BACHELOR OF SCIENCE IN MATERIALS SCIENCE AND NANOENGINEERING (BSMSNE) DEGREE

Program Learning Outcomes (Student Outcomes) for the BSMSNE Degree

Upon completing the BSMSNE degree, students will demonstrate:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Program Educational Objectives for the BSMSNE Degree

The Bachelor of Science in Materials Science and NanoEngineering (BSMSNE) degree prepares graduates to succeed in professional careers by equipping them with the expertise sought by top graduate schools and corporations. Recognizing that graduates may embark on diverse educational and career paths, the Program Educational Objectives (PEO) that graduates will achieve within a few years of obtaining their Bachelor of Science in Materials Science and NanoEngineering (BSMSNE) degree from Rice University are:

1. Graduates will demonstrate technical proficiency and professional achievement in their work which may include scientific inquiry as well as problem-solving, process optimization, and/or design in materials engineering and related fields.
2. Graduates will be accomplished at communicating and working collaboratively in diverse work environments.
3. Graduates seeking post-baccalaureate education will achieve appropriate levels of success in admission to and progression through those programs. Graduates entering professional careers will achieve appropriate career progression and success.

Requirements for the BSMSNE Degree

For general university requirements, see Graduation Requirements (ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements). Students pursuing the BSMSNE degree must complete:

- A minimum of 30 or 34 courses (90-94 credit hours) depending on course selection to satisfy major requirements.
- A minimum of 130-134 credit hours depending on course selection to satisfy degree requirements.
- A minimum of 15 courses (38 credit hours) taken at the 300-level or above.

Students seeking the BSMSNE must complete at least 90 semester hours in general math and science, core, and specialization elective courses within the total requirements of 130 hours.

The courses listed below satisfy the requirements for this major. In certain instances, courses not on this official list may be substituted upon approval of the major's academic advisor, or where applicable, the department's Director of Undergraduate Studies. (Course substitutions must be formally applied and entered into Degree Works by the major's Official Certifier (https://registrar.rice.edu/facstaff/degeworks/officialcertified).) Students and their academic advisors should identify and clearly document the courses to be taken.

Summary

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>Total Credit Hours Required for the Major in Materials Science and NanoEngineering</td>
<td>90-94</td>
<td></td>
</tr>
<tr>
<td>Total Credit Hours Required for the BSMSNE Degree</td>
<td>130-134</td>
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Degree Requirements

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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Required Math and Science Prerequisites

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
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<tbody>
<tr>
<td>MATH 101</td>
<td>SINGLE VARIABLE CALCULUS I</td>
</tr>
<tr>
<td>MATH 105</td>
<td>AP/OTH CREDIT IN CALCULUS I</td>
</tr>
<tr>
<td>MATH 102</td>
<td>SINGLE VARIABLE CALCULUS II</td>
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<tr>
<td>MATH 106</td>
<td>AP/OTH CREDIT IN CALCULUS II</td>
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<td>Select 1 from the following:</td>
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<tr>
<td>PHYS 101</td>
<td>MECHANICS (WITH LAB)</td>
</tr>
<tr>
<td>PHYS 103</td>
<td>and MECHANICS DISCUSSION</td>
</tr>
<tr>
<td>PHYS 111</td>
<td>HONORS MECHANICS (WITH LAB)</td>
</tr>
<tr>
<td>Select 1 from the following:</td>
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<tr>
<td>PHYS 102</td>
<td>ELECTRICITY &amp; MAGNETISM (WITH LAB)</td>
</tr>
<tr>
<td>PHYS 104</td>
<td>and ELECTRICITY AND MAGNETISM DISCUSSION</td>
</tr>
<tr>
<td>PHYS 112</td>
<td>HONORS ELECTRICITY &amp; MAGNETISM (WITH LAB)</td>
</tr>
<tr>
<td>MATH 211</td>
<td>ORDINARY DIFFERENTIAL EQUATIONS AND LINEAR ALGEBRA</td>
</tr>
<tr>
<td>MATH 212</td>
<td>MULTIVARIABLE CALCULUS</td>
</tr>
<tr>
<td>CHEM 121</td>
<td>GENERAL CHEMISTRY I</td>
</tr>
<tr>
<td>CHEM 123</td>
<td>and GENERAL CHEMISTRY LABORATORY I</td>
</tr>
<tr>
<td>CHEM 122</td>
<td>GENERAL CHEMISTRY II</td>
</tr>
<tr>
<td>CHEM 124</td>
<td>and GENERAL CHEMISTRY LABORATORY II</td>
</tr>
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</table>
CAAM 210 INTRODUCTION TO ENGINEERING COMPUTATION 3
CAAM 335 MATRIX ANALYSIS 3

Select 1 from the following: 3

PHYS 201 WAVES, LIGHT, AND HEAT
CHEM 211 ORGANIC CHEMISTRY I
& CHEM 213 and ORGANIC CHEMISTRY DISCUSSION
CHEM 301 PHYSICAL CHEMISTRY I

Core Requirements
MSNE 201 INTRODUCTION TO NANOENGINEERING 3
MSNE 301 MATERIALS SCIENCE 3
MSNE 302 MATERIALS PROCESSING AND NANOMANUFACTURING 3
MSNE 303 MATERIALS SCIENCE JUNIOR LAB 1
MSNE 311 MATERIALS SELECTION AND DESIGN 4
MSNE 401 THERMODYNAMICS IN MATERIALS SCIENCE 3
MSNE 402 MECH PROPERTIES OF MATERIALS 3
MSNE 406 PHYSICAL PROPERTIES OF SOLIDS 3
MSNE 407 CAPSTONE DESIGN PROJECT I 4
MSNE 408 CAPSTONE DESIGN PROJECT II 3
MSNE 411 METALLOGRAPHY AND PHASE RELATIONS 3
MSNE 415 CERAMICS AND GLASSES 3
MSNE 435 CRYSTALLOGRAPHY & DIFFRACTION 3
MSNE 437 CRYSTALLOGRAPHY & DIFFRAC LAB 1
MSNE 450 MATERIALS SCIENCE SEMINAR 1
& MSNE 451 and MATERIALS SCIENCE SEMINAR

Elective Requirements
Select 1 elective course from the Engineering Cluster (see course list below) 3-4
Select 1 elective course from the Math and Science Cluster (see course list below) 3-4
Select 2 elective courses from the Technical Cluster or select additional Engineering Cluster courses (see course lists below) 6-8

Total Credit Hours Required for the Major in Major in Materials Science and NanoEngineering 90-94
University Graduation Requirements (ga.rice.edu/undergraduate-students/academic-policies-procedures/graduation-requirements)* 40
Total Credit Hours 130-134

Footnotes and Additional Information
* Includes coursework completed as distribution credit, FWIS, LPAP, upper-level, residency (hours taken at Rice), 60 hours outside of the major (if applicable), and any additional academic program requirements. The “hours outside of the major” requirement may include all of the above university requirements.

Course Lists to Satisfy Requirements
Elective Requirements
To fulfill the remaining Materials Science and NanoEngineering major requirements for the BSMSNE degree, students must complete a total of 4 additional courses (a minimum of 12 credit hours). 1 course (3-4 credit hours) must come from the Engineering Cluster, 1 course (3-4 credit hours) must come from the Math and Science Cluster. The 2 remaining courses (6-8 credit hours) must come from the Technical Cluster or from additional Engineering Cluster coursework.

Engineering Cluster (no MSNE courses)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>BIOE 370</td>
<td>BIOMATERIALS</td>
<td>3-4</td>
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<tr>
<td>CEVE 201</td>
<td>PRINCIPLES OF ENVIRONMENTAL ENGINEERING</td>
<td></td>
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<tr>
<td>CEVE 311 / MECH 311</td>
<td>MECHANICS OF SOLIDS AND STRUCTURES</td>
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<tr>
<td>CEVE 427 / MECH 427</td>
<td>COMPUTATIONAL STRUCTURAL MECHANICS AND FEM</td>
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<tr>
<td>CEVE 434</td>
<td>FATE AND TRANSPORT OF CONTAMINANTS IN THE ENVIRONMENT</td>
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</tr>
<tr>
<td>CHBE 390</td>
<td>CHEMICAL KINETICS AND REACTOR DESIGN</td>
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<tr>
<td>CHBE 401</td>
<td>TRANSPORT PHENOMENA I</td>
<td></td>
</tr>
<tr>
<td>ELEC 241 &amp; ELEC 240</td>
<td>FUNDAMENTALS OF ELECTRICAL ENGINEERING I and FUNDAMENTALS OF ELECTRICAL ENGINEERING I LABORATORY</td>
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<tr>
<td>ELEC 243</td>
<td>ELECTRONIC MEASUREMENT SYSTEMS</td>
<td></td>
</tr>
<tr>
<td>ELEC 261</td>
<td>ELECTRONIC MATERIALS AND QUANTUM DEVICES</td>
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<tr>
<td>ELEC 361</td>
<td>QUANTUM MECHANICS FOR ENGINEERS</td>
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<tr>
<td>ELEC 462</td>
<td>OPTOELECTRONIC DEVICES</td>
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</tr>
<tr>
<td>ENGI 302 / CEVE 302</td>
<td>SUSTAINABLE DESIGN</td>
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<tr>
<td>ENGI 303 / CEVE 322</td>
<td>ENGINEERING ECONOMICS</td>
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<tr>
<td>MECH 211 / CEVE 211</td>
<td>ENGINEERING MECHANICS</td>
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<tr>
<td>MECH 403</td>
<td>COMPUTER AIDED DESIGN</td>
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<tr>
<td>MECH 417 / CEVE 417</td>
<td>FINITE ELEMENT ANALYSIS</td>
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<tr>
<td>MECH 481</td>
<td>HEAT TRANSFER</td>
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</table>

Total Credit Hours 3-4

Math and Science Cluster (no MSNE or Engineering courses)

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>ASTR 201</td>
<td>STARS, GALAXIES, AND THE UNIVERSE</td>
<td>3-4</td>
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<tr>
<td>ASTR 202</td>
<td>EXPLORATION OF THE SOLAR SYSTEM</td>
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<tr>
<td>BIOC 201</td>
<td>INTRODUCTORY BIOLOGY</td>
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<tr>
<td>BIOC 301</td>
<td>BIOCHEMISTRY I</td>
<td></td>
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<tr>
<td>BIOC 385 / NEUR 385</td>
<td>FUNDAMENTALS OF CELLULAR AND MOLECULAR NEUROSCIENCE</td>
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<td>CAAM 336</td>
<td>DIFFERENTIAL EQUATIONS IN SCIENCE AND ENGINEERING</td>
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<tr>
<td>CAAM 378</td>
<td>INTRODUCTION TO OPERATIONS RESEARCH AND OPTIMIZATION</td>
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<tr>
<td>CAAM 415 / ELEC 488 / NEUR 415</td>
<td>THEORETICAL NEUROSCIENCE: FROM CELLS TO LEARNING SYSTEMS</td>
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</table>

Select at least 1 from the following: 3-4
CAAM 435 / MATH 435  DYNAMICAL SYSTEMS  3-4
CAAM 453  NUMERICAL ANALYSIS I  3
CAAM 501  ANALYSIS I  3
CAAM 519  COMPUTATIONAL SCIENCE I  3
CHEM 211  ORGANIC CHEMISTRY I  3
& CHEM 213  and ORGANIC CHEMISTRY DISCUSSION II  3
CHEM 212  ORGANIC CHEMISTRY II  3
& CHEM 214  and ORGANIC CHEM DISCUSSION II  3
CHEM 301  PHYSICAL CHEMISTRY I  3
CHEM 302  PHYSICAL CHEMISTRY II  3
CHEM 330  ANALYTICAL CHEMISTRY  3
CHEM 360  INORGANIC CHEMISTRY  3
ESCI 307 / CEVE 307 / ENST 307  ENERGY AND THE ENVIRONMENT  3
ESCI 321  EARTH SYSTEM EVOLUTION AND CYCLES  3
MATH 302  ELEMENTS OF ANALYSIS  3
MATH 354  HONORS LINEAR ALGEBRA  3
MATH 355  LINEAR ALGEBRA  3
PHYS 201  WAVES, LIGHT, AND HEAT  3
PHYS 202  MODERN PHYSICS  3
PHYS 301  INTERMEDIATE MECHANICS  3
PHYS 302  INTERMEDIATE ELECTRODYNAMICS  3
PHYS 355  INTRODUCTION TO BIOLOGICAL PHYSICS  3
STAT 280  ELEMENTARY APPLIED STATISTICS  3
STAT 305  INTRODUCTION TO STATISTICS FOR BIOSCIENCES  3

Technical Cluster (MSNE or Engineering courses)  3
Code  Title  Credit Hours  3-4
Select at least 2 courses from the following (or select additional coursework from the Engineering Cluster):
MSNE 365 / ELEC 365  NANOMATERIALS FOR ENERGY  3
MSNE 409  PHYSICAL METALLURGY  3
MSNE 433  COMPUTATIONAL MATERIALS MODELING  3
MSNE 505  MICROSTRUCTURE AND NANOSTRUCTURE EVOLUTION  3
MSNE 523  PROPERTIES, SYNTHESIS AND DESIGN OF COMPOSITE MATERIALS  3
MSNE 538 / CEVE 538  COMPUTATIONAL NANOSCIENCE FOR GREEN INFRASTRUCTURE  3
MSNE 545 / ELEC 545  THIN FILMS  3
MSNE 555  MATERIALS IN NATURE AND BIO-MIMETIC STRATEGIES  3
MSNE 560 / CHBE 560  COLLOIDAL AND INTERFACIAL PHENOMENA  3
MSNE 569  SCIENCE AND APPLICATIONS OF CORROSION SCIENCE AND ENGINEERING  3
MSNE 580 / CHEM 580  MICROSCOPY METHODS IN MATERIALS SCIENCE  3
MSNE 581  MICRO AND NANO HEAT TRANSPORT  3
MECH 581  METHODOLOGIES AND DESIGN  3
MSNE 593 / CHBE 593  INTRODUCTION TO POLYMER PHYSICS AND ENGINEERING  3
MSNE 594 / CHBE 594  PROPERTIES OF POLYMERS  3
MSNE 650  NANOMATERIALS AND NANOMECHANICS  3

Total Credit Hours  6

Footnotes and Additional Information
1 The Technical Cluster also includes the Engineering cluster.

Policies for the BSMSNE Degree

Transfer Credit
For Rice University's policy regarding transfer credit, see Transfer Credit (ga.rice.edu/undergraduate-students/academic-policies-procedures/transfer-credit). Some departments and programs have additional restrictions on transfer credit. The Office of Academic Advising maintains the university's official list of transfer credit advisors on their website: https://oaa.rice.edu. Students are encouraged to meet with their academic program's transfer credit advisor when considering transfer credit possibilities.

Departmental Transfer Credit Guidelines
Students pursuing the BSMSNE degree should be aware of the following departmental transfer credit guidelines:

• Requests for transfer credit will be considered by the program director (and/or the program's official transfer credit advisor) on an individual case-by-case basis.

Additional Information
For additional information, please see the Materials Science and NanoEngineering website: https://msne.rice.edu/

Opportunities for the BSMSNE Degree

Academic Honors
The university recognizes academic excellence achieved over an undergraduate's academic history at Rice. For information on university honors, please see Latin Honors (ga.rice.edu/undergraduate-students/honors-distinctions/university) (summa cum laude, magna cum laude, and cum laude) and Distinction in Research and Creative Work (ga.rice.edu/undergraduate-students/honors-distinctions/university). Some departments have department-specific Honors awards or designations.

Research Opportunities
Many MSNE majors participate in undergraduate research; some even start during their freshman year. To get involved, speak to a MSNE undergraduate advisor or directly to a MSNE faculty member.

Fifth-Year Master's Degree Option for Rice Undergraduate Students
Rice undergraduate students have an option to pursue the Master of Materials Science and NanoEngineering (MMSNE) degree by adding an additional fifth year to their four undergraduate years of science and engineering studies.

Advanced Rice undergraduate students in good academic standing may apply to the MMSNE degree program during their junior or senior year. Upon acceptance, depending on course load, financial aid status, and
other variables, they may then start taking some required courses of the master’s degree program. A plan of study will need to be approved by the student’s undergraduate advisor and the MMSNE program director.

As part of this option and opportunity, Rice undergraduate students:

- must complete the requirements for a bachelor’s degree and the master’s degree independently of each other (i.e. no course may be counted toward the fulfillment of both degrees).
- should be aware there could be financial aid implications if the conversion of undergraduate coursework to that of graduate level reduces their earned undergraduate credit for any semester below that of full-time status (12 credit hours).
- more information on this Undergraduate - Graduate Concurrent Enrollment opportunity, including specific information on the registration process can be found here (ga.rice.edu/undergraduate-students/academic-opportunities/undergraduate-graduate-concurrent-enrollment).

**Additional Information**

For additional information, please see the Materials Science and NanoEngineering website: [https://msne.rice.edu/](https://msne.rice.edu/)