

# MATERIALS SCIENCE AND ENGINEERING, PH.D.

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The Ph.D. in Materials Science and Engineering (PhD-MSE) is an interdisciplinary graduate program housed in the Center for Materials Research (CMR) under the Department of Physics. Persons holding baccalaureate or Master of Science degrees in chemistry, physics, materials science, engineering, or related disciplines are eligible for application and potential admission.

The Ph.D. program addresses the critical technical workforce needs of industry, academia, and government laboratories in the Commonwealth and the nation for scientific and engineering leadership in the area of advanced nanostructured materials and engineering. The program will prepare highly trained technical professionals in the area of nanostructured materials science and engineering for the next generation photonic, electronic, magnetic, biomedical materials and devices, and for renewable clean energy generation.

The Materials Science and Engineering (Ph.D.) program at Norfolk State University prepares students for careers in industry, federal or private research laboratories, and academia. The program transitions students from physical sciences, engineering and related fields into the discipline of advanced materials with special nanostructures and properties. The dissertation research component of the program is typically conducted in the research labs at the Center for Materials Research (CMR). However, research may also be conducted off campus through special programs at federal research facilities such as NASA Langley Research Center or DOE National Research Laboratories, with prior approval of the advisor and graduate program coordinator (GPC).

The MSE program is designed to provide students with fundamental knowledge, analytical skills, and research experience necessary to contribute significantly to federal and commercial research efforts in the forefront of Materials Science and Engineering in NSU's Center for Materials Research. Therefore, the curriculum includes an overview of MSE and its current research areas and offers an in-depth study of advanced materials synthesis, characterization of macroscopic and microscopic physical properties, theoretical and computational modeling, and device engineering.

The curriculum of the program features technical core courses, professional development courses, elective courses, research, and a dissertation. The technical core courses establish baseline knowledge that brings students with diverse undergraduate background to a fundamental understanding of their new discipline. These courses impart a set of fundamental knowledge and skills to students with baccalaureate degrees in chemistry, physics, electrical engineering and related disciplines; and consequently, provide a new intellectual identity to those involved in the study and preparation of advanced materials.

Students may also enroll in a broad range of advanced elective courses to prepare for the interdisciplinary needs of their dissertation research. This additional elective coursework is selected in consultation with the student's advisor and GPC. The professional development courses grant unique preparation to strengthen communication/presentation skills and involve post-graduation planning and career-oriented training.

The program for students entering with a B.S. degree consists of 9 credit hours of technical core courses, 3 hours of professional development courses, a minimum of 18 hours of elective courses, 36 credit hours of research, and 9 credit hours for preparation and oral defense of the dissertation. A minimum of 75 credit hours must be taken at NSU.

The dissertation research component of the program will be conducted in research labs at the Center for Materials Research. However, research may also be conducted on-campus through the Department of Computer Science or the Department of Engineering and off-campus through special programs at federal research facilities or at other research partner organizations with prior approval of the dissertation advisor and mentoring committee. All research conducted by doctoral students shall be supervised by a faculty advisor at CMR.

All general policies and procedures of the Norfolk State University Graduate School are in effect, except those that are superseded by the following specific policies of the Ph.D. in Materials Science program. The program is governed by the policies of the NSU Graduate Council (GC), which meets regularly during the regular academic year. Between GC meetings, the program is coordinated by the Graduate Program Coordinator and designated CMR committees.

## Academic Standards

In order to graduate, students must complete the curriculum posted with a minimum 3.0 grade point average on a 4.0 scale. Each student's progress is monitored by the Graduate Program Coordinator (GPC), with input from the student's research advisor.

The system of grading is as follows:

Grade	Grade Points	Interpretation
A	4.0	Excellent
A-	3.70	Excellent
B+	3.30	Good
B	3.00	Satisfactory

*\* Course must be repeated to fulfill graduation requirement.*

Students with a GPA of 3.00 or higher are considered to be in good academic standing. In order to receive graduate teaching assistantships (GTAs), students must generally be in good academic standing, and be making normal progress toward degree completion.

Failure to maintain the required 3.0 GPA may result in probationary status or suspension from the program as outlined below.

Students on probationary status generally do not receive renewals of graduate teaching assistantships (GTAs) and may not be eligible for university tuition grants. Students who were admitted on a provisional basis will not be changed to regular status unless the required 3.0 GPA is obtained.

Students placed on suspension may not be permitted to enroll in additional courses in the program until reinstatement is granted by the appropriate MSE program committee. The request for reinstatement should include explanation of mitigating circumstances surrounding past academic performance and/or justification for predicting future success in the program if reinstatement is granted. The MSE program committee will review the request and may interview the suspended student prior to making a final recommendation. The committee may require successful

completion of relevant undergraduate courses as a precondition for reinstatement.

## Center for Materials Research

CMR was established in 1992 to coordinate the ongoing interdisciplinary polymeric, bio and photonic materials and films, fabrication of those materials into devices for a range of applications including biomedical engineering, electronic/photonic/magnetic devices, clean and renewable energy conversion and storage devices. The CMR is housed in the Marie V. McDemmond Center for Applied Research on the NSU Campus, where the following research laboratories are located: Micro-and Nanotechnology Center (6,000-sqft cleanroom), Materials Characterization Laboratories (electron transmission, scanning, and atomic force microscopes, scanning probe microscope, surface analysis system: LEED, XPS, and AES, X-ray diffraction and fluorescence, IR and UV- Vis), Laser Laboratories for spectroscopy and high speed dynamics, Nuclear Magnetic and Electron Spin Resonance (NMR and ESR) Laboratories, Organic/Polymer Synthesis and Characterization Laboratories, Neural Engineering and Nanoelectronic labs, Crystal Physics and Quantum Electronic Labs, Biomaterials and Toxicology Labs, Thin Film Processing and the Device Fabrication Labs.

## Curriculum

### Minimum Degree Requirements

All students are required to complete a minimum total of 75 credit hours, including 36 hours of research and 9 hours of dissertation credits as described in the curricula.

This requirement includes the following 12 semester hours of core courses:

Code	Title	Credits
<b>Professional Core Courses</b>		
MSE 600	Materials Science/Engineering Seminar I	1
MSE 601	Materials Science & Engineer Seminar II	1
MSE 605	Ethics of Research	1
<i>Technical Core Courses</i>		
MSE 530	Materials Science	3
MSE 533	Polymers/Composites	3
MSE 535	Electronic and Optic Material	3
<b>Technical Electives <sup>1</sup></b>		
Select nine (9) credit hours of approved technical core electives. Additional substitutions may also be approved. (This list may not be complete or updated)		9
CHM 545	Mathematical Method	
PHY 580	Quantum Mechanics for Material Science	
MSE 575	Basic Instrumentation for Material Sci	
MSE 607	Materials for Nanotechnology	
MSE 635	Optical Materials	
MSE 660	Organic Optoelectronic Materials/Devices	
MSE 704	Thin Film Phenomena	
<b>Additional Electives</b>		
Select nine (9) credit hours from an elective list. Additional electives may also be approved. (This list may not be complete or updated)		9
CHM 633	Molecular Dynamics	
CHM 663	Atomic/ Molecular Spectroscopy	
EEN 562	Semiconductor Processing Technology	

EEN 663	Solid State Devices	
MSE 580	Advanced Organic Synthesis	
MSE 609	Intro to Computational Materials Science	
MSE 703	Materials Devices for Energy Conversion	
PHY 653	Solid State Physics	
PHY 675	Electricity and Magnetism	
<b>Research/ Dissertation Courses <sup>2</sup></b>		
MSE 697	Research I	3
MSE 698	Research II	3
MSE 699	Research III	3
MSE 897	Research I	9
MSE 898	Research II	9
MSE 899	Research III	9
MSE 900	Dissertation	9
<b>Total Credits</b>		<b>75</b>

After completing three technical core courses and at least three hours of research courses (MSE-69X), students can be enrolled in a zero credit PhD qualifying/candidacy exam course, MSE-770, before or when being registered in the doctoral dissertation course MSE-900.

All students are required to complete a total of 45 credits of research and dissertation coursework. A student's dissertation advisory committee, composed of the student's advisor and four other members (see program student handbook for details), advises the students through his/her PhD qualifying and dissertation research work. The dissertation is defended in a public/open forum as the Final Dissertation Defense. After the delivery and approval of a finalized dissertation manuscript and satisfaction of all other academic/financial requirements, the Ph.D. degree documents will be issued/certified by the university registrar.

<sup>1</sup> In addition to the 12 credit hours of required core courses, students must complete nine (9) credit hours of approved technical core electives.

<sup>2</sup> All students are required to complete 45 credits of research and dissertation course work. A dissertation committee, composed of the student's advisor and four other members, advises the students through his/her research work. The dissertation is defended in an open forum as the Final Dissertation Defense. After the delivery and approval of a finalized dissertation manuscript the Ph.D. degree will be awarded.

## Admissions Requirements

The requirements for admission to the Ph.D. Program in Materials Science and Engineering are as follows:

1. A bachelor's degree in chemistry, physics, materials science, engineering or a related field from a regionally accredited institution and have a 3.0 grade point average on a 4.0 scale.
2. Submission of a complete application including the following:
  - a. Completed Application Forms
  - b. Application Fee
  - c. Statement of Purpose of at least 500 words explaining how the program will advance your career goals.
  - d. Updated Resume
  - e. At least three current Letters of Recommendation from persons who are qualified to evaluate your academic and

research experience. Letters must be submitted via the online application portal. Recommenders must also complete the online recommendation form.

- f. Official Transcripts from all undergraduate institutions attended. Unofficial transcripts will be accepted for admission decisions, but final official transcripts are required for enrollment if accepted. NSU undergraduate students may submit final unofficial transcripts for enrollment. Foreign transcripts need to be evaluated/translated/certified by an approved third-party evaluator such as the World Educational Services (WES).
- g. TOEFL scores for international applicants, minimum score of 79 (Internet) or 550 (Paper).

Admission to the Ph.D. program in Materials Science and Engineering may be regular, provisional, or conditional. The admissions committee will conduct a holistic review of all applicants and may adjust/waive certain requirements while complying with the university and School of Graduate Studies and Research general admission policies.

#### **Non-degree Status**

Non-degree status may be granted to a person who has a baccalaureate degree in an appropriate field and who wishes to take particular courses without pursuing a graduate degree. The courses may be taken on a credit or a non-credit basis. Generally, a maximum of nine credit hours with a 3.0 average or above may be applied toward degree requirements if the non-degree student is subsequently admitted to the Ph.D. in Materials Science and Engineering program. Non-degree students are ineligible for fellowships or assistantships administered by the Graduate Committee.

#### **Transfer Credits**

The program for students who enter the program after completion of a M.S. in Materials Science or related disciplines, from NSU or any other accredited physical science or engineering program, consists of a minimum of 3 hours of professional development courses, 6 hours of research and 9 hours in additional elective courses, 27 credit hours of Ph.D. research, and 9 credit hours for preparation and oral defense of the dissertation. A minimum of 54 credit hours must be taken at NSU. Transfer students should consult the Program Coordinator for further information regarding transfer credits.

#### **Residence Requirements**

Candidates for the Ph.D. in Materials Science and Engineering must be enrolled at Norfolk State University for a minimum of six semesters prior to graduation. Dissertation research must be conducted under the supervision of a regular or adjunct NSU faculty member approved by the appropriate Materials Science and Engineering Graduate Committee.

#### **Re-Admission**

A student planning to interrupt his/her approved plan of study should consult his/her advisor. In some cases, continuous registration may be required by the Graduate School, or the filing of a "continuous matriculation" form may be required. Re-admission to the program after an absence of a semester or longer is not automatic and requires the filing of an admission application.