 UT Dallas 2019 Graduate Catalog

Erik Jonsson School of Engineering and Computer Science

Department of Materials Science and Engineering

Objectives

The objective of the Master of Science (MS) degree in materials science and engineering is to provide intensive preparation for the professional practice in modern materials science by those engineers and scientists who wish to continue their education. The objective of the Doctor of Philosophy (PhD) program in materials science and engineering is to prepare individuals to perform original, cutting-edge research in materials science, particularly in the areas of nano-structured materials, electronics, optical and magnetic materials, bio-mimetic materials, polymeric materials, MEMS materials and systems, organic electronics, and advanced processing of modern materials.

Scholarship Opportunities

The Erik Jonsson School of Engineering and Computer Science offers competitive scholarship awards for very well qualified students. Interested students should request application materials by contacting the Department of Materials Science and Engineering.

Master of Science in Materials Science and Engineering

33 semester credit hours minimum

Department Faculty

Professors: Orlando Auciello, Yves J. Chabal, Kyeongjae (KJ) Cho, Massimo V. Fischetti, Julia W. P. Hsu, Jiyoung Kim, Moon J. Kim, Manuel Quevedo-Lopez, Amy V. Walker, Robert M. Wallace, lj1h160330
Professors Emeritus: Yves J. Chabal, Don Shaw, beg031000
Associate Professors: Lev D. Gelb, Walter E. Voit, Chadwin D. Young
Assistant Professor: William Vandenberghe


Admission Requirements

The University's general admission requirements are discussed on the Graduate Admission page. A student lacking undergraduate prerequisites for graduate courses in Materials Science and Engineering (MSEN) must complete these prerequisites or receive approval from the graduate advisor and the course instructor. A diagnostic exam may be required. Specific admission requirements are as follows:
Student has met standards equivalent to those currently required for admission to the PhD or master's degree programs in Materials Science, Electrical Engineering, Mechanical Engineering, Chemical Engineering, Chemistry, Physics, Biology, or closely related programs.

- A grade point average (GPA) in undergraduate-level coursework of 3.5 or better on a 4.0 point scale.
- GRE revised scores which are recommended as 154 or above, 154 or above, and 4 for the verbal, quantitative, and analytical writing components, respectively, are advisable based on our experience with student success in the program.

Students, who fulfill only some of the above requirements, if admitted conditionally, will be required to take graduate level courses as needed to make up any deficiencies.

Fast Track Baccalaureate/Master's Degrees

In response to the need for advanced education in Materials Science and Engineering, a Cross Track program is available to well-qualified UT Dallas undergraduate students. Qualified seniors pursuing the BS degree in other Departments may take up to 15 graduate semester credit hours that may be used to complete the baccalaureate degree and also to satisfy the requirements for the master's degree. This is accomplished by (1) taking courses (typically electives) during one or more summer semesters, and (2) beginning graduate coursework during the senior year. Details are available from the Associate Dean for Undergraduate Education.

Degree Requirements

The University's general degree requirements are discussed on the Graduate Policies and Procedures page.

The MSEN MS degree requires a minimum of 33 semester credit hours. All students must have an academic advisor and an approved degree plan. Courses taken without advisor approval will not count toward the 33 semester credit hour requirement. Successful completion of the approved course of studies leads to the MS degree.

MS students may elect to complete a thesis as part of their degree. Those opting to do so must carry out a research project under the direction of a faculty or affiliated faculty in Materials Science and Engineering, and write and defend a thesis on the research project. A Supervisory Committee will be appointed once the faculty member accepts the student for a research project. Students choosing the thesis option must also complete three semester credit hours of MSEN 6V98 Thesis.

Students must take the following four core classes, and meet grade requirements stated in the Departmental Degree Requirement Policy in order to remain in good standing:

- **MSEN 5310** Thermodynamics of Materials
- **MSEN 5360** Materials Characterization
- **MSEN 6319** Quantum Mechanics for Materials Scientists
- **MSEN 6324 (EEMF 6324)** Electronic, Optical and Magnetic Materials

Note: the presence of a course number in parentheses indicates that this course is
cross-listed in another department. A student may petition for waiver of core courses based on prior coursework of equivalent scope and level. If so waived, students may replace core courses with elective courses for up to a total of twelve semester credit hours.

A minimum of 9 semester credit hours of advanced coursework is required from the following list, including at least 3 semester credit hours of MSEN 6380, MSEN 6381, or MSEN 6383.

- **MSEN 5361** Fundamentals of Surface and Thin Film Analysis
- **MSEN 5377 (PHYS 5377)** Computational Physics of Nanomaterials
- **MSEN 6310 (MECH 6367)** Mechanical Properties of Materials
- **MSEN 6323** Quantum Mechanics for Materials Scientists II
- **MSEN 6325** Semiconductor Materials, Defects and Devices
- **MSEN 6339** Nanostructured Materials: Synthesis, Properties and Applications
- **MSEN 6340** Introduction to Electron Microscopy
- **MSEN 6362** Diffraction Science
- **MSEN 6380** Phase Transformations and Kinetic Processes in Materials
- **MSEN 6381** Advanced Ceramic Materials
- **MSEN 6383** Modern Physical Metallurgy

These courses are intended to provide greater depth and advanced training in areas broadly relevant to Materials Science and Engineering research.

The remaining semester credit hours may be taken from the following list of elective courses (or other electives which have been approved by the student's thesis advisor or the graduate director as appropriate.):

- **MSEN 5300 (PHYS 5376)** Introduction to Materials Science
- **MSEN 5320** Materials Science for Sustainable Energy
- **MSEN 5331 (CHEM 5331)** Advanced Organic Chemistry I
- **MSEN 5333 (CHEM 5333)** Advanced Organic Chemistry II
- **MSEN 5340 (CHEM 5340)** Advanced Polymer Science and Engineering
- **MSEN 5341 (CHEM 5341)** Advanced Inorganic Chemistry I
- **MSEN 5344** Thermal Analysis
- **MSEN 5353** Integrated Circuit Packaging
- **MSEN 5355 (CHEM 5355)** Analytical Techniques I
- **MSEN 5356 (CHEM 5356)** Analytical Techniques II
- **MSEN 5371 (PHYS 5371)** Solid State Physics
**MSEN 5375** Electronic Devices Based On Organic Solids

**MSEN 5383** (EEMF 5383 and PHYS 5383) Plasma Technology

**MSEN 5410** (BIOL 5410) Biochemistry

**MSEN 5440** (BIOL 5440) Cell Biology

**MSEN 6313** (EEOP 6313) Semiconductor Opto-Electronic Devices

**MSEN 6320** (EEMF 6320) Fundamentals of Semiconductor Devices

**MSEN 6321** (EEMF 6321) Active Semiconductor Devices

**MSEN 6322** (EEMF 6322, MECH 6348) Semiconductor Processing Technology

**MSEN 6327** (EEMF 6327) Semiconductor Device Characterization

**MSEN 6338** Advanced Theory of Semiconductors

**MSEN 6341** Advanced Electron Microscopy

**MSEN 6348** (EEMF 6348, MECH 6341) Lithography and Nanofabrication

**MSEN 6355** (BMEN 6355) Nanotechnology and Sensors

**MSEN 6358** (BIOL 6358) Bionanotechnology

**MSEN 6361** Deformation Mechanisms in Solid Materials

**MSEN 6371** (PHYS 6371) Advanced Solid State Physics

**MSEN 6374** (PHYS 6374) Optical Properties of Solids

**MSEN 6377** (PHYS 6377) Physics of Nanostructures: Carbon Nanotubes, Fullerenes, Quantum Wells, Dots and Wires

**MSEN 6382** (EEMF 6382, MECH 6347) Introduction to MEMS

**MSEN 6V98** Thesis

**MSEN 7320** (EEMF 7320) Advanced Semiconductor Device Theory

**MSEN 7V80** Special Topics in Materials Science and Engineering

**MSEN 8V40** Individual Instruction in Materials Science and Engineering

**MSEN 8V70** Research in Materials Science and Engineering

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**Doctor of Philosophy in Materials Science and Engineering**

*75 semester credit hours minimum beyond the baccalaureate degree*

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**Department Faculty**

Professors: Orlando Auciello, Yves J. Chabal, Kyeongjae (KJ) Cho, Massimo V. Fischetti, Julia W. P. Hsu, Jiyoung Kim, Moon J. Kim, Manuel Quevedo-Lopez, Amy V. Walker, Robert M. Wallace, ljh160330

Professors Emeritus: Yves J. Chabal, Don Shaw, beg031000

Associate Professors: Lev D. Gelb, Walter E. Voit, Chadwin D. Young
Assistant Professor: William Vandenberghe


Admission Requirements

The University's general admission requirements are discussed on the [Graduate Admission](https://catalog.utdallas.edu/2019/graduate/programs/ecs/materials-science) page.

A student lacking undergraduate prerequisites for graduate courses in Materials Science and Engineering (MSEN) must complete these prerequisites or receive approval from the graduate advisor and the course instructor.

A diagnostic exam may be required. Specific admission requirements follow.

- Student has met standards equivalent to those currently required for admission to the PhD or master's degree programs in Materials Science, Electrical Engineering, Mechanical Engineering, Chemical Engineering, Chemistry, Physics, Biology, or closely related programs.
- A grade point average (GPA) in undergraduate-level coursework of 3.5 or better on a 4.0 point scale
- GRE revised scores which are recommended as 154 or above, 154 or above, and 4 for the verbal, quantitative, and analytical writing components, respectively, are advisable based on our experience with student success in the program.

Students who fulfill some of the above requirements, if admitted conditionally, will be required to take graduate level courses as needed to make up any deficiencies.

Degree Requirements

The University's general degree requirements are discussed on the [Graduate Policies and Procedures](https://catalog.utdallas.edu/2019/graduate/programs/ecs/materials-science) page.

The MSEN PhD requires a minimum of 75 semester credit hours beyond the baccalaureate degree. These credits must include at least 30 semester credit hours of graduate-level coursework in MSEN.

All students must have an academic advisor and an approved degree plan. Courses taken without advisor approval will not count toward the 75 semester credit hour requirement. Specific coursework requirements are given below.

Students must pass the MSEN Qualifying Exam within their first 4 long semesters of graduate study. Once they have passed the Qualifying Exam, students may assemble their Dissertation Committee. Students must develop and defend a Research Proposal before the Dissertation Committee; this is to be done prior to completion of 60 semester credit hours.

Each doctoral student must carry out original research in the area of Materials Science and Engineering, under the direction of a faculty or affiliated faculty of Materials Science and Engineering, and complete and defend a dissertation on the research project. Research towards the degree should be completed under [MSEN 8V70](https://catalog.utdallas.edu/2019/graduate/programs/ecs/materials-science) Research in Materials Science and Engineering; students must also complete a minimum of 3 semester credit hours of [MSEN 8V99](https://catalog.utdallas.edu/2019/graduate/programs/ecs/materials-science) Dissertation.
Students must take the following four core classes, and meet grade requirements stated in the Departmental Degree Requirement Policy in order to remain in good standing:

- **MSEN 5310** Thermodynamics of Materials
- **MSEN 5360** Materials Characterization
- **MSEN 6319** Quantum Mechanics for Materials Scientists
- **MSEN 6324** (EEMF 6324) Electronic, Optical and Magnetic Materials

Note: the presence of a course number in parentheses indicates that this course is cross-listed in another department.

A student may petition for waiver of core courses based on prior coursework of equivalent scope and level. If so waived, students may replace core courses with elective courses for up to a total of twelve semester credit hours.

A minimum of 9 semester credit hours of advanced coursework is required from the following list, including at least 3 semester credit hours of **MSEN 6380**, **MSEN 6381**, or **MSEN 6383**.

- **MSEN 5340** (CHEM 5340) Advanced Polymer Science and Engineering
- **MSEN 5361** Fundamentals of Surface and Thin Film Analysis
- **MSEN 5377** (PHYS 5377) Computational Physics of Nanomaterials
- **MSEN 6310** (MECH 6367) Mechanical Properties of Materials
- **MSEN 6323** Quantum Mechanics for Materials Scientists II
- **MSEN 6325** Semiconductor Materials, Defects and Devices
- **MSEN 6327** (EEMF 6327) Semiconductor Device Characterization
- **MSEN 6339** Nanostructured Materials: Synthesis, Properties and Applications
- **MSEN 6340** Introduction to Electron Microscopy
- **MSEN 6362** Diffraction Science
- **MSEN 6380** Phase Transformations and Kinetic Processes in Materials
- **MSEN 6381** Advanced Ceramic Materials
- **MSEN 6383** Modern Physical Metallurgy

These courses are intended to provide greater depth and advanced training in areas broadly relevant to Materials Science and Engineering research.

Any remaining semester credit hours of coursework may be taken from the following list of elective courses (or other electives which have been approved by the student's thesis advisor):

- **MSEN 5300** (PHYS 5376) Introduction to Materials Science
- **MSEN 5320** Materials Science for Sustainable Energy
MSEN 5331 (CHEM 5331) Advanced Organic Chemistry I
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MSEN 5344 Thermal Analysis
MSEN 5353 Integrated Circuit Packaging
MSEN 5355 (CHEM 5355) Analytical Techniques I
MSEN 5356 (CHEM 5356) Analytical Techniques II
MSEN 5371 (PHYS 5371) Solid State Physics
MSEN 5383 (EEMF 5383 and PHYS 5383) Plasma Technology
MSEN 5410 (BIOL 5410) Biochemistry
MSEN 5440 (BIOL 5440) Cell Biology
MSEN 6313 (EEOP 6313) Semiconductor Opto-Electronic Devices
MSEN 6320 (EEMF 6320) Fundamentals of Semiconductor Devices
MSEN 6321 (EEMF 6321) Active Semiconductor Devices
MSEN 6322 (EEMF 6322, MECH 6348) Semiconductor Processing Technology
MSEN 6327 (EEMF 6327) Semiconductor Device Characterization
MSEN 6338 Advanced Theory of Semiconductors
MSEN 6341 Advanced Electron Microscopy
MSEN 6348 (EEMF 6348, MECH 6341) Lithography and Nanofabrication
MSEN 6355 (BMEN 6355) Nanotechnology and Sensors
MSEN 6358 (BIOL 6358) Bionanotechnology
MSEN 6361 Deformation Mechanisms in Solid Materials
MSEN 6371 (PHYS 6371) Advanced Solid State Physics
MSEN 6374 (PHYS 6374) Optical Properties of Solids
MSEN 6377 (PHYS 6377) Physics of Nanostructures: Carbon Nanotubes, Fullerenes, Quantum Wells, Dots and Wires
MSEN 6382 (EEMF 6382, MECH 6347) Introduction to MEMS
MSEN 7320 (EEMF 7320) Advanced Semiconductor Device Theory
MSEN 7V80 Special Topics in Materials Science and Engineering
MSEN 8V40 Individual Instruction in Materials Science and Engineering
MSEN 8V70 Research in Materials Science and Engineering
MSEN 8V99 Dissertation

https://catalog.utdallas.edu/2019/graduate/programs/ecs/materials-science
Description of Facilities Available for Conducting Research

An extensive array of the materials characterization, synthesis, and processing tools exist in the department for student use in research. Characterization capabilities include advanced high-resolution electron microscopy, x-ray diffraction, a large variety of surface analysis methods, and electrical characterization. Thin film deposition methods include atomic layer deposition, sputter deposition, thermal deposition, molecular beam epitaxy, chemical vapor deposition, pulsed laser deposition, and gas phase adsorption. Fabrication methods can be accomplished in the Cleanroom Research Laboratory as well (research.utdallas.edu/cleanroom). Computational modeling activities include studies from the atomistic to the macroscopic level. Details of the capabilities and faculty research can be obtained at mse.utdallas.edu.