



NORFOLK STATE UNIVERSITY®

Norfolk State University



SCHOOL OF SCIENCE AND TECHNOLOGY

**Master Program in
Materials Science**

Center for Materials Research



NORFOLK STATE UNIVERSITY

SCHOOL OF SCIENCE AND TECHNOLOGY

M.S. Program in Materials Science

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The Master of Science in Materials Science program is an interdisciplinary program administered cooperatively by the physics, chemistry, and engineering graduate faculty. Persons holding baccalaureate degrees in chemistry, physics, materials science, or related disciplines are eligible for admission

The Materials Science program is designed to provide students with the knowledge, analytical skills, and research experience necessary to contribute significantly to federal and commercial research efforts in the forefront of materials science. Therefore, the curriculum includes an overview of materials science and current research areas, in-depth study of relevant physical theories, and applied research. All students are required to complete a master's thesis. The thesis research component of the program is typically coordinated through the Center for Materials Research. However, research may also be conducted off campus through special programs at federal research facilities such as NASA Langley Research Center or Los Alamos National Laboratory, with prior approval of the thesis advisor.

Upon completion of the M.S. in Materials Science program, students will demonstrate the following competencies:

- (1) an understanding of basic materials properties, materials testing techniques, and underlying physical principles as required for successful completion of course work;
- (2) general knowledge of current research problems in materials science as evidenced through seminar presentations and written reports;
- (3) a practical working knowledge of at least one major piece of research instrumentation (such as a nuclear magnetic resonance spectrometer or a Czochralski crystal growth station) to the satisfaction of the thesis advisor, and
- (4) an ability to prepare advanced professional reports as evidenced by the successful completion and defense of a master's thesis.

All general policies and procedures of the Norfolk State University Graduate Studies Office are in effect, except those that are superseded by the following specific policies of the M.S. in Materials Science program. The program is governed by the Graduate Committee, which meets at least three times annually. Between meetings, the program is administered by the CMR Educational Hub Director. The Hub Director also provides academic advising for graduate students.

ADMISSION

The application requirements for the M.S. Program in Materials Science 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 Letters of Recommendation from persons who are qualified to evaluate your academic and research experience
 - f) Official Transcripts
 - g) TOEFL scores for international applicants.

Admission to the graduate program in Materials Science may be regular or conditional. For regular admission, applicants must have a bachelor's degree in chemistry, physics, materials science, or a related field from a regionally accredited institution and have a 3.0 grade point average on a 4.0 scale. Equivalent degrees from foreign institutions may also be accepted, with the additional requirement of a minimum computerized TOEFL score of 220 for non-native English speakers.

Conditional admission may be granted to applicants who do not meet the criteria for regular admission. Upon the completion of nine (9) or more graduate credits with a 3.0 or better, the student may petition the Materials Science Graduate Committee for conversion from conditional to regular 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 M.S. in Materials Science program. Non-degree students are ineligible for fellowships or assistantships administered by the Materials Science Graduate Committee.

TRANSFER CREDITS

Generally, a maximum of nine (9) credit hours of graduate work at another accredited institution may be accepted as transfer credit, provided that the conditions of the Office of Graduate Studies are met. However, under unusual circumstances, the Materials Science Graduate Committee may recommend that additional credits be accepted toward degree requirements. Transfer students should consult the Program Coordinator for further information regarding transfer credits.

RESIDENCE REQUIREMENTS

Candidates for the M.S. in Materials Science must be enrolled at Norfolk State University for a minimum of two semesters prior to graduation. Thesis research must be conducted under the supervision of a regular or adjunct NSU faculty member approved by the Materials Science 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 Studies Office, 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.

MINIMUM DEGREE REQUIREMENTS

All students are required to complete a total of 33 credit hours, including research and thesis preparation credits. This requirement includes the following 18 semester hours of core courses:

- CHM 545 Mathematical Methods
- MSE 530 Materials Science
- MSE 533 Polymers and Polymer-Based Composite Materials
- MSE 535 Electronic and Photonic Materials
- MSE 575 Instrumentation for Materials Science
- PHY 580 Quantum Mechanics for Materials Scientists

In addition to the core courses, students must complete nine (9) hours of approved technical electives and a minimum of six (6) hours of research in Materials Science. Preparation of a thesis and oral thesis defense is required. Students are expected to present their findings at local and national conferences and to participate in related workshops and short courses as determined by the research advisor.

ACADEMIC STANDARDS

In order to graduate, students must complete the curriculum with a minimum 3.0 grade point average on a 4.0 scale. Each student’s progress is reviewed at the end of each semester by the Materials Science Graduate Committee.

The system of grading is as follows:

<u>Grade</u>	<u>Grade Points</u>	<u>Interpretation</u>
A	4.00	Excellent
A-	3.70	Excellent

B+	3.30	Good
B	3.00	Satisfactory
B-	2.70	Fair
C+ or below	Unsatisfactory (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 teaching or research assistantships, students must generally be in good academic standing, register for a minimum of nine (9) credit hours of approved course work each semester, and be making normal progress toward degree completion.

Failure to maintain the required 3.0 GPA results in probationary status or suspension from the program as outlined below. (NOTE: Undergraduate level courses may not be included in the calculation of the hours earned, or the calculation of the GPA.)

<u>Hours Earned</u>	<u>Probation GPA</u>	<u>Suspension GPA</u>
0-9	2.00 – 2.99	1.99 and below
10-19	2.30 – 2.99	2.29 and below
20-29	2.50 – 2.99	2.49 and below
30 or more	2.80 – 2.99	2.79 and below

Students on probationary status generally do not receive renewals of teaching or research assistantships and are not eligible for 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 are not permitted to enroll in additional courses in the Materials Science program until reinstatement is granted by the Materials Science Graduate 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 Materials Science Graduate 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.

DESCRIPTION OF COURSES

CHM 545

Mathematical Methods (Three Credits)

This course deals with application of series solutions of differential equations, vector analysis, determinants and matrices, complex variables, and integral transforms to problems encountered in the physical sciences.

CHM 573

Advanced Inorganic Chemistry (Three Credits)

This course examines the principles of structure, bonding, and reactivity patterns of inorganic compounds. The application of group theory to chemistry and spectroscopy, especially vibrational and electronic structure of metal complexes and crystals, is also examined.

- CHM 633** **Molecular Dynamics (Three Credits)**
 This course examines modern concepts in reaction-transport phenomena, transition state theory, and reaction dynamics. Experimental techniques and physical models for reactivity at a microscopic level are discussed.
- CHM 663** **Atomic and Molecular Spectroscopy (Three Credits)**
 This course deals with the study of the interaction of radiation with matter. The application of quantum mechanics for the spectroscopic determination of the rotational, vibrational, and electronic structure of matter are examined.
- MSE 530** **Materials Science (Three Credits)**
 This course presents basic knowledge of the internal structure, properties, processing, and characterization of materials, including metals, ceramics, inorganic composites, and “smart” materials.
- MSE 533** **Polymers and Polymer-Based Composite Materials (Three Credits)**
 This course deals with general concepts about polymers and polymeric materials/composites, their compositions, chemical structure, synthesis and fabrication, characterization and properties.
- MSE 535** **Electronic and Photonic Materials (Three Credits)**
 This course deals with the internal structure, chemistry and physics of semiconductors, magnetic and photonic materials as related to their electronic and optical properties, as well as their applications. The course also focuses on how electronic materials are produced, and how to control processing to achieve desired materials performance.
- MSE 575** **Instrumentation for Materials Science (Three Credits)**
 This course presents scientific data manipulation and visualization with IDL; data collection and data analysis with the LabView Interface; powder x-ray diffraction technique.
- MSE 610** **Special Topics I (Three Credits)**
 This course is a special topic in Materials Science course. Topics will be determined by the instructor.
- MSE 635** **Optical Materials (Three Credits)**
Prerequisite: CHM 545 Mathematical Methods, MSE 535 Electronic and Photonics Materials, PHY 580 Quantum Mechanics for Materials Scientists or Permission of the instructor.
 The course relates optical behavior and its underlying processes to the chemical, physical, and microstructural properties of the materials so that students gain insight into the kinds of materials, engineering and processing

conditions that are required to produce materials exhibiting a desired optical property.

- MSE 697** **Research (One – Nine Credits)**
Prerequisite: Permission of instructor
- MSE 698** **Research (One – Nine Credits)**
Prerequisite: Permission of instructor
- MSE 710** **Special Topics II (Three Credits)**
This is a special topic in Materials Science course. Topics will be determined by the instructor.
- MSE 750** **Continuing Registration (One Credit)**
- MSE 797** **Research (One – Nine Credits)**
Prerequisite: Permission of instructor
- MSE 798** **Research (One – Nine Credits)**
Prerequisite: Permission of instructor
- MSE 799** **Thesis Research (One – Nine Credits)**
Prerequisite: Permission of instructor of Master's thesis research.
- PHY 580** **Quantum Mechanics for Materials Scientists (Three Credits)**
This course covers basic principles, the Schroedinger equation, wave functions, representation of dynamical variables as operators or matrices; bound and continuum states in one-dimensional systems; bound states in central potentials; hydrogen atoms; Perturbation Theory; the interaction of electromagnetic radiation with atomic systems; rotations and angular momentum and applications to solid-state systems.
- PHY 653** **Solid State Physics (Three Credits)**
This course covers mechanical, thermal, and electric properties of solids; crystal structure; Band Theory; semiconductors; phonons and transport phenomena.
- PHY 675** **Electricity and Magnetism (Three Credits)**
This course covers the development of Maxwell's equations; Conservation Laws; problems in electrostatics and magnetostatics; time-dependent solutions of Maxwell's equations; motion of particles in electromagnetic fields; plane waves in dielectric and conductive media; dipole and quadrupole radiation from nonrelativistic systems; Fourier analysis of radiation field and photons, and scattering and diffraction of electromagnetic waves.

M.S. IN MATERIALS SCIENCE

Curriculum

First Semester Courses		Credit Hours
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MSE 530	Materials Science	3
CHM 545	Mathematical Methods	3
MSE 533	Polymers and Polymer-Based Composite Materials	3

Second Semester Courses		Credit Hours
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MSE 535	Electronic and Photonic Materials	3
MSE 575	Instrumentation for Materials Science	3
PHY 580	Quantum Mechanics for Materials Scientists	3

Third Semester Courses		Credit Hours
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Technical Elective		3
Technical Elective		3
MSE 697	Research	3

Fourth Semester Courses		Credit Hours
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Technical Elective		3
MSE 799	Thesis Research	3

TOTAL HOURS: 33

Technical Electives to be Selected From:

CHM 573	Advanced Inorganic Chemistry	3
CHM 633	Molecular Dynamics	3
CHM 663	Atomic and Molecular Spectroscopy	3
PHY 653	Solid State Physics	3
PHY 675	Electricity and Magnetism	3
MSE 610	Special Topics I	3
MSE 710	Special Topics II	3