This Ph.D. program in Electrical Engineering will address the need for highly qualified engineers to lead innovative research and development activities in various fields of electrical engineering. This program will equip students with the essential skills in leadership, innovation, communication, and entrepreneurship in several targeted and important fields of electrical engineering. The outcomes of the program will prepare graduates for success in multiple sectors of industry, academia, and government. The proposed program will be the first doctoral program in Texas to integrate electrical engineering with entrepreneurship and commercialization with a focused emphasis on advancements in areas including energy production and management, semiconductor development and commercialization, and advanced computing and communications technologies.

Application Requirements

The items listed below are required for admission consideration for applicable semesters of entry during the current academic year. Submission instructions, additional details, and changes to admission requirements for semesters other than the current academic year can be found on The Graduate College's website (http://www.gradcollege.txstate.edu). International students should review the International Admission Documents page (http://mycatalog.txstate.edu/graduate/admission-documents/international/) for additional requirements.

- completed online application
- $55 non-refundable application fee

  or

- $90 non-refundable application fee for applicants with international credentials
- exceptional applicants with a bachelor's degree in electrical engineering or a closely related discipline from a regionally accredited university will be considered for admission but must complete an additional 24 semester credit hours of master's level courses when admitted.
- official transcripts from **each institution** where course credit was granted
- competitive GPA
- official GRE (general test only) with competitive scores in verbal, quantitative reasoning and writing sections (required if entering from any university other than Texas State University)
- resume/CV outlining education, work experience, scholarships/grants, publications/presentations, other accomplishments
- statement of purpose outlining the applicant's personal history and goals that are relevant for why the applicant wants to pursue this degree at TXST
- Three letters of recommendation evaluating the applicant's skill and potential in this degree program
- Interviews may be conducted with applicants through Zoom, Teams, or other video conferencing applications

TOEFL, PTE, IELTS or Duolingo Scores

Non-native English speakers who do not qualify for an English proficiency waiver:

- official TOEFL iBT scores required with a 78 overall.
- official PTE scores required with a 52 overall.
- official IELTS (academic) scores required with a 6.5 overall and minimum individual module scores of 6.0
- official Duolingo Scores required with a 110 overall.
- official TOEFL Essentials scores required with an 8.5 overall.

This program does not offer admission if these scores are not met.

Additional Information:

The program will admit full-time and part-time students once per year for fall admissions.

Degree Requirements

The Doctor of Philosophy (Ph.D.) degree with a major in Electrical Engineering requires 78 semester credit hours.

Course Requirements

Code	Title	Hours
Required Courses		
EE 7300	Research Methods and Technical Writing in Electrical and Computer Engineering	3
EE 7331	AI and Machine Learning for Engineers	3
MSEC 7301	Practical Skills in Commercialization and Entrepreneurship	3
MSEC 7302	Leadership Skills in Commercialization and Entrepreneurship	3
Choose 24 hours from the following:		24
ENGR 5310	Probability, Random Variables, & Stochastic Processes for Engineers	
EE 5320	Advanced Computer Architecture and Arithmetic	
EE 5321	Computer-Aided Engineering Simulations on HPC Systems	
EE 5323	Digital Image Processing	
EE 5330	Embedded and Real-Time Computing	
EE 5331	Machine Learning for Engineering Applications	
EE 5350	Advanced Electronic Circuit Design	
EE 5353	Fundamentals of Advanced Semiconductor Technology	
EE 5354	Flexible Electronics	
EE 5355	Electronic Materials and Devices	
EE 5357	Power Systems for Engineering	
EE 5360	Thin Film Technology	
EE 5361	Nanofabrication Technology for Semiconductor Device Processing	
EE 5372	Advanced Networking	
EE 5374	Advanced Wireless Communication	
EE 5375	Smart Grid: an Application Development Platform	
EE 5377	Statistical Signal Processing	
EE 5398A	Antenna Theory, Design and Applications	
EE 5398B	Electronic Materials and Beyond for Sustainable Energy	
EE 5398C		
IE 5310	Advanced Statistical Design of Experiments for Engineers	
CS 5310	Network and Communication Systems	
CS 5318	Principles of Programming Languages	

CS 5329	Algorithm Design and Analysis	
CS 5332	Data Base Theory and Design	
CS 5341	Advanced Network Programming	
CS 5343	Wireless Communications and Networks	
CS 5346	Advanced Artificial Intelligence	
CS 5351	Parallel Processing	
CS 5352	Distributed Computing	
CS 5395	Independent Study in Advanced Computer Science	
Breadth		
Choose 6 hours from the following: [1]		6
Machine Learning, AI, Computer and Digital Design		
CS 7313	Advanced Machine Learning and Pattern Recognition	
CS 7323	Image Processing and Computer Vision	
EE 7301	Advanced Digital System Design	
EE 7302	Hardware Acceleration for Machine Learning	
Microelectronics, Nanotechnology and Networks		
EE 7303	Physical Electronics	
EE 7304	Modern Semiconductor Devices	
EE 7372	Wireless and Mobile Networks	
EE 7374	Smart Data Networks	
Smart Energy, Power and Mobility Systems		
EE 7305	Energy Storage and Sustainability	
EE 7306	Artificial Intelligence in Smart Grids	
EE 7307	Mobile and Microgrid Design and Operations	
EE 7308	High and Medium Voltage Power Transmission	
Prescribed Electives		
Choose 12 hours from the following:		12
CS 7313	Advanced Machine Learning and Pattern Recognition	
CS 7323	Image Processing and Computer Vision	
CS 7331	High-Performance Computing	
CS 7332	Advanced Parallel Computing	
CS 7341	Cyberspace Security	
CS 7342	Advanced Computer Networking	
CS 7343	Mobile Networks and Computing	
CS 7387	Research in Computer Science	
CS 7389A	Service Computing	
CS 7389C		
CS 7389D		
CS 7389E		
EE 7301	Advanced Digital System Design	
EE 7302	Hardware Acceleration for Machine Learning	
EE 7303	Physical Electronics	
EE 7304	Modern Semiconductor Devices	
EE 7305	Energy Storage and Sustainability	
EE 7306	Artificial Intelligence in Smart Grids	
EE 7307	Mobile and Microgrid Design and Operations	
EE 7308	High and Medium Voltage Power Transmission	
EE 7359	Research in Electrical Engineering	
EE 7374	Smart Data Networks	
EE 7372	Wireless and Mobile Networks	
MSEC 7310	Nanoscale Systems and Devices	
MSEC 7311	Materials Characterization	
MSEC 7330	Computational Materials Science	
MSEC 7395A	Microwave & Power Device Physics and Materials	
MSEC 7395B	Thin Film Photovoltaic Devices	
MATH 7321	Graph Theory	
MATH 7325	Statistics 1	
Dissertation		
Choose a mimimum of 24 hours from the following:		24
EE 7199	Dissertation	
EE 7299	Dissertation	
EE 7399	Dissertation	
EE 7599	Dissertation	
EE 7699	Dissertation	
EE 7999	Dissertation	
Total Hours		**78**

Candidacy Criteria

A minimum GPA of 3.0 on all coursework undertaken in the doctoral program is required for admission to candidacy. Grades below a B on any graduate coursework cannot be applied toward the doctoral degree. Incomplete grades must have been cleared before approval for advancement to candidacy can be granted. Before advancing to candidacy, no more than six semester credit hours of dissertation can be taken.

Students will advance to candidacy after they have completed all required and elective coursework (except for dissertation credit hours), passed their comprehensive exam, and successfully defended their dissertation proposal. This should be done by the time the student has completed 60 semester credit hours. If the comprehensive exam is not passed, the student can take a second and final one in the following semester. Students will be dismissed from the program if they do not pass the comprehensive exam the second time.

Candidacy and Dissertation

When all requirements for admission to candidacy have been met, the doctoral program director forwards the Application for Advancement to Candidacy to the Dean of The Graduate College for review and approval. This application form is available on The Graduate College's website.

No credit will be applied toward a student's doctoral degree for coursework completed more than five years before the date the student is admitted to candidacy. This time limit applies to course credit earned at Texas State and course credit transferred to Texas State from other institutions.

All doctoral students must complete a dissertation with original research and demonstrate mature scholarship, critical judgment, and familiarity with tools and methods in the chosen area. The dissertation project must adhere to the dissertation proposal and cover the topic approved by the student's dissertation committee.

After being admitted to candidacy, students must be continuously enrolled for dissertation hours each fall and spring semester until the defense of their dissertation. At least 18 semester credit hours of dissertation research must be taken after having advanced to candidacy. If a student receives supervision on a dissertation during the summer or is graduating in the summer, the student must be enrolled in dissertation

hours for the summer. All candidates for graduation must be enrolled in dissertation hours during the semester in which the degree is to be conferred, even if they have already satisfied the minimum dissertation hours.

Comprehensive Exam

Each doctoral student must pass a comprehensive examination. This should be done by the time the student has completed 36 semester credit hours (for students entering with a master's degree, 60 semester credit hours for those entering with a bachelor's degree) and can only be done after identifying the dissertation committee, fulfilling the programming requirement, and completing all required courses. Students must pass the comprehensive exam by the time 45 semester credit hours (for students entering with a master's degree, 60 semester credit hours for those entering with a bachelor's degree) have been accrued to be dismissed from the program. If the comprehensive exam is not passed, the student can take a second and final one in the following semester. Students will be dismissed from the program if they do not pass the comprehensive exam the second time.

The comprehensive examination for the Ph.D. program in electrical engineering will be an all-encompassing, written examination administered in person under the supervision of the program's Doctoral Advisor. The exam intends to evaluate students' grasp of their coursework and their ability to integrate and apply their knowledge in the field. The comprehensive exam will be structured into six one-hour sections, curated to cover foundational and advanced electrical engineering topics adequately. The exam will be six hours, divided into two distinct segments. The first three hours of the exam will focus on fundamental topics primarily encountered in undergraduate courses in electrical engineering. This segment aims to test the student's grasp of the core principles that are the bedrock of their further studies and research. Following this, the final three hours will shift the focus to advanced topics typically covered in 5000-level courses. This segment assesses students' understanding of complex concepts and ability to apply them in practical scenarios.

Each topic is allocated an hour, providing a robust and comprehensive evaluation of student's knowledge in each area. Students can select six topics that align closely with their research subject area. This approach allows us to tailor the exam to each student's learning journey while maintaining a rigorous assessment standard. The faculty, renowned experts in their respective domains, will prepare each section, ensuring the exam content reflects the field's breadth and depth. This approach allows us to tailor the exam to each student's learning journey while still maintaining a rigorous standard of assessment across the board. The faculty, renowned experts in their respective domains, will prepare each section, ensuring the exam content reflects both the breadth and depth of the field.

The Doctoral Advisor will coordinate all aspects of the exam, from facilitating the drafting of exam sections by faculty members to overseeing the administration and grading of the exam. They will also serve as a point of contact for students throughout the examination process, addressing any concerns and providing guidance as needed. This comprehensive exam is an integral part of the program, designed to ensure our students have a robust understanding of the concepts they have studied and are prepared to undertake high-level research and professional responsibilities in electrical and computer engineering.

Dissertation Proposal and Proposal Defense

Each Ph.D. student must prepare a written dissertation proposal and defend it orally. This should be done by the time the student has completed 36 semester credit hours (for students entering with a master's degree and 60 hours for students entering with a bachelor's degree) and after identifying the dissertation committee, passing the comprehensive exam, and completing all required courses and boot camps. Any student who does not defend his/her dissertation proposal by the time 45 semester credit hours or students entering with a master's degree and 60 hours for students entering with a bachelor's degree) have been accrued will be dismissed from the program. If the proposal defense is not passed, the student can take a second and final defense in the following long semester. Students will be dismissed from the program if they do not pass the proposal defense the second time.

The proposal must outline the substance and scope of the planned dissertation research and explain its merits. It must include at least an introduction, the methodology to be used, a survey of the relevant literature, and preliminary results that demonstrate the feasibility. The proposal aims to establish that the student has a sufficient grasp of the fundamentals of the chosen dissertation topic to execute the research.

The proposal defense entails a public presentation of the student's dissertation proposal followed immediately by a closed defense of the proposal attended only by the student and their dissertation committee. The dissertation proposal must be approved by the student's dissertation advisor and a majority of the remaining members of the dissertation committee. The student's dissertation committee members must indicate their approval on the Doctoral Dissertation Proposal Form and the Defense of Dissertation Proposal Form. These forms are available on The Graduate College's website.

A final copy of the dissertation proposal, accompanied by the signed approval forms, must be turned in to the doctoral program director, who will forward them to the dean of The Graduate College for review and final approval.

All doctoral students must complete a dissertation with original research and demonstrate mature scholarship, critical judgment, and familiarity with tools and methods in the chosen area. The dissertation project must adhere to the dissertation proposal and cover the topic approved by the student's dissertation committee.

Dissertation Advisor

The Ph.D. program director serves as the initial advisor of each student accepted into the program. The director then works with the student and the faculty to identify possible dissertation advisors. By 18 semester credit hours have been accrued, each doctoral student is expected to have secured a qualified dissertation advisor who agrees to advise and mentor the student. The mentoring by the dissertation advisor should include providing regular feedback to students and supervising them throughout the Ph.D. program – specifically in the execution of the dissertation research – and helping them identify short- and long-term career goals—for the Ph.D. Dissertation/Research Advisor Assignment Form must be completed by the student and the dissertation advisor and approved by the Dean of The Graduate College. This form may be downloaded from The Graduate College's website.

If a student has not identified a willing and qualified dissertation advisor by the time, he/she has accrued 27 semester credit hours, the student will be dismissed from the program.

Dissertation Committee

The Dissertation Committee will consist of 4 members, including the student's dissertation committee chair who must be a regular graduate faculty member in the program, two other graduate faculty members from the electrical engineering program, and a PhD holder from industry or a government agency or one doctoral graduate faculty from another department or program at Texas State University or from another university. The student's dissertation committee chair will chair the committee. The student, the dissertation committee chair, and the Dean of The Graduate College will approve the composition of the dissertation committee.

The dissertation defense consists of two parts. The first part is a public presentation of their dissertation research. The second part of the defense immediately follows the public presentation. It is restricted to the student's dissertation committee participation and entails an oral examination of the dissertation research. Approval of the dissertation requires positive votes from the student's dissertation advisor and the majority of the remaining members of the dissertation committee. Notice of the defense presentation will be publicly posted at least two weeks in advance.

Dissertation Defense

Once the dissertation has been completed, a final exam (referred to as the dissertation defense) on the dissertation must be conducted. The dissertation defense can only be scheduled once all other academic and program requirements have been fulfilled. A complete dissertation draft must be given to the dissertation committee members at least one month before the defense. However, students are highly encouraged to provide drafts earlier so that the committee members can provide feedback, which the student, in consultation with the dissertation advisor, will address in later drafts to ensure that the dissertation is defendable, and each committee member is satisfied before the dissertation defense takes place.

The dissertation defense consists of two parts. The first part is a public presentation of their dissertation research. The second part of the defense immediately follows the public presentation. It is restricted to the student's dissertation committee participation and entails an oral examination of the dissertation research. Approval of the dissertation requires positive votes from the student's dissertation advisor and the majority of the remaining members of the dissertation committee. Notice of the defense presentation will be publicly posted at least two weeks in advance.

If the dissertation defense is not approved, the student can take a second and final dissertation defense in the following long semester. Students who do not pass the dissertation defense the second time will be dismissed from the program.

The dissertation defense results must be recorded in the Dissertation Defense Report Form and submitted to The Graduate College before the Dean of The Graduate College can approve the dissertation. This form can be downloaded from The Graduate College's website. The student must submit his/her dissertation to The Graduate College for final approval. The guidelines for submission and approval of the dissertation can be obtained from The Graduate College.

Students must pass the dissertation defense by the time 90 semester credit hours have been accrued. The doctoral program will review each student annually to ascertain his/her progress toward the degree and will consult the student's dissertation advisor and dissertation committee on this matter as needed. Any student who does not pass the dissertation defense by the time 90 semester credit hours accrued will be dismissed from the program.

Doctoral level courses in Electrical Engineering: EE (p. 4), MSEC (p. 6)

Courses Offered

Electrical Engineering (EE)

EE 7199. Dissertation.
This course includes original research and writing in electrical engineering, to be accomplished under direct supervision of the PhD research advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

EE 7299. Dissertation.
This course includes original research and writing in electrical engineering, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

EE 7300. Research Methods and Technical Writing in Electrical and Computer Engineering.
This course prepares students for advanced research by examining how to plan, conduct, and report on empirical investigations. This course covers techniques applicable to each of the steps of a research project, including formulating research questions, theory building, data analysis, building evidence, assessing validity, and publishing. Students practice a variety of research methodologies and explore the capacities and limitations of specific approaches. Other topics covered are principles of good writing, format of a scientific manuscript, issues in publication and peer review, utilizing different online databases, attributing credit for prior work, respecting intellectual property rights, and maintaining ethics in research.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7301. Advanced Digital System Design.
This course covers digital systems design using hardware description languages and their associated tooling to capture, integrate, verify, simulate, and synthesize digital hardware. The course examines modern hardware design flows using high-level synthesis and register-transfer-level (RTL) synthesis. It covers the role of hardware description languages in the verification, simulation, and integration process of hardware modules in large digital systems. The course projects offer an integrated experience in advanced digital systems design combining hardware description languages, hardware design methodologies, and hardware design practice on a programmable target, such as an FPGA or ASIC.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7302. Hardware Acceleration for Machine Learning.
This course is a comprehensive exploration of AI system design, from the intricacies of deep learning architecture to hardware considerations. The course covers a range of computing platforms in CPUs, TPUs, and GPUs, emphasizes FPGA fundamentals and programming, and delves into memory structures crucial for AI. It also provides strategies for optimizing power consumption in system-level and RT-level design.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7303. Physical Electronics.
This course addresses the advanced concepts of semiconductor device physics and operations. The course helps students to gain a foundation in the area of physical electronics as a basis of continued course work and research in nano- and micro- electronics devices and systems. Topics will include quantum mechanics, the statistics of particles, transport in crystalline semiconductors, and optoelectronic devices.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7304. Modern Semiconductor Devices.
This course reviews and deepens understanding of advanced topics in semiconductor devices. Topics of this course include semiconductor physics, metal-semiconductor contacts, the physical principles and operation of P-N junctions, MOS capacitors, MOS field-effect transistors, scaling and short-channel effects of modern and future MOSFETs, and optoelectronic devices such as photodetectors, solar cells, light emitters and display devices.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7305. Energy Storage and Sustainability.
This course provides a basic understanding of the various mechanisms and related technologies that are currently employed for energy storage and sustainability. Topics covered range from basic concepts to the most important methods for energy storage. General principles involved in various electro-chemical technologies are introduced, followed by a presentation of the most important battery systems. Most important storage methods and major areas of application are discussed, in addition to policies and actions needed to transition to 100% clean, renewable energy and storage for businesses, nonprofit and government organizations. State-of-the-art and challenging research topics are discussed.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7306. Artificial Intelligence in Smart Grids.
This course introduces artificial intelligence (AI) and machine learning (ML) techniques, algorithms, and tools for smart grid applications. Topics covered range from fundamentals of machine learning and artificial intelligence to state-of-the-art research on using AI and ML algorithms and tools to design, operate, and manage smart grids. Related applications are covered, including but not limited to energy forecasting, smart meter data analytics, and nonintrusive load monitoring.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7307. Mobile and Microgrid Design and Operations.
This course covers advanced modeling, control, resilience and security technologies useful for grid modernization from the angle of microgrid design, analysis and operation. Topics include smart inverters, microgrid architectures, distributed energy resources modeling, microgrid hierarchical control, microgrid stability, fault management, resilient microgrids through programmable networks, reliable networked microgrids, and cyber security.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7308. High and Medium Voltage Power Transmission.
This course covers electric power transmission and distribution systems. With increased amounts of distributed generation (photovoltaics, small-scale wind), distributed storage, and controllable loads, it has become more and more important for researchers and power industry professionals to understand power distribution and transmission systems. This course provides an introduction to distribution grids, including their components, typical topologies, and operational strategies. Then, it covers power flows in distribution grids and distribution transformers. Additionally, the course covers the fundamentals of electric loads, including electric load modeling, analysis, and control methodologies.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7331. AI and Machine Learning for Engineers.
This course provides an in-depth exploration of fundamental machine learning concepts and techniques, including supervised, unsupervised, and semi-supervised learning, alongside practical applications of these concepts in real-world problems. It further delves into the intricate world of deep learning, investigating critical topics such as deep neural networks, convolutional neural networks, and recurrent neural networks, as well as recent advancements in the field. Additionally, the course explores essential reinforcement learning concepts, including Markov Decision Processes, Q-learning, and policy gradients, preparing students for advanced AI research and development for engineering applications.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7354. Advanced Flexible Electronics.
This course covers the materials systems, processes, device physics and applications of flexible electronics. Study of materials will include amorphous and nanocrystalline silicon, organic and polymeric semiconductors, and solution cast films of carbon nanotubes, graphene and other 2D materials. Contemporary research and advancement in the areas of high-speed transistors, switches, photovoltaics, and communication devices will be covered.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7359. Research in Electrical Engineering.
This research course is for doctoral students in electrical engineering who have not yet passed their candidacy exam, typically under supervision of the PhD Research Advisor.
3 Credit Hours. 0 Lecture Contact Hours. 12 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

EE 7372. Wireless and Mobile Networks.
This course provides an in-depth presentation of concepts, fundamentals, and technologies of modern wireless and mobile networks. Topics covered include wireless signal propagation characteristics and modeling, coding and modulation, link-layer techniques for reliable communications, and multiple access schemes and protocols. Wireless local area networks, wireless personal area networks, sensor networks, and wide area networks (5G/6G networks) are also covered, as are low-power wide area networks energy-aware and energy-harvesting schemes and protocols. Additional topics include mobile ad-hoc networks and variants, such as unmanned aerial networks and vehicle ad hoc networks, Internet of Things, and AI- and ML-based mobile and wireless networks.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7374. Smart Data Networks.
This course covers fundamentals for the design of smart data networks, which represent the evolution of data networks by taking advantage of artificial intelligence and machine-learning technologies to push the boundaries of traditional networks and the internet. All layers of the protocol stack are re-examined with a focus on how AI and ML-based technologies can advance the design of new protocols and algorithms. Hence, the course covers AI- and ML-enhanced medium access control protocols, routing, congestion control, transport protocols, multimedia streaming, network applications, traffic characterization, and advanced networking topics, such as IoT and digital twins.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

EE 7399. Dissertation.
This course includes original research and writing in electrical engineering, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

EE 7599. Dissertation.
This course includes original research and writing in electrical engineering, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

EE 7699. Dissertation.
This course includes original research and writing in electrical engineering, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
6 Credit Hours. 6 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

EE 7999. Dissertation.
This course includes original research and writing in electrical engineering, to be accomplished under direct supervision of the dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

Materials Science, Engineering and Commercialization (MSEC)

MSEC 7100. Doctoral Assistant Development.
The course is designed to equip the doctoral students with skills and an understanding of proper procedures to be effective teaching assistants. This course does not earn graduate degree credit.
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Course Attribute(s): Graduate Assistantship|Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

MSEC 7101. Commercialization Forum.
The course is a seminar series exposing students to commercialization issues. The series includes as speakers: successful entrepreneurs, businessmen, research directors, production and process control engineers, intellectual property and licensing experts, management consultants, and technology transfer specialists. Repeatable four times for credit.
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

MSEC 7102. MSEC Seminar.
This course is an introduction to current materials science and engineering topics with presentations by subject matter experts as the basis for weekly discussions. Students participate by asking questions and actively engaging the seminar speaker. Students are also expected to give public presentations based upon their own field of research at the STAR (Student Technology and Research) Showcase. Repeatable four times for credit.
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

MSEC 7103. Research in Materials Science, Engineering, and Commercialization.
This research course is for students in Materials Science, Engineering, and Commercialization who have not yet passed their candidacy exam, typically under supervision of the PhD Research Advisor. Repeatable (with MSEC 7203 & MSEC 7303 hours) for doctoral credit up to 6 hours.
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MSEC 7199. Dissertation.
Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester. Repeatable for credit.
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MSEC 7203. Research in Materials Science, Engineering, and Commercialization.
This research course is for students in Materials Science, Engineering, and Commercialization who have not yet passed their candidacy exam, typically under supervision of the PhD Research Advisor. Repeatable (with MSEC 7103 and MSEC 7303 hours) for doctoral credit up to 6 hours.
2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MSEC 7299. Dissertation.
Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester. Repeatable for credit.
2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MSEC 7301. Practical Skills in Commercialization and Entrepreneurship.
This course is the first of a two-course series to impart business and commercialization skills by producing a business plan. Key areas covered include intellectual property law, technology transfer and licensing strategies, business plan development, business finance strategies, management structures, project management methods, statistical quality and process control.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7302. Leadership Skills in Commercialization and Entrepreneurship.
This course is the second of a two-course series to impart business and commercialization skills by producing a business plan. Key areas covered include intellectual property law, technology transfer and licensing strategies, business plan development, business finance strategies, management structures, project management methods, statistical quality and process control. Prerequisite: MSEC 7301 with a grade of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7303. Research in Materials Science, Engineering, and Commercialization.
This research course is for students in Materials Science, Engineering, and Commercialization who have not yet passed their candidacy exam, typically under supervision of the PhD Research Advisor. Repeatable (with MSEC 7103 & MSEC 7203 hours) for doctoral credit up to 6 hours.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MSEC 7304. Collaborative Research/Commercialization Experience.
This course allows Ph.D. level graduate students to initiate, conduct and participate in a collaborative research or commercialization experience with graduate faculty in addition to research conducted under MSEC 7103, MSEC 7303, MSEC 7199 and MSEC 7399. This course recognizes the collaborative nature of the scientific and commercialization enterprise. Repeatable for doctoral credit up to 6 hours.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

MSEC 7310. Nanoscale Systems and Devices.
This course is an in-depth treatment of physical phenomena in nanoscale structures, and consequences for electronic, photonic, mechanical and other types of devices. The course provides a strong background in devices with applications in nanoelectronics, biomedical systems, micro- and nanoscale manipulation, adaptive optics, and microfluidics.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7311. Materials Characterization.
This course covers skills and knowledge required for microscopy methods including transmission electron microscopy, scanning electron microscopy, scanning tunneling electron microscopy, atomic force microscopy, and confocal microscopy. It covers x-ray and neutron diffraction techniques including structure analysis, powder and glancing angle diffraction, pole figure, texture analysis, and small angle scattering.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Dif Tui- Science & Engineering
Grade Mode: Standard Letter

MSEC 7315. Quantum Mechanics for Materials Scientists.
This course includes quantum-mechanical foundation for study of nanometer-scale materials, principles of quantum physics, stationary-states for one-dimensional potentials, symmetry considerations, interaction with the electromagnetic radiation, scattering, reaction rate theory, spectroscopy, chemical bonding and molecular orbital theory, solids, perturbation theory, and nuclear magnetic resonance.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7320. Nanocomposites.
Characteristics of nanoparticles utilized in nanocomposites, techniques for surface modification, methods for nanoparticle dispersion forming nanocomposites, types of nanocomposites, characteristics of nanocomposites, analytical methods for characterization of composites, and common applications will be discussed. Particular attention will be given to the science and theories explaining the unique behavior of nanocomposites.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7325. Principles of Technical Project Management.
This course includes planning, budgeting, identification of risks and risk mitigation approaches, resource allocation, review of milestones and schedules, and evaluating projects to measure success. Responsibilities of project managers in the areas of problem solving, motivating and managing creative technical staff in project and matrix organizations will be included.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7330. Computational Materials Science.
Application of computational techniques to molecular and atomic modeling of materials is discussed along with quantum mechanical modeling, density functional theory approaches, forcefield based molecular modeling, mesoscale modeling, energy minimization, molecular dynamics, vibrational spectra, crystal structures, phase equilibria, physical property prediction, and electronic structure related to magnetic and electrical properties. Prerequisite: CHEM 3340 with a grade of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7340. Biomaterials and Biosensors.
The course covers the growing field of biomaterials science including materials for prosthetics and implants, mimetic materials, biosensors, diagnostic devices, and drug delivery systems. Particular attention will be given to nanomaterials for diagnosis and treatment of diseases including targeted cancer treatments, drug delivery systems, and advanced imaging methods.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7350. Frontiers of Nanoelectronics.
This course provides an introduction to the operating principles of nanoscale electronic and optical devices. The emphasis is on how leading edge nano-fabrication technology takes advantage of quantum mechanics of reduced sizes and dimensions. Specific examples of devices based on quantum wells, wires, dots and molecular electronics are given.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7355. Fluid Flow in Porous Media.
In this course, the fundamental theory of transport and fluid flow in heterogeneous porous media will be presented. First, the equations that govern transport and fluid flow processes will be derived. Both analytical and numerical methods will be used to solve these equations in order to characterize and predict flow fields in porous media. These skills will then be applied to practical problems that involve porous media such as soils, rocks, biological tissues, concrete, etc. The knowledge gained from studies of fluid flow in natural porous materials will be employed to design/optimize systems with engineered porous media.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7360. Nanomaterials Processing.
The course will cover various aspects of materials processing related to semiconductor devices. Topics covered include properties of electronic materials, thin film deposition, etching, lithography, and related device physics with an emphasis on the nanoscale. Fabrication and characterization techniques will be covered, including clean room usage. Prerequisite: MSEC 7401 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7370. Advanced Polymer Science.
Advanced topics in polymer science are discussed with a focus on high performance polymers such as high impact, conducting, shape memory, high temperature and the underlying phenomena that provide these unusual properties, and advanced polymer topic areas such as flame retardancy, barrier properties, dielectric properties, rheology, and fiber reinforced composites.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7395A. Microwave & Power Device Physics and Materials.
This course will develop an understanding of basic microwave and power device physics and technology and the advanced materials that are used in today's cutting-edge research & development. The primary focus will be wide bandgap semiconductor materials and devices, and their performance metric versus the industry standard Si-based devices. Prerequisite: MSEC 7401 and MSEC 7402 both with grades of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395B. Thin Film Photovoltaic Devices.
This course is a survey of the Materials Science of photovoltaic devices with emphasis on device physics including the photovoltaic effect, photon absorption, electrons and holes, generation and recombination, the pn-junction, charge separation, monocrystalline solar cells, thin film solar cells, III-V solar cells, and losses. Prerequisite: MSEC 7401 and MSEC 7402 both with grades of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395C. Materials for Sustainable Energy.
This course introduces principles and applications of sustainable energy materials used for energy generation, conversion, and storage. Topics of study include principles (thermodynamics, kinetics, transport phenomena, equivalent circuits, catalysis, and electrochemistry) and selection and performance criteria important for applications including batteries, supercapacitors, fuel cells, electrolyzers, dielectrics, biomass, and piezoelectrics. Prerequisite: MSEC 7401 and MSEC 7402 both with grades of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395D. Polymer Characterization and Processing.
This course will cover the concepts critical to the characterization and processing of organic polymers. Topics critical to characterization will include molecular weight determination, thermo/mechanical characterization, X-ray scattering, and polymer spectroscopy. Processing topics will include polymer rheology, principles of polymer processing, solution processing, and extrusion. Prerequisite: CHEM 4351 or CHEM 5351 or MSEC 7370 any with a grade of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395E. Industrial Ecology and Sustainability Engineering.
This course covers the basic principles of life cycle analysis (LCA) of engineered products, materials, and processes. Topics covered include: biological ecology, industrial ecology, resource depletion, product design, process design, material selection, energy efficiency, product delivery, use, end of life and LCA.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395F. Catalysis in Materials Science.
This course introduces principles and applications of catalysis in materials science. The primary topics of study will include catalysis as a means of synthesizing materials and materials as catalysis. Subtopics will focus on specific catalysts (Ziegler-Natta, ROMP, and cross-coupling catalysts) and specific catalytic processes (hydrogenation, photoredox, and electrocatalysis).
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395G. Applied Plasma Physics.
Applied plasma physics focusing on the broad range of technical plasma devices, and to analyze and describe the main plasma physical characteristics and principles of operation. Emphasis will be on physical insight, application, and problem solving. Prerequisite: MSEC 7401 and MSEC 7402 both with grades of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395H. Environmental Chemistry.
Advanced study in environmental chemistry, with an emphasis on aquatic resources and materials science and engineering. Principles of geochemistry and atmospheric chemistry will be covered as they relate to environmental pollution monitoring and control. Principles and applications of green chemistry will also be discussed.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395I. Structure and Properties of Alloys.
This course in an advanced exploration of the structure and properties of engineering alloys. Strengthening mechanisms of alloys are explored with specific applications to the alloys studied. The processing, properties, and structure of ferrous and nonferrous alloys are explored including new and emerging alloys. Prerequisite: Instructor approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395J. Advanced Concrete Materials and Durability.
This course delves into a comprehensive coverage of Portland cement concrete materials as well as resilient and sustainable materials used for building and transportation infrastructure. Topics include cement and aggregate properties, chemical and mineral admixtures, mixture proportioning, concrete microstructure, concrete durability, long-term performance, durability prediction and modeling, durability of alternative cement, multi-scale assessment, and dimensional stability.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395K. Electrical and Magnetic Characterization Methods.
This course introduces electric and magnetic characterization methods important to metals, magnetic and semiconductor materials and devices. Various measurement techniques and methods will be reviewed. Students will learn to work with characterization tools.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395L. Advanced Solid State Physics.
This course reviews models of a solid and energy band theory. Additional topics may include interaction of electromagnetic waves with solids, lattice vibrations and phonons, many body effects in solids, device physics, quantum phenomena, carrier transport properties, current device configurations, and materials interface problems. Prerequisite: MSEC 7401 with a grade of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395M. Semiconductor Devices and Processing.
This course addresses the basics of semiconductor devices, silicon and compound semiconductor material fabrication, photolithography, etching, control of dopant profiles for the formation of shallow junctions needed for nanoscale devices, ion implantation and microstructure engineering, different types of doping phenomena, the carrier action and charge transport properties, defect microstructures, low-resistivity Ohmic contacts, and different fabrication concepts of conventional and emerging micro-/nano-electronic devices. In addition, students will be involved in laboratory projects and seminar presentations. Prerequisite: MSEC 7401 with a grade of "B" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395N. Advanced Infrastructure Materials.
This course provides a comprehensive presentation of advanced infrastructure materials including cement concrete, asphalt concrete, wood, steel, etc. Emphasis is placed on a fundamental understanding of the raw ingredients of cement concrete and how these ingredients affect concrete fresh and hardened properties. A brief introduction of other common infrastructure materials is also included in this course. Students will be asked to solve an infrastructure material related problem using advanced analytical and simulation tools.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395O. Modern Concepts in Materials Science.
This course provides an overview of the modern concepts and principles that are used to describe and predict the physical properties of materials. An emphasis will be placed on developing and applying fundamental materials science concepts: atoms and atomic bonding, fundamentals of crystallography, elementary diffraction by solid-state materials, defects, solid solution and phase equilibrium. Particular attention will be given to the science and theories explaining the unique behavior of different classes of materials, i.e. ceramics, metals, polymers, electronic materials and composites.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395P. Optical properties of solids.
This course introduces the optical properties of solids, including electronic and vibrational transitions in inorganic and organic thin films and multilayers. Various optical characterization methods and techniques will be reviewed including UV/VIS spectroscopy, ellipsometry, Raman spectroscopy, Fourier transfer infrared spectroscopy, photoluminescence spectroscopy, and Xray fluorescence spectroscopy. Students will learn to work with spectroscopy characterization methods and learn how to interpret the various spectra.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7395Q. Scanning probe microscopy and nanoscience.
In this course, various topics of nanoscience such as nanomechanics, nanoelectronics, and nano-optics will be introduced through the lens of scanning probe microscopy (SPM). Students will learn various scanning probe microscopy techniques along with their physical principles and applications to nanoscience. Instrumentation aspects of the SPM techniques will also be covered.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

MSEC 7399. Dissertation.
Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester. Repeatable for credit.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MSEC 7401. Fundamental Materials Science and Engineering.
Course covers fundamentals of chemical kinetics, physical properties, and continuum mechanics. Topics include electronic and atomic structure, structure of crystalline materials, imperfections, thermodynamic and kinetic principles and equations for closed and open systems, statistical models, phase diagrams, diffusion, phase transformations, conservation laws, and kinematics.
4 Credit Hours. 4 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7402. Advanced Materials Science and Engineering Concepts.
Fundamentals of quantum mechanics, physics of solid state, and physical electronics and photonics for advanced materials will be discussed. Topics will include quantum basis for properties of solids, lattice vibration, free electron model for magnetism, semiconductors, nanostructures and mesoscopic phenomena, superconductivity, and recent advances in new types of materials. Prerequisite: MSEC 7401 with a grade of "C" or better.
4 Credit Hours. 4 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

MSEC 7599. Dissertation.
Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester. Repeatable for credit.
5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MSEC 7699. Dissertation.
Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester. Repeatable for credit.
6 Credit Hours. 6 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit

MSEC 7999. Dissertation.
Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor. While conducting dissertation research and writing, students must be continuously enrolled each long semester.
9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Credit/No Credit