the principles and algorithms of VLSI physical design. The algorithms are presented in an intuitive manner so that the student can concentrate on the basic idea of the algorithms. The students are provided enough details to implement the algorithms.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(ECE 8324|Minimum Grade of C|May not be taken concurrently)
AND (ECE 5324|Minimum Grade of C|May not be taken concurrently)

ECE 9412. Nonlinear Control System. 3 Credit Hours.

Modeling of nonlinear systems, types of nonlinearity; Phase Plane Analysis, construction of phase portrait, limit cycle, saddle point; Existence and uniqueness of solutions, sensitivity; Lyapunov Stability, region of attraction, construction of Lyapunov functions; Perturbation Analysis variation of parameters, Method of averaging, Describing Functions, frequency domain analysis; Sliding Mode Control, sliding surface; Feedback Linearization, Lie algebra, state and output linearization, applications.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 8412|Minimum Grade of C|May not be taken concurrently.

ECE 9512. Detection, Estimation, and Modulation Theory. 3 Credit Hours.

Signal detection and estimation in white and non-white noise, MAP estimation, applications in data and telecommunications. Wiener and Kalman-Bucy filters, linear and non-linear modulation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ENGR 5033|Minimum Grade of C|May not be taken concurrently.

ECE 9514. Adaptive Signal Processing. 3 Credit Hours.

Adaptive filter techniques such as Weiner filter, Linear Prediction, Least-Mean-Square, Recursive Least-Squares, Kalman Filtering algorithms. Introduction to the application of adaptive filters to communications, control, and speech processing.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(ECE 5514|Minimum Grade of C|May not be taken concurrently)
AND ECE 8514|Minimum Grade of C|May not be taken concurrently)

ECE 9524. Digital Image Processing. 3 Credit Hours.

P2D digital filters, digital image edge detection and segmentation, feature extraction, deblurring, wavelet transforms, JPEG image compression, Fourier optics.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 8514|Minimum Grade of C|May not be taken concurrently.

ECE 9622. Parallel Processing Architectures. 3 Credit Hours.

This course provides an in-depth study of the design, engineering, and evaluation of modern parallel computers. Design issues covered include: naming, replication, synchronization, latency, overhead, and bandwidth. Other topics include scalable multiprocessors and interconnection network design.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ECE 8612|Minimum Grade of C|May not be taken concurrently.

ECE 9991. Directed Research. 1 to 6 Credit Hour.

Under the guidance of a faculty member, students will select a topic in electro-technology to be researched using at least five references. An extensive research paper must be submitted which will be reviewed by two faculty members. The project report must also be presented at an open seminar. Projects related to industrial applications are encouraged. For non-thesis students only.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ECE 9994. Preliminary Examination Preparation. 1 to 6 Credit Hour.

This course is intended for Ph.D. students who have completed their coursework but who have not yet passed both the Ph.D. Preliminary Examination.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ECE 9995. Project. 1 to 3 Credit Hour.

Under the guidance of a faculty member, students will select a topic in electro-technology to be researched using at least five references. Student present the research at an open seminar, and submits an extensive research paper, which will be reviewed by two faculty members. Projects related to industrial applications are encouraged. For non-thesis students only.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ECE 9996. Thesis. 1 to 3 Credit Hour.

Under the guidance of a faculty member, students will select a topic in electro-technology, and conduct research leading to submission and oral presentation of a thesis proposal and the final defense of the thesis. For thesis students only.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ECE 9998. Pre-Dissertation Research. 1 to 6 Credit Hour.

This course is intended for Ph.D. students who have passed both the Preliminary and Qualifying Examinations but who have not been elevated to candidacy.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ECE 9999. Dissertation Research. 1 to 6 Credit Hour.

This course is intended only for those students who have achieved Ph.D. Candidacy status. A minimum of 6 semester hours is required for graduation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Student Attribute Restrictions: Must be enrolled in one of the following Student Attributes: Dissertation Writing Student.

Repeatability: This course may be repeated for additional credit.

Engineering Management Courses

EMGT 5631. Design Thinking. 1.5 Credit Hour.

Many technologists view design as a function that takes place after the product or solution has been developed. Design thinking offers an alternative, customer driven approach to the commercialization of technological innovation, which embeds potential customer usage patterns into the development from the outset. Design thinking is thus a radical approach to the design process that enables much higher levels of innovation (and therefore commercial success) into the design process, especially in comparison with the traditional view of design that tends to foster incremental thinking. In this course we will share case studies of successful and unsuccessful product design, and provide participants with a series of tools to help them understand and deploy a design thinking process. In the course we will share frameworks for identifying market and technology trends that can stimulate opportunities for radical designs based on user engagement. With an improved understanding of the design thinking process participants will be better prepared for commercial success, whether they work in a large company deploying new solutions, or are interested in starting their own venture. The course will place particular emphasis on the importance and role of experimentation and learning from failure, as well as provide access to a series of tools that can help an organization decide whether, or not, to continue with a specific development process. In this course, students learn theories and practices for innovation, tools and methods for design inquiry, and characteristics of "design attitude." The course emphasizes hands-on project and studio-style project works.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

EMGT 5632. Idea to Invoice: Managing the New Product Development Process. 3 Credit Hours.

The course is designed to give technology students insights into the market and commercial factors that should be considered when developing new products or technologies. This course offers students the chance to understand and apply a number of analytical, decision making, and planning tools that can be used to guide the development of new products (and services) from idea to the marketplace (invoice). The course highlights critical issues associated with linking business objectives to technology development, and how each influences the other. Specific topics addressed include: the development of new product strategy and policy, selection of product market strategies, deployment and application of new product development processes, portfolio management, product development tools and metrics, market research, and importantly the people and organizational issues associated with the product development process. Participants in the course will learn to appreciate the advantages of introducing more formal new product development processes that break down the overall process into stages, and understand how and why the consideration of different strategic, technical and financial issues at each stage improve the likelihood of long-term commercial success. Not only will the course prepare participants for an active role in the product development process in a large organization or to participate in the technology development process in a new venture, they will also be prepared to obtain a certificate as a New Product Development Professional (NPDP) Certification offered by the PDMA.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

EMGT 5633. Management Principles for Innovators, Engineers and Technologists. 3 Credit Hours.

This is an introductory course for engineers and technologists who have no formal business training. It includes an introduction to the theory of the firm and the principles of management. It includes looking at the evolution of management, and the new roles for leaders and managers in innovative organizations. The course also gives a basic overview of corporate finance, and explains the various components of balance sheets, profit and loss and cash flow statements. Finally, the course deals with basic human resource and people management issues in the contexts of large organizations trying to adapt to rapid changes in the market.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

EMGT 5634. Project Management Overview and Project Management Essentials. 1.5 Credit Hour.

This course is designed for individuals working in both large and small organizations who are often faced with the challenges of managing multiple priorities and projects with limited resources. Whether these projects include a research and development project, the opening of a new production line, or the construction of a new facility, individuals are accountable for their on-time and on-budget performance. This course is an introduction course and follows a life-cycle approach to managing projects, beginning with project initiation concerns and ending with project termination.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

EMGT 5635. Financial Management for Technologists. 1.5 Credit Hour.

This course provides students with a real world understanding of what the key financial reports of a company actually mean and what is really important as a manager. It focuses on understanding profit and loss statements, budgets and cash flows. Also, it examines various methods for calculating financial return, and provides tools to help participants better budget, track project costs and decide between project alternatives.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

EMGT 5636. Lean Six Sigma and the Science of Improvement. 3 Credit Hours.

The discipline of quality management is increasingly recognized as an essential element in the management of any company. Quality management provides a number of approaches and tools to help individuals in both large and small organizations ensure that products and solutions consistently meet and exceed customer expectations, while ensuring that the company's processes maximize operational efficiency. In this course we will introduce a number of quality management tools: Six-Sigma, kaizen and TQM, that participants will be expected to deploy on actual cases. In addition, students will be provided with an overview of statistical tools that are essential when deploying a quality management system (i.e. Pareto Analysis, correlations and regression). The course will also focus on developing appropriate measurement systems, in order to use quantitative as well as qualitative tools to help identify specific areas that need attention. This will help quantify the magnitude of identified problems, prioritize the sequence in which each is going to be addressed, and then measure improvements made. The course is essential to those operating in larger companies, but the tools deployed will be useful to anyone looking to improve the effectiveness and efficiency of a smaller business, including those running their own ventures.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

EMGT 5637. Marketing Technological Products and Services. 1.5 Credit Hour.

This course applies the theories and constructs of marketing to the challenges of marketing technological products and services to organizational buyers. A firm's marketing initiatives can directly impact firm revenues (and costs), and ultimately firm value. It is therefore essential that managers understand the process of developing and managing marketing strategy (target market selection and customer value proposition). This course provides insight into marketing programs (product, promotion, place, and pricing), and describes how those programs can be integrated to yield a superior customer value proposition. A focus on technological products and business-to-business customers will be maintained throughout the course. Various pedagogical methods are utilized, including lectures, case studies, in-class presentations, and group projects.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

EMGT 5638. Executive Engineering Leadership. 1.5 Credit Hour.

This is an eclectic, interactive course aimed at facilitating technology professionals for the development of a deeper understanding of selected topics that contribute to heightened self-awareness as the foundation for a higher level of personal and executive development and effectiveness. The course examines the inter-relatedness between leadership and management, cognitive and affective aspects of executive behavior and managerial decision-making. It includes topics such as individual self-analysis of leadership style, communications skills, personal goals and values, interpersonal skills, team-building, negotiation skills, conflict management and group dynamics.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

EMGT 5633|Minimum Grade of B-|May be taken concurrently.

EMGT 5639. Advanced Financial Management for Technologists. 1.5 Credit Hour.

This course is a continuation of EMGT 5635 and studies problems in planning, controlling, and directing engineering through the perspective of financial analysis. The course will exam the constructs of profitability, liquidity, and the organizational structure of the engineering function using financial analysis and forecasting. Financial techniques will be applied to adjust engineering operations to meet the organization's total financial position and goals. Various pedagogical methods are utilized, including lectures, homework and quiz assignments, exams, and a team financial analysis project of technology based organization.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

EMGT 5635|Minimum Grade of B-|May be taken concurrently.

EMGT 5642. Project Management – Project Planning, Implementation and Case Study. 1.5 Credit Hour.

This course follows EMGT 5634 and includes project planning and scheduling which are given the most emphasis, making use of the PERT and CPM approaches. A course project is required. This course is designed to provide simple project management tools to help participants define project scope, agree on project milestones and track project performance. For individuals with multiple projects, learning these project management techniques is both an essential way of assigning priorities and increasing the likelihood of good performance, and in communicating with project participants and other stakeholders to allocate responsibilities and monitor outcomes. This course will provide participants with a number of project management tools and the opportunity to deploy them on case studies, in order for them to learn which tools are most appropriate for a specific application. In addition, the experience of using project management tools will help them to make sure they establish the groundwork for success when taking on new projects. Participants in this course may also gain credits for certification from the Project Management Institute (PMI).

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

EMGT 5634|Minimum Grade of B|May be taken concurrently.

EMGT 8110. Special Topics in Engineering Management. 1.5 to 3 Credit Hour.

Selected topics in Engineering Management. Please consult with instructor for detailed description.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

EMGT 9682. Independent Study in Engineering Management. 3 Credit Hours.

The Independent Study course will allow students to work on a relevant project in the field of Engineering Management under the direct supervision of faculty.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

EMGT 9995. Capstone for Engineering Management. 3 Credit Hours.

The Capstone course will allow students to complete final projects in their Engineering Management program.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

Engineering Courses

ENGR 5011. Engineering Mathematics I. 3 Credit Hours.

This is a survey course in essential mathematics for first-year graduate students in engineering and physical sciences. Topics include analytic methods in ordinary differential equations, complex-variable theory, the laplace transform and its inversion, and initial-value problems and boundary-value problems. Matlab, numerical methods, and introductory numerical algorithm design are introduced.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5012. Engineering Mathematics II. 3 Credit Hours.

This is a survey course in classical numerical and analytical methods for partial differential equations, for first-year masters and doctoral students in engineering and physical sciences. Topics include analytic methods and numerical methods for partial differential equations in cartesian and non-cartesian coordinate systems, and an introduction to perturbation theory. The course will emphasize quantitative analysis, and assignments will entail computational algorithm design.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5022. Engineering Analysis and Applications. 3 Credit Hours.

Vector space, basis, projection, null space, function space, L2 and space of continuous functions, Hilbert space, orthogonality, generalized Fourier series, linear transformation, adjoint transformation, eigenvalue problem, linear functional, Gateaux and Frechet differential, constrained optimization, infinite dimensional systems, complex analysis.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5031. Engr Prob Stats Stoc Met. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5032. Probability, Statistics, and Stochastic Methods. 3 Credit Hours.

A balanced approach to probability, statistics, stochastic models, and stochastic differential equations with special emphasis on engineering applications. Random variables, probability distributions, Monte Carlo simulations models, statistical inference theory, design of engineering experiments, reliability and risk assessment, fitting data to probability distributions, ANOVA, stochastic processes, Brownian motion, white noise, random walk, colored noise processes. Differential equations subject to random initial conditions, random forcing functions, and random parameters. Partial differential equations subject to stochastic boundary conditions. New techniques for non-linear differential equations. Computer simulation with MAPLE and other symbolic algebra software.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5033. Probability and Random Processes. 3 Credit Hours.

Sets and events, Random variables, Distribution and density functions, Functions of multiple random variables, Moments and conditional statistics, Information entropy, stochastic processes, wide-sense stationary process, ergodicity, correlation, and power spectrum of stationary processes. Applications to sampling theory and signal modulation and detection.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5110. Special Topics. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 5116. Spacecraft Systems Engineering. 3 Credit Hours.

The concept of systems engineering is introduced using a satellite application. Systems engineering is a top-down approach to the design, implementation, testing, and deployment of large-scale systems to meet the needs of users. The topics will include systems engineering methodology, dynamics of spacecraft, and celestial mechanics. This course will also introduce the notion of invention and innovation, and how they are related to the intellectual property issues.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5117. Experimental Methods. 3 Credit Hours.

Application and design of experimental techniques and measurement systems used in engineering laboratories. Introduction to the DMM, digital scope, and computer-based data acquisition systems for measurements of force, motion, pressure, temperature, and flow in steady and unsteady systems. Data transmission, data analysis and presentation, and computer interfacing techniques. Statistical methods and uncertainty analysis. Hands-on experience with state-of-the-art instrumentation systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5121. Design of Experiments. 3 Credit Hours.

The practice of modern science and engineering is synonymous with the ability to plan, design and conduct experiments efficiently and effectively, and analyze the resulting data to obtain objective conclusions in applications ranging from new product design and development to phenomenological/basic science studies. In this course we will focus primarily on methodological and design issues in planning experiments rather than on statistical analysis of the data. Nevertheless, we will briefly review various statistical analysis approaches required for fully designed experiment. Case studies involving single factor experiments, factorial designs, manipulation checks, etc. will be used to develop hands on skills for designing your own experiments. The course will have a focus on engineering approach to design of experiments with a particular emphasis on problem definition, system identification, data collection, statistical analysis, and hypothesis testing. For the final project, you will prepare a fellowship or grant (e.g. NSF GRFP or AHA Predoctoral) application ready for submission to a funding agency.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5314. Continuum Mechanics. 3 Credit Hours.

This course covers tensors, kinematics of a continuum, stress, integral formulations, linear isotropic elastic solid, and an introduction to Newtonian Fluid (CLO 3).

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5334. Dynamical Systems. 3 Credit Hours.

This course focuses on the algebraic and differential equations governing the static and dynamic 3D motion of 3D bodies, including vectors, vector differentiation, and dyads. The equations of motion for multibody systems will be derived using Newton-Euler, Lagrange, and Kane's methods. Computational tools for 3D force and motion analysis will be used to simulate physical systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5511. Fluid Dynamics. 3 Credit Hours.

Navier-Stoke's equation, Laminar and turbulent flow, boundary layer phenomena, compressible fluid flow including isotropic flow, shock waves, friction flow, and flow with heat transfer.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 5576. Computational Fluid Dynamics. 3 Credit Hours.

This course introduces the fundamentals of numerical solution methods for thermal and fluid dynamics applications. Focus is placed on the development of explicit and implicit methods for solving linear and nonlinear partial differential equations for heat conduction, wave propagation, and potential flow. Important topics pertaining to the use of commercial and research grade CFD software are included. As a final course objective, students will develop a solution method for 2D incompressible flow using MATLAB or a similar programming environment.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

ENGR 8110. Special Topics. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9182. Independent Study I. 3 Credit Hours.

Special study in a particular aspect of engineering under the direct supervision of a graduate faculty member. May be taken once by MS/MSE students and once by Ph.D. students.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9185. Experience in Engineering Profession I. 1 to 3 Credit Hour.

This course involves work experience in industry on current industrial practices of advanced engineering concepts under the supervision of a faculty advisor and an industrial mentor. At the end of the internship period, the student submits a technical report that is suitable for general public release. The report is graded by the faculty advisor in consultation with the industrial mentor. Students already employed in the industry are not eligible to register for this course.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9282. Independent Study II. 3 Credit Hours.

Special study in a particular aspect of engineering under the direct supervision of a graduate faculty member. May be taken once by Ph.D. students.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9285. Exper Engineer Prof II. 1 to 3 Credit Hour.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9990. Engineering Seminar. 1 to 3 Credit Hour.

Students present their research results at an open seminar. The seminars may be arranged on a biweekly basis over the semester. Active participation of all graduate students is expected.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9991. Directed Research. 1 to 6 Credit Hour.

Under the guidance of a faculty member, the student will conduct independent research on a selected topic in engineering.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9994. Preliminary Examination Preparation. 1 to 6 Credit Hour.

This course is intended for Ph.D. students who have completed their coursework but who have not yet passed both the Ph.D. Preliminary Examination.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9995. Project. 1 to 3 Credit Hour.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9996. Thesis. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9998. Pre-Dissertation Research. 1 to 6 Credit Hour.

This course is intended for Ph.D. students who have passed both the Preliminary and Qualifying Examinations but who have not been elevated to candidacy.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

ENGR 9999. Dissertation Research. 1 to 6 Credit Hour.

This course is intended only for those students who have achieved Ph.D. Candidacy status. A minimum of 6 semester hours is required for graduation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Student Attribute Restrictions: Must be enrolled in one of the following Student Attributes: Dissertation Writing Student.

Repeatability: This course may be repeated for additional credit.

Mechanical Engineering Courses

MEE 5110. Special Topics. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

MEE 5117. Finite Element Analysis. 3 Credit Hours.

Concepts and techniques of finite element and finite difference methods; mesh generation techniques; computer graphics presentation methods. Application to solids, liquids, and gases in the areas of stress, strain, deflection elasticity, heat transfer, fluid flow, and combustion.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5201. Thermodynamics of Materials. 3 Credit Hours.

An introductory master's level course that explores materials from a thermodynamic perspective: Includes the laws of thermodynamics, free energy, chemical potential, stability, etc. A detailed analysis of phase diagrams is presented in the second half of the course.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5203. Advanced Materials Science. 3 Credit Hours.

Chemical bonding, crystallography, defects and their effects on material properties, nucleation, growth, and microstructure development.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5205. Microscopy and Microanalysis of Materials. 3 Credit Hours.

This course will cover various Microscopy and Microanalysis techniques which are widely used in research labs and in industries to characterize micro and nano structure and chemical composition of solid matter. Among them are visual light, scanning probe and electron beam microscopy and associated spectroscopy. The primary focus will be on fundamental aspects and experimental methods of Scanning Electron Microscopy (SEM) and associated spectroscopy. The SEM facility will be used for individual student projects. Particular attention will be given to the selection criteria used for choosing the appropriate technique for materials characterization.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5211. Frontiers in Mechanical Engineering. 3 Credit Hours.

This is a survey course designed to introduce graduate students to cutting-edge research in the mechanical-engineering sciences. Topics will be taken from active research areas in the Mechanical Engineering Department, including (but not limited to) biomechanics, multifunctional materials, materials processing and/or manufacturing, acoustic sensors, nano/micro-technologies, and robotics. The course will have a coordinator, but the lectures will be given by a variety of mechanical-engineering faculty selected for their research expertise.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

College Restrictions: Must be enrolled in one of the following Colleges: Engineering, Science & Technology.

Repeatability: This course may not be repeated for additional credits.

MEE 5212. Tribology and Surface Engineering. 3 Credit Hours.

Tribology encompasses the interdisciplinary science and engineering of interacting surfaces in relative motion. Tribology is in every aspect of our lives and has a tremendous impact on manufacturing, energy production and use, transportation vehicles, health care, mining safety and reliability, and space exploration. This course introduces the nature of engineering surfaces, methods of surface characterization, modes of friction and wear, theories of contacts, and lubrication.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5312. Mechanics of Composite Materials. 3 Credit Hours.

Introduction to the behavior of composite materials and their use in engineering structures: behavior and properties of the constituent fibers and matrices, micromechanical predictions of composite properties, anisotropic elasticity, behavior of composite laminae, classical lamination theory; fracture mechanisms, failure theories; behavior of composite plates and beams.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5314. Impact and Crashworthiness. 3 Credit Hours.

This course is an advanced course on impact mechanics, impact biomechanics, as well as vehicle crashworthiness standards and accident data analysis. Students will learn about FMVSS and NCAP crash tests, FARS and NASS real world accident databases, and methods to analyze crash and accident data.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5411. Introduction to Mobile Robotics. 3 Credit Hours.

Introduction to Mobile Robotics will teach you, through the use of project-based learning, fundamental concepts in mapping, planning, control, and dynamics that are used in mobile robotics. By the end of this course you will be able to program both a ground and aerial robot to autonomously and safely navigate through an obstacle-filled environment. You will work with both simulated and real robots and use both off-the-shelf software and write code from scratch using ROS.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

MEE 4412|Minimum Grade of C-|May not be taken concurrently
OR MEE 5412|Minimum Grade of C-|May not be taken concurrently.

MEE 5412. Modern Dynamics for Robotics. 3 Credit Hours.

This course focuses on the algebraic and differential equations governing the static and dynamic 3D motion of rigid bodies, including vectors, vector differentiation, and dyads. The equations of motion for multibody systems will be derived using Newton-Euler, Lagrange, and Kane's methods. Computational tools for 3D force and motion analysis will be used to simulate physical systems.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5413. Robotic Manipulation. 3 Credit Hours.

This course is an introduction to the design, modeling and control of robot manipulators, using modern dynamic formulations for multi-degree of freedom, 3D rigid body systems. This course covers 3D spatial transformations, forward and inverse kinematics, Jacobians, joint space and operational space control, and force control. This course also introduces ROS for communication and control of 2 6 axis robotic arms.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

MEE 5412|Minimum Grade of C-|May not be taken concurrently
OR ENGR 5334|Minimum Grade of C-|May not be taken concurrently.

MEE 5414. Optimization and Control of Mechanical Systems. 3 Credit Hours.

This course focuses on designing optimal controllers for constrained and unconstrained dynamical systems. Topics include optimization, calculus of variations, dynamic programming, linear optimal control, trajectory optimization, optimal estimation, and model predictive control. Applications of the course concepts in classical problems as well as in modern systems will be discussed through several examples.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5423. Engineering Acoustics. 3 Credit Hours.

This graduate level course introduces the fundamentals of engineering acoustics and will help students establish a deep understanding of the physics of acoustic-wave propagation. Students will also be able to acquire knowledge on computational tools used to study acoustic systems, and explore emerging areas in acoustics including acoustic metamaterial and bio-inspired acoustic sensors.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

ENGR 5012|Minimum Grade of C|May be taken concurrently.

MEE 5511. Thermodynamic Properties. 3 Credit Hours.

Review of quantum mechanics and introduction to statistical mechanics. Statistical thermodynamics and various models of matter. Accuracy and trends of the predicted properties of various materials.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5512. Compressible Fluid Dynamics. 3 Credit Hours.

This course introduces students to the subject of high speed gas dynamics. Compressible flows exhibit fundamentally different behavior from those in low speed, constant density fluids. Such flows are found in aerodynamics, combustors, turbines, jets, gas pipelines, and wind tunnel facilities. Students study phenomena associated with supersonic flows, including normal and oblique shocks, expansion fans, and compressible flows with friction and/or heat transfer. An introduction to high temperature and rarified gas dynamics is also included.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5575. Renewable and Alternative Energy. 3 Credit Hours.

This survey course considers current technologies for renewable and alternative energy, including: different scenarios of producing energy; mechanical heat engines; ocean thermal energy converters; thermoelectricity; solar radiation; biomass; photovoltaic converters; wind energy; and ocean engines. The course will also consider the design of hydrogen-powered systems and of polymer electrolyte-membrane fuel cells.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5577. Power Generation and Storage Technologies. 3 Credit Hours.

This course will give an overview of electric power generation technologies including coal, gas, and nuclear power plants, as well as some emerging technologies such as photovoltaic. This course will also discuss technologies used in power transmission and distribution such as overhead power line conductors. Power storage technologies will also be introduced including compressed air, flywheel, hydrogen, and batteries.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5578. Fundamentals of Combustion. 3 Credit Hours.

This course is focused on concepts and applications of chemically reacting systems. Topics include heat of reaction, chemical equilibrium, chemical kinetics, chemical mechanisms, coupling chemical and thermal analyses of reacting systems, laminar premixed and diffusion flames, turbulent flames and pollutant emissions.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5643. Manufacturing Engineering. 3 Credit Hours.

This course will provide an overview of existing and emerging manufacturing technologies in the modern society. Topics include state-of-the-art processing methods for metals and alloys, ceramics and powder metallurgy, polymers and composites, additive manufacturing of a wide range of solid materials, as well as micro- and nano- fabrications.

Field of Study Restrictions: Must be enrolled in one of the following Fields of study: Mechanical Engineering.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5731. Cardiovascular Fluid Dynamics. 3 Credit Hours.

Mechanics of blood circulation, fluid mechanics of the heart, blood flow in arteries, unsteady flow in veins, current concepts in circulatory assist devices, biofluidics, and other selected topics.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5732. Tissue Biomechanics. 3 Credit Hours.

Tissue Biomechanics course is an introductory course about the mechanical properties of living tissues. The emphasis of the course is on the meaning of constitutive models for bio-solids and bio-fluids. Topics include a review of elastic, viscous, and viscoelastic constitutive models; bioviscoelastic solids; mechanical properties of blood vessels; mechanics of skeletal and heart muscles.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 5733. Viscoelasticity. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

MEE 8110. Special Topics. 3 Credit Hours.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

MEE 8315. Fracture Mechanics. 3 Credit Hours.

This course will cover essential topics of fracture mechanics such as elastic stress intensity factor and Griffith energy balance, determination of the elastic field at a sharp crack tip via eigenfunction expansion methods, elastic-plastic crack tip fields, J integrals analysis, fatigue crack growth, and experimental determination of fracture toughness. Emphasis will be given to calculation of stress intensity factors using modern numerical methods, determination of critical crack sizes, and prediction of fatigue crack propagation rate.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may not be repeated for additional credits.

Pre-requisites:

(ENGR 5314|Minimum Grade of C-|May not be taken concurrently)

AND (MEE 5203|Minimum Grade of C-|May not be taken concurrently)

MEE 9182. Independent Study I. 3 Credit Hours.

Special study in a particular aspect of engineering under the direct supervision of a graduate faculty member. May be taken once by MS/MSE students and once by Ph.D. students.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

MEE 9282. Independent Study II. 3 Credit Hours.

Special study in a particular aspect of engineering under the direct supervision of a graduate faculty member. May be taken once by Ph.D. students.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

MEE 9991. Directed Research. 1 to 6 Credit Hour.

Under the guidance of a faculty member, the student will conduct independent research on a selected topic in engineering.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

MEE 9994. Preliminary Examination Preparation. 1 to 6 Credit Hour.

This course is intended for Ph.D. students who have completed their coursework but who have not yet passed both the Ph.D. Preliminary Examination.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

MEE 9995. Project. 1 to 3 Credit Hour.

A project assigned with the approval of the Mechanical Engineering Graduate Committee and conducted under the supervision of a graduate faculty advisor. An oral presentation in an open seminar and a written report are required to complete the independent project. Projects related to industrial applications are encouraged. For non-thesis students only.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

MEE 9996. Thesis. 1 to 3 Credit Hour.

Master's thesis. May be taken twice.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

MEE 9998. Pre-Dissertation Research. 1 to 6 Credit Hour.

This course is intended for Ph.D. students who have passed both the Preliminary and Qualifying Examinations but who have not been elevated to candidacy.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Repeatability: This course may be repeated for additional credit.

MEE 9999. Dissertation Research. 1 to 6 Credit Hour.

This course is intended only for those students who have achieved Ph.D. Candidacy status. A minimum of 6 semester hours is required for graduation.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate.

Student Attribute Restrictions: Must be enrolled in one of the following Student Attributes: Dissertation Writing Student.

Repeatability: This course may be repeated for additional credit.