

Texas State University
Doctor of Philosophy (Ph.D.) major in Materials Science, Engineering, and Commercialization

The Materials Science, Engineering, and Commercialization program (MSEC) offers a doctoral degree that will prepare the next generation of scientists and engineers to perform interdisciplinary research on scale-dependent materials and equip them to emerge as effective entrepreneurial leaders in the advancement of high tech 21st-century global discovery and innovation.

Admission Requirements

** All documentation must be submitted to the Graduate College

- Baccalaureate degree from a regionally accredited college or university
- Master's degree from a regionally accredited college or university in Biology, Chemistry, Engineering, Materials Science, Physics, Technology, or a closely related field with a minimum grade point average of 3.5 on a 4.0 scale
- ApplyTexas Application and \$40.00 Application Fee
- Official transcripts from each senior level post-secondary institution attended
- Graduate Record Exam (GRE) preferred score of 304 or better (verbal and quantitative combined)
- Test of English as a Foreign Language (TOEFL) score of 550 (paper-based), or 78 (iBT) and section scores of 19/listening, 19/speaking, 19/reading, and 18/writing or higher or IELTS (Academic) - 6.5 or higher with minimum individual module score of 6.0, if applicable
- Letter outlining applicant's personal history and life goals that are relevant to obtaining a doctoral degree, and in particular, why they want to pursue the commercialization aspect of the MSEC program.
- Three (3) letters of recommendation evaluating the applicant's skill and potential to be successful in the Materials Science, Engineering, and Commercialization Ph.D. program
- Current curriculum vita or resume
- Telephone or on-site interview with Core doctoral faculty (interviews may be conducted via phone, internet, or face-to-face)

Note: International students may need to provide additional documents such as financial statements.

**Detailed description of these requirements can be found on our website at www.msec.txstate.edu

Deadlines

For priority consideration, all prospective applicants are encouraged to submit their applications by February 1. The application deadline for Fall admission is June 1 for International applicants and June 15 for U.S. applicants.

Application materials must be submitted online using the [ApplyTexas website](https://www.applytexas.org/adappc/gen/c_start.WBX) (https://www.applytexas.org/adappc/gen/c_start.WBX). Please allow 2 working days for the application to be received by Texas State.

Assistantship

If admitted to our program, each **full time student** will be guaranteed two years of salary as long as performance expectations are met. To be eligible for the assistantship, the student must be enrolled in at least nine hours each semester of employment and maintain a minimum 3.0 Texas State grade point average in coursework leading toward the completion of the doctoral degree. For detailed information, go to

<http://www.gradcollege.txstate.edu/funding/assistantships.html>

For more information about our program, visit our website at www.msec.txstate.edu or contact our office at 512.245.1839.

Doctor of Philosophy (Ph.D.) major in Materials Science, Engineering, and Commercialization
Suggested Degree Plan for Coursework by Semester

**Individual plans may vary*

Summer before Semester 1: Five-day Business Boot Camp

Semester 1

MSEC 7401 Fundamental Materials Science and Engineering (4 Hour Credit)

MSEC 7301 Practical Skills in Commercialization and Entrepreneurship (3 Hour Credit) MSEC

7101 Commercialization Forum (1 Hour Credit)

MSEC 7102 Materials Science, Engineering, and Commercialization Seminar (1 Hour Credit)

***Choose research advisor and committee**

Semester 2

MSEC 7402 Advanced Materials Science and Engineering Concepts (4 Hour Credit)

MSEC 7302 Leadership Skills in Commercialization and Entrepreneurship (3 Hour Credit) MSEC

7101 Commercialization Forum (1 Hour Credit)

MSEC 7102 Materials Science, Engineering, and Commercialization Seminar (1 Hour Credit)

***Defend business plan**

Summer after Semester 2: Five-day Entrepreneurship Boot Camp

Semester 3

MSEC 7101 Commercialization Forum (Lead) (1 Hour Credit)

MSEC 7102 Materials Science, Engineering, and Commercialization Seminar (Lead) (1 Hour Credit) MSEC

Prescribed Elective(s)

***Submit grant proposal no later than the 5th week of Semester 4**

Semester 4

MSEC 7101 Commercialization Forum (Lead) (1 Hour Credit)

MSEC 7102 Materials Science, Engineering, and Commercialization Seminar (Lead) (1 Hour Credit) MSEC

Prescribed Electives

***Submit dissertation proposal to committee**

***Complete the Advancement of Candidacy Examination – 1st attempt**

Semester 5

MSEC 7999 Dissertation in Materials Science, Engineering, and Commercialization (9 Hour Credit)

***Complete the Advancement of Candidacy Examination – Last attempt**

Semester 6

MSEC 7999 Dissertation in Materials Science, Engineering, and Commercialization (9 Hour Credit)

Semester 7 and after

MSEC 7199 Dissertation in Materials Science, Engineering, and Commercialization (1 Hour Credit)

TOTAL - Minimum required semester credit hours 55

Doctor of Philosophy (Ph.D.) major in Materials Science, Engineering, and Commercialization

Suggested Degree Plan for Coursework by Semester

**Individual plans may vary*

Prescribed Elective Courses

MSEC 7103 Research in Materials Science, Engineering, and Commercialization

MSEC 7303 Research in Materials Science, Engineering, and Commercialization

MSEC 7304 Collaborative Research/Commercialization Experience

MSEC 7310 Nanoscale Systems and Devices

MSEC 7311 Materials Characterization

MSEC 7312 Thermodynamics and Kinetics for Materials Scientists

MSEC 7315 Quantum Mechanics for Materials Scientists

MSEC 7320 Nanocomposites

MSEC 7325 Principles of Technical Project Management

MSEC 7330 Computational Materials Science

MSEC 7340 Biomaterials & Biosensors

MSEC 7350 Frontiers of Nanoelectronics

MSEC 7360 Nanomaterials Processing

MSEC 7370 Advanced Polymer Science

MSEC 7395 Special Topics in Materials Science and Engineering

Courses Offered

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, and is graded on a credit (CR), progress (PR), or no credit (F) basis.

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. Second year students will present business plans that they developed. Repeatable four times for credit.

MSEC 7102 - Materials Science, Engineering, and Commercialization Seminar

This course is an introduction to current topics through reading of scientific literature with presentations by guest lecturers as the basis for weekly discussions. Students participate by choosing current, high-quality research articles for discussion and will present at least one article during the term. Repeatable for credit.

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. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable (with MSEC 7303 hours) for doctoral credit up to 6 hours.

MSEC 7199 - Dissertation in Materials Science, Engineering, and Commercialization

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 term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Acceptance into candidacy.

MSEC 7299 - Dissertation in Materials Science, Engineering, and Commercialization

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 term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Acceptance into candidacy.

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.

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.

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. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable (with MSEC 7103 hours) for doctoral credit up to 6 hours.

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 scientific and commercialization enterprise. Repeatable for doctoral credit up to 6 hours.

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.

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.

MSEC 7312 - Thermodynamics and Kinetics for Material Scientists

This course provides a solid understanding of thermodynamics and kinetics of materials, how the rules of thermodynamics and kinetics relate to real-world phenomena, such as phase transformations, phase diagrams, microstructural evolution, and how to use processing to produce a desired microstructure.

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.

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.

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.

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 or equivalent.

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.

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.

MSEC 7360 - Nanomaterials Processing

The course will cover various aspects of processing of nanomaterials from synthesis through incorporation into consumer goods. Specific topics to be covered in the synthesis of nanomaterials will include CVD, MBE, precipitation, spray drying, hydrothermal, electrochemical, mechanical grinding, phase separation, and shock wave.

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. Prerequisites: CHEM5353 or equivalent.

MSEC 7395A – Electronic Device 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. Prerequisites: MSEC 7401, MSEC 7402 with a B or higher.

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. Prerequisites: MSEC 7401, MSEC 7402 with a B or higher.

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. Prerequisites: MSEC 7401 and MSEC 7402 with grades of "B" or higher.

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.

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.

MSEC 7399 - Dissertation in Materials Science, Engineering, and Commercialization

Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor/dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Admission into candidacy.

MSEC 7401 - Fundamental Materials Science and Engineering

Fundamentals of chemical kinetics, physical properties, and continuum mechanics will be discussed. Topics include electronic and atomic structure of solids, structure of crystalline materials, structural imperfections, fundamental thermodynamic and kinetic principles and equations for closed and open systems, statistical models, phase diagrams, diffusion, phase transformations, conservation laws, and continuum kinematics. Prerequisite: Business Boot Camp.

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.

MSEC 7599 - Dissertation in Materials Science, Engineering, and Commercialization

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 term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Acceptance into candidacy.

MSEC 7699 - Dissertation in Materials Science, Engineering, and Commercialization

Original research and writing in Materials Science, Engineering, and Commercialization, is to be accomplished under direct supervision of the PhD Research Advisor/dissertation advisor. While conducting dissertation research and writing, students must be continuously enrolled each long term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit. Prerequisite: Admission into candidacy.

MSEC 7999 - Dissertation in Materials Science, Engineering, and Commercialization

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 term. Graded on a credit (CR), progress (PR), no-credit (F) basis. Repeatable for credit.

Prerequisite: Acceptance into candidacy.