Ph.D. Program

A typical program for a materials science (MSC) Ph.D. student entering with a B.S. degree consists of a minimum of 24 credit hours of MSC graduate courses, exclusive of reading courses, 8 credit hours of other related courses, and 58 credit hours of research. A typical program for an MSC Ph.D. student entering with an M.S. degree consists of a minimum of 24 credit hours of MSC graduate courses plus 36 credit hours of research. Students must successfully complete an oral defense of their theses.

M.S. Program

The M.S. degree in materials science requires a minimum of 30 credit hours of graduate courses. There are two paths to obtaining an M.S.: Plan A, with thesis, and Plan B, without thesis. Plan B is the normal, default, option for entering students. If a student wishes to pursue a Plan A path instead, it is the student's responsibility to make arrangements with a faculty thesis advisor to supervise his/her work and to inform the MSC program office of this.

For students electing to obtain the M.S. degree with thesis (Plan A), the following requirements apply: The 30 credit hours must include a minimum of 20 credit hours of MSC graduate courses plus 10 credit hours for research, and the student must successfully complete an oral defense of his/her thesis, after all other degree requirements have been completed.

For students electing to obtain the M.S. degree without a thesis (Plan B), the following requirements apply: The 30 credit hours must include a minimum of 24 credit hours of MSC graduate courses plus 6 credit hours of other related courses. A student in Plan B must pass a comprehensive oral examination. Two formats are offered for the exam: 1) a course-based exam, or 2) a literature-based exam.

Required courses

It is assumed all incoming students have completed a basic undergraduate course in materials, such as our course MSC 202, Introduction to Materials Science. If not, students must complete MSC 202, which is a three credit hour course for graduate students.

All first year graduate students are required to register for the Materials Science Program Seminar Series (MSC 496). The materials science program director should be indicated as the instructor for the course with zero credit hours. Grading for this course is based on attendance. The dates and times of the seminars will be posted on the program web page and announced via e-mail. Attendance of at least three seminars per semester will result in a grade of A. The grade will drop one letter grade for each seminar missed below three unless the student has an excused absence.

All Materials Science degree programs require completion of at least one course selected from each of the two categories listed below- Thermodynamics and Structure /Property relationships.

Other courses should be selected from the available courses in MSC and allied fields, in consultation with the student's advisor. These additional courses must include a minimum number of credits that bear the MSC designation. This number depends on the specific program (Ph.D., Plan A M.S., Plan B M.S.) as described above.

1) **Thermodynamics** (must select a minimum of one course from this list)

MSC 405- THERMODYNMCS OF NANO & MICROSOLIDS (cross-listed as ME 460)
MSC 485- THERMODYNAMICS &STAT MECHANICS (cross-listed as CHE 485)
MSC 455- THERMODYNAMICS & STAT MECH (cross-listed as CHM 455)
MSC 418 - STATISTICAL MECHANICS (cross-listed as PHY 418)

2) **Structure/ Property Relationships** (must select a minimum of one course from this list)

MSC 541 – NANOSCALE CRYSTALLINE DEFECTS (cross-listed as ME 541)
MSC 408 - MICROSTRUCTURE (cross-listed as ME 463)
MSC 456 – CHEMICAL BONDS- FROM MOLECULES TO MATERIALS (CHM 456)
MSC 409 - MECHANICAL PROPERTIES (cross-listed as ME 481)

Course options and threads

Students interested in working towards a Materials Science degree have a wide range of courses from which to draw in constructing their programs of study. The following "threads" list a few recommended courses that may be of particular interest to students focused on specific aspects of the field. A list of additional recommended courses is also given below.

These threads are intended to suggest courses that may be of particular interest to students focused in each area. However, provided other requirements are met (e.g. minimum number of credit hours with the MSC designation), students may select courses from different threads in consultation with their academic advisor. In making their selections students are strongly encouraged to consider the need for breadth, as well as depth, given the broad nature of the field.

Materials Processing and Characterization Thread: Courses introduce students to characterization and processing tools needed to understand and form materials into complex structures and integrated devices.

MSC 407 Solids and Materials Laboratory (ME 462)

MSC 431 Chemistry of Advanced Materials (CHE 480)

MSC 463 NMR CHM 422/423

MSC 403 Characterization methods in Materials Science- Diffraction (ME 451)

MSC 461 Fracture and Fatigue (ME 461)

Electronic and Optical Properties of Materials Thread: Courses establish fundamental electronic and optical properties of silicon, ceramics, and glasses to motivate advanced applications in optics, alternative energy, and medicine.

MSC 420 Introduction to Condensed Matter (PHY 420)

MSC 426 Semiconducting Devices (ECE 423)

MSC 470 Optical Properties of Materials (OPT 421)

MSC 460 Solar Cells (CHE 460)

MSC 456 Chemical Bonds (CHM 456)

ECE 492 Physics and Application of Nanophotonic and Nanomechanical Devices

Polymers and Biomaterials Thread: Courses emphasize both fundamental and applied concepts of polymer science and biomaterials.

MSC 410 Mechanical Properties of Polymers (ME 411)

MSC 433 Polymer Science and Engineering (CHE 486)

MSC 445 Biomaterials (BME 445)

MSC 413 Engineering of Soft Matter (CHE 413)

MSC 454 Interfacial Engineering (CHE 454)

All Materials Science Courses:

MSC 452 (BME 432) Controlled Release systems

MSC 442 (BME 442) Microbiomechanics

MSC 445 (BME 445) Biomaterials

MSC 451 (BME 451) Biomedical Ultrasound

MSC 462 (BME 462) Cell & Tissue Engineering

MSC 483 (BME 483) Biosolid Mechanics

BME 485 Cell & Membrane Mechanics (Spring 2010)

MSC 413 (CHE 413) Engineering of Soft Matter

CHE 430 Organic Electronics (PHY 429)

CHE 447 Optics and Liquid Crystals for Chemical Engineers(MSC 432)

MSC 454 (CHE 454) Interfacial Engineering

MSC 458 (CHE 458) Electrochemical Engineering and Fuel Cells

MSC 460 (CHE 460) Solar Cells

MSC 469 (CHE 469) Biotechnology and Bioengineering

MSC 434 (CHE 487) Polymer Rheology and Processing

MSC 431 (CHE 480) Chemistry of Advanced Materials

MSC 482 (CHE 482) Processing Microelectronic Devices

MSC 433 (CHE 486) Polymer Science and Engineering

MSC 472 (CHE 492) Biointerfaces

MSC 402 (CHM 402) Bio-Physical Chemistry I

MSC 404 (CHM 404) Bio-Physical Chemistry II

MSC 416 (CHM 416) X-ray Crystallography

MSC 463 (CHM 423) NMR

MSC 456 (CHM 456) Chemical Bonds

MSC 436 (CHM 458) Molecular Spectroscopy and Structures

MSC 468 (CHM 460) Chemical Kinetics

MSC 426 (ECE 423) Semiconducting Devices (MSC 426)

MSC 484 (ECE 434) Microelectromechanical Systems

MSC 520 (ECE 520) Spin Based Electronics

MSC 580 (ECE 580) Nano-Electro-Opto-Bio

EES 448 High Temperature Geochemistry

EES 480 Material Properties of Deformed Rock

ME 405 Diffusion

ME 411 Mechanical Properties of Polymers (MSC 410)

MSC 432 (ME 432) Optomechanics

MSC 449 (ME 449) Elasticity

MSC 403 (ME 451) Characterization methods in Materials Science- Diffraction

MSC 461 (ME 461) Fracture and Fatigue

MSC 407 (ME 462) Solids and Materials Laboratory

MSC 507 (OPT 407) SEM Practicum

MSC 470 (OPT 421) Optical properties of Materials

MSC 464 (OPT 424) Fundamentals of Lasers

MSC 471 (OPT 443) Optical Fabrication and Testing (MSC 471)

MSC 474 (OPT 463) Nano-optics

MSC 420 (PHY 420) Introduction to Condensed Matter