

# Ph.D. in Materials Science and Engineering

## Degree Requirements

Students with an appropriate master's degree in materials science or related field, physics, chemistry or engineering, are required to complete a minimum of 60 credits beyond the master's degree. Specific course selection, the area of specialization and dissertation topics are approved by the program advisor on an individual basis.

Students entering with bachelor's degrees are required to complete a minimum of 78 credits: 42 credits of course work and 36 credits of doctoral dissertation research. For the course work, the required courses for the M.S. in Materials Science and Engineering are mandatory; no less than 24 credits must be materials science and engineering courses, and no less than 12 credits must be at the 700 level and none at the 500 level. Specific course selection, the area of specialization, and dissertation topics are approved by the program advisor on an individual basis.

## Ph.D. in Materials Science and Engineering (entering with master's degree)

600- or 700-level course work <sup>1</sup>		12
700-level courses <sup>1</sup>		12
MTSE 790	Doc Dissertation & Res	36
MTSE 791	Graduate Seminar (every semester)	0
<b>Total Credits</b>		<b>60</b>

<sup>1</sup> Minimum of 9 credits must be in MTSE courses.

## Ph.D. in Materials Science and Engineering (entering with bachelor's degree)

### Required Courses

MTSE 601	Fundamentals of Engineering Materials	3
MTSE 602	Thermodynamics of Materials	3
MTSE 619	Nano-scale Characterization of Materials	3
Select three of the following:		9
MTSE 610	Mechanical Properties of Materials	
MTSE 681	Composite Materials	
MTSE 682	Introduction to Ceramics	
MTSE 688	Mathematical and Statistical Methods in Materials Science	
BME 672	Biomaterials	
BME 667	Bio-Control Systems	
BME 698	Selected Topics	
CHE 681	Polymerization-Principles and Practice	
CHE 682	Polymer Structures and Properties	
CHE 602	Selected Topics in Chemical Engineering I	
ECE 657	Semiconductor Devices	
PHYS 682	Introduction To MemS	
PHYS 687	Physics of Materials	

### Remaining Courses

600- or 700-level course work <sup>1</sup>		12
700-level courses <sup>1</sup>		12
MTSE 790	Doc Dissertation & Res	36
MTSE 791	Graduate Seminar (every semester)	0
<b>Total Credits</b>		<b>78</b>

<sup>1</sup> Minimum of 24 credits must be in MTSE courses.

## Areas of Specializations

The range of possible specializations is broad. Students should consult the graduate advisor in designing the area of specializations and related degree requirements. Three focused areas and suggested courses are listed below.

**Electronic and Photonic Materials**

MTSE 681	Composite Materials	3
MTSE 682	Introduction to Ceramics	3
MTSE 687	Glass Science and Engineering	3
MTSE 688	Mathematical and Statistical Methods in Materials Science	3
MTSE 719	Physical Principles of Characterization of Solids	3
MTSE 722	Science and Technology of Thin Films	3
MTSE 723	Defects in Solids	3
MTSE 724	Transport of Electrons and Phonons in Solids	3
MTSE 725	Crystallography and Diffraction	3
PHYS 661	Solid-State Physics	3
PHYS 682	Introduction To Mems	3
PHYS 687	Physics of Materials	3
PHYS 789	Physics of Advanced Semiconductor Device Processing	3
PHYS 661	Solid-State Physics	3
CHE 627	Introduction to Biomedical Engineering	3
CHE 702	Selected Topics in Chemical Engineering II (Selected Topics in Chemical Engineering II)	3
ECE 623	Fourier Optics	3
ECE 625	Fiber and Integrated Optics	3
ECE 626	Optoelectronics	3
ECE 657	Semiconductor Devices	3
ECE 658	VLSI Design I	3
ECE 659	Fabrication Principles of Electronic and Optoelectronic Devices	3
ECE 739	Laser Systems	3
ECE 760	Solid-State Image Sensors	3

**Particulate and Nano Materials**

MTSE 681	Composite Materials	3
MTSE 682	Introduction to Ceramics	3
MTSE 687	Glass Science and Engineering	3
MTSE 688	Mathematical and Statistical Methods in Materials Science	3
MTSE 719	Physical Principles of Characterization of Solids	3
MTSE 722	Science and Technology of Thin Films	3
MTSE 725	Crystallography and Diffraction	3
BME 672	Biomaterials	3
CHE 681	Polymerization-Principles and Practice	3
CHE 682	Polymer Structures and Properties	3
BME 669	Engineering Physiology	3
BME 672	Biomaterials	3
CHE 627	Introduction to Biomedical Engineering	3
PHYS 661	Solid-State Physics	3
PHYS 682	Introduction To Mems	3
PHYS 687	Physics of Materials	3
ME 675	Mechanics of Fiber Composites	3
ME 676	Applied Plasticity	3
ME 678	Engineering Design of Plastic Products	3

**Polymers and Biomaterials**

MTSE 681	Composite Materials	3
MTSE 682	Introduction to Ceramics	3
MTSE 687	Glass Science and Engineering	3
MTSE 688	Mathematical and Statistical Methods in Materials Science	3

MTSE 719	Physical Principles of Characterization of Solids	3
MTSE 722	Science and Technology of Thin Films	3
MTSE 725	Crystallography and Diffraction	3
BME 672	Biomaterials	3
BME 667	Bio-Control Systems	3
BME 698	Selected Topics	3
CHE 681	Polymerization-Principles and Practice	3
CHE 682	Polymer Structures and Properties	3
BME 669	Engineering Physiology	3
CHE 627	Introduction to Biomedical Engineering	3
CHE 702	Selected Topics in Chemical Engineering II	3
CHEM 661	Instrumental Analysis Laboratory	3
CHEM 673	Biochemistry	3
MATH 661	Applied Statistics	3
ME 670	Introduction to Biomechanical Engineering	3
ME 671	Biomechanics of Human Structure and Motion	3
ME 675	Mechanics of Fiber Composites	3
ME 676	Applied Plasticity	3
ME 678	Engineering Design of Plastic Products	3
ME 679	Polymer Processing Techniques	3
ME 680	Polymer Processing Equipment	3

Courses in metallic biomaterials and polymeric biomaterials offered at Rutgers Biomedical and Health Sciences may be taken as electives. See the graduate advisor for information on how to register for them.

### Other Fields of Materials Science and Engineering

MTSE 681	Composite Materials	3
MTSE 682	Introduction to Ceramics	3
MTSE 687	Glass Science and Engineering	3
MTSE 688	Mathematical and Statistical Methods in Materials Science	3
MTSE 719	Physical Principles of Characterization of Solids	3
MTSE 722	Science and Technology of Thin Films	3
MTSE 723	Defects in Solids	3
MTSE 724	Transport of Electrons and Phonons in Solids	3
MTSE 725	Crystallography and Diffraction	3
PHYS 661	Solid-State Physics	3
BME 672	Biomaterials	3
BME 667	Bio-Control Systems	3
BME 698	Selected Topics	3
CHE 681	Polymerization-Principles and Practice	3
CHE 682	Polymer Structures and Properties	3
CHE 627	Introduction to Biomedical Engineering	3
CHE 702	Selected Topics in Chemical Engineering II (Selected Topics in Chemical Engineering II )	3
CHEM 661	Instrumental Analysis Laboratory	3
CHEM 673	Biochemistry	3
MATH 661	Applied Statistics	3
ME 670	Introduction to Biomechanical Engineering	3
ME 671	Biomechanics of Human Structure and Motion	3
ME 675	Mechanics of Fiber Composites	3
ME 676	Applied Plasticity	3
ME 678	Engineering Design of Plastic Products	3
ME 679	Polymer Processing Techniques	3
ME 680	Polymer Processing Equipment	3

PHYS 682	Introduction To Mems	3
PHYS 687	Physics of Materials	3

## Qualifying Examination

The student must pass a written and an oral qualifying examination. The written qualifying exam given every summer is administered to test general academic preparation and competence in the research of materials science and engineering. Within one year after passing the written qualifying exam, the student is required to pass the oral qualifying exam to achieve Ph.D. candidacy, in which the potential Ph.D. candidate presents a preliminary research proposal for approval by the dissertation committee. The student will be allowed two attempts to pass the written or oral qualifying exam.

The 4 topics of written qualifying exam are:

MTSE 601	Fundamentals of Engineering Materials	3
MTSE 602	Thermodynamics of Materials	3
MTSE 619	Nano-scale Characterization of Materials	3
Select one of the following:		
MTSE 722	Science and Technology of Thin Films	
CHE 681	Polymerization-Principles and Practice	
BME 672	Biomaterials	

## Formation of Dissertation Committee

Within one year of passing the written qualifying examination, doctoral students must form a five-member dissertation committee that meets the approval of the graduate program director for materials science and engineering. The committee must include the dissertation advisor, three additional faculty members from the program, and at least one member from outside the program or NJIT.

## Dissertation and Defense

An oral presentation and public defense of the doctoral dissertation is required.