

COLLEGE OF ENGINEERING  
DEPARTMENT OF BIOMEDICAL ENGINEERING AND MECHANICS  
**MINOR IN ENGINEERING SCIENCE AND MECHANICS**  
FOR STUDENTS ENTERING UNDER UG CATALOG 2021-2022

To obtain a minor in ESM a student must complete 21 credit hours of ESM courses as indicated below. Courses must be taken on an A-F basis. An in-minor GPA of 2.0 is required, with a minimum grade of C- in each course.

Students completing the minor must obey all prerequisite rules.  
Some courses below have prerequisites not required for the minor.

**1. Complete the following required courses: Credits**

ESM 2104 or ESM 2114	Statics <i>Pre: MATH 1226. Co: MATH 2204 or MATH 2204H or MATH 2224 or MATH 2406H</i>	3
	Statics and Structures <i>Co: MATH 2204 or MATH 2204H or MATH 2406H</i>	3
ESM 2204	Mechanics of Deformable Bodies <i>Pre: (2104 or 2114), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H)</i>	3
ESM 2304	Dynamics <i>Pre: (2104 or 2114), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H). Co: MATH 2214</i>	3

**2. Complete one of the following (Fluid Mechanics Requirement):\***

ESM 3234 Or ESM 3024 Or ME 3414*	Fluid Mechanics I – Control Volumes <i>Pre: 2304, PHYS 2306</i>	3
	Introduction to Fluid Mechanics <i>Pre: 2304</i>	3
	Fluid Dynamics <i>Pre: 2004, (MATH 2114 or 2214H or MATH 2405H), (MATH 2204 or MATH 2204H or MATH 2406H), (MATH 2214 or MATH 2214H or MATH 2406H). Co: 2134</i>	3
Or CEE 3304*	Fluid Mechanics for CEE <i>Pre: 2104, CEE 2804</i>	3
Or AOE 3014*	Fluid Dynamics for AOE <i>Pre: (AOE 2104 OR AOE 2204), (MATH 2214 or MATH 2214H), ESM 2304</i>	3

**3. Complete six credits from the list on the following page. At least 3 credits must be at 4XXX or above:†**

**4. Complete 3 credits of approved ESM research or graduate level education:†**

The research requirement may be fulfilled through Senior Design Courses (e.g. BMES 4015/6, ME 4015/6, MSE 4075/6, etc.) or through a departmental undergraduate research course (e.g. BMES 4994, ESM 4994, ME 4994, etc.). Research must demonstrate application of fundamental Engineering Science & Mechanics principles and the project must be approved in advance to count for the requirement.

\* Students taking a non-ESM course to satisfy Item 2 must take an additional 3 credit hours of ESM coursework from Item 3.

† Any 3 credit 5000 or 6000 level ESM class may be substituted for any elective in Item 3 and/or the Research Requirement of Item 4. ESM 5004 and/or ESM 5944 may not be counted.

**Lists of Approved Electives for Item 3:  
Complete six credits. At least 3 credits must be at 4XXX or above.†**

<b>Solid Mechanics:</b>		
ESM 3054 (MSE 3054)	Mechanical Behavior of Materials <i>Pre: 2204, (MSE 2034 or MSE 2044 or MSE 3094 or AOE 3094 or CEE 3684)</i>	3
ESM 3064 (MSE 3064)	Mechanical Behavior of Materials Lab <i>Pre: 2204. Co: 3054</i>	1
ESM 4024	Advanced Mechanical Behavior of Materials <i>Pre: 3054 or ESM 3054</i>	3
ESM 4044 (CEE 4610)	Mechanics of Composite Mechanics <i>Pre: 2204 or AOE 2024</i>	3
ESM 4444 (AOE 4054)	Stability of Structures <i>PRE: AOE 3024 OR CEE 3404</i>	3
<b>Fluid Mechanics:</b>		
ESM 3334	Fluid Mechanics II - Differential Analysis <i>Pre: 3234 or ME 3404. Co: MATH 4574</i>	3
<b>Dynamics:</b>		
ESM 3124	Dynamics II – Analytical & 3D Motion <i>Pre: 2304, MATH 2214, (MATH 2224 or MATH 2204 or MATH 2204H)</i>	3
ESM 4114 (AOE 4514)	Nonlinear Dynamics and Chaos <i>Pre: (2304 or PHYS 2504), (MATH 2214 or MATH 2214H)</i>	3
<b>Biomechanics:</b>		
ESM 4105	Engineering Analysis of Physiologic Systems <i>Pre: 2304, MATH 2214</i>	3
ESM 4106	Engineering Analysis of Physiologic Systems <i>Pre: 2304, MATH 2214</i>	3
ESM 4204	Musculoskeletal Biomechanics <i>Pre: 2304, (CS 1044 or CS 1064 or CS 1114 or AOE 2074 or ESM 2074 or ME 2004)</i>	3
ESM 4224	Biodynamics & Control <i>Pre: ESM 2304</i>	3
ESM 4234	Mechanics of Biological Materials and Structures <i>Pre: 3054, (2074 or ME 2004)</i>	3
ESM 4245	Mechanics of Animal Locomotion <i>Pre: 3054</i>	3
ESM 4246	Mechanics of Animal Locomotion <i>Pre: 3234</i>	3
ESM 4304	Hemodynamics <i>Pre: 3334 or ME 3404</i>	3
<b>Modeling and Optimization:</b>		
ESM 4084 (AOE 4084)	Engineering Design Optimization <i>Pre: (MATH 2224 or MATH 2204 or MATH 2204H)</i>	3
ESM 4194 (ME 4194)	Sustainable Energy Solutions <i>Pre: (CHEM 1035 or 1055), PHYS 2306</i>	3
ESM 4614 (BMES 4614)	Probability-Based Modeling, Analysis, and Assessment <i>Pre: 2204</i>	3
ESM 4734 (AOE 4024)	Introduction to Finite Elements <i>Pre: (CS 3414 or MATH 3414 or AOE 2074 or ESM 2074), (MATH 2224 or MATH 2224H or MATH 2204 or MATH 2204H)</i>	3

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† Any 3 credit 5000 or 6000 level ESM class may be substituted for any elective in Item 3 and/or the Research Requirement of Item 4. ESM 5004 and/or ESM 5944 may not be counted.