

# ENGINEERING MECHANICS: ASTRONAUTICS

**Admissions to the Engineering Mechanics: Astronautics Named Option have been suspended as of fall 2020 and will be discontinued as of fall 2026. If you have any questions, please contact the department (<https://engineering.wisc.edu/departments/mechanical-engineering/>).**

The astronautics option in engineering mechanics prepares students for design, development, and research, with an emphasis on applied mathematics and astronautics. Its purpose is to improve and expand the educational opportunities of students at the university who wish to pursue careers in astronautics and space-related areas. This is accomplished by providing in depth exposure to course sequences in astrodynamics, orbital mechanics, and flight dynamics, as well as a core curriculum of structural and material analysis, advanced dynamics, and vibrations. The program requires a minimum of 128 credits.

## REQUIREMENTS

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The following curriculum applies to students admitted to the engineering mechanics degree program and declared the astronautics option.

#### SUMMARY OF REQUIREMENTS

Code	Title	Credits
	Mathematics and Statistics	22
	Science	10
	Engineering Science	27
	Engineering Mechanics/Astronautics Core	40
	Technical Electives	5
	Communication Skills	8
	Liberal Studies	16
	<b>Total Credits</b>	<b>128</b>

#### MATHEMATICS AND STATISTICS

Code	Title	Credits
MATH 221	Calculus and Analytic Geometry 1	5
	or MATH 217	Calculus with Algebra and Trigonometry II
MATH 222	Calculus and Analytic Geometry 2	4
MATH 234	Calculus--Functions of Several Variables	4
MATH 320	Linear Algebra and Differential Equations	3
MATH 321	Applied Mathematical Analysis I: Vector and Complex Calculus	3
STAT 324	Introduction to Statistics for Science and Engineering	3
	<b>Total Credits</b>	<b>22</b>

#### SCIENCE

Code	Title	Credits
Select one of the following:		
CHEM 109	Advanced General Chemistry	5-9
CHEM 103 & CHEM 104	General Chemistry I and General Chemistry II	
PHYSICS 202	General Physics	5
	<b>Total Credits</b>	<b>10-14</b>

#### ENGINEERING SCIENCE

Code	Title	Credits
INTEREGR 170	Design Practicum	3
M E 231	Geometric Modeling for Design and Manufacturing	3
E P 271	Engineering Problem Solving I	3
	or COMP SCI 200	Programming I
	or COMP SCI 220	Data Science Programming I
	or COMP SCI 310	Problem Solving Using Computers
M E 361	Thermodynamics	3
M E 363	Fluid Dynamics	3
	or CIV ENGR 310	Fluid Mechanics
E C E 376	Electrical and Electronic Circuits	3
	or PHYSICS 321	Electric Circuits and Electronics
M E 364	Elementary Heat Transfer	3
E C E 332	Feedback Control Systems	3
	or M E 446	Introduction to Feedback Control
Computing Elective (select one)		3
	COMP SCI 300	Programming II
	COMP SCI 412	Introduction to Numerical Methods
E M A/E P 471	Intermediate Problem Solving for Engineers	
E M A/E P 476	Introduction to Scientific Computing for Engineering Physics	
	<b>Total Credits</b>	<b>27</b>

#### ENGINEERING MECHANICS/ASTRONAUTICS CORE

Code	Title	Credits
<b>Required Courses</b>		
E M A 201	Statics	3
E M A 202	Dynamics	3
E M A 303	Mechanics of Materials	3
E M A/M E 307	Mechanics of Materials Lab	1
E M A 405	Practicum in Finite Elements	3
E M A 469	Design Problems in Engineering	3
E M A 506	Advanced Mechanics of Materials I	3
<b>Experimental Mechanics</b>		
Select one of the following:		
E M A/M E 540	Experimental Vibration and Dynamic System Analysis	3
E M A/M E 570	Experimental Mechanics	
E M A 611	Advanced Mechanical Testing of Materials	

E M A 522	Aerodynamics Lab	
E M A 521	Aerodynamics	3
or M E 563	Intermediate Fluid Dynamics	
E M A 542	Advanced Dynamics	3
E M A 545	Mechanical Vibrations	3
E M A 569	Senior Design Project	3
<b>Spacecraft &amp; Structural Dynamics Elective (select one)</b>		<b>3</b>
E M A/ ASTRON 550	Astrodynamics	
E M A 610	Structural Finite Element Model Validation	
E M A 642	Satellite Dynamics	
<b>Aerospace Fluid Mechanics Elective (select one)</b>		<b>3</b>
E M A 523	Flight Dynamics and Control	
E M A 601	Special Topics in Engineering Mechanics (Topic: Rocket Propulsion)	
or E M A 524	Rocket Propulsion	
<b>Total Credits</b>		<b>40</b>

## TECHNICAL ELECTIVES

Code	Title	Credits
Select five credits at an academic level that requires 2 semesters of calculus or 2 semesters of physics as a prerequisite. E M A 1 may also be used to satisfy this requirement.		5

## COMMUNICATION SKILLS

Code	Title	Credits
ENGL 100	Introduction to College Composition	3
or COM ARTS 100	Introduction to Speech Composition	
or LSC 100	Science and Storytelling	
or ESL 118	Academic Writing II	
INTEREGR 275	Technical Presentations (was EPD 275)	2
INTEREGR 397	Engineering Communication	3
<b>Total Credits</b>		<b>8</b>

## LIBERAL STUDIES

Code	Title	Credits
<b>College of Engineering Liberal Studies Requirements</b>		
Complete Requirements ( <a href="https://guide.wisc.edu/undergraduate/engineering/#requirements1">https://guide.wisc.edu/undergraduate/engineering/#requirements1</a> ) <sup>1</sup>		16
<b>Total Credits</b>		<b>16</b>

<sup>1</sup> Students must take 16 credits that carry H, S, L, or Z breadth designators. These credits must fulfill the following subrequirements:

1. A minimum of two courses from the same subject area (<https://registrar.wisc.edu/subjectareas/>) (the description before the course number). At least one of these two courses must be designated as above the elementary level (I, A, or D) in the course listing.
2. A minimum of 6 credits designated as humanities (H, L, or Z in the course listing), and an additional minimum of 3 credits designated as social science (S or Z in the course listing). Foreign language courses count as H credits. Retroactive credits for language courses

may not be used to meet the Liberal Studies credit requirement (they can be used for subrequirement 1 above).

3. At least 3 credits in courses designated as ethnic studies (lower case "e" in the course listing). These courses may help satisfy subrequirements 1 and 2 above, but they count only once toward the total required. *Note:* Some courses may have "e" designation but not H, S, L, or Z designation; these courses do not count toward the Liberal Studies requirement.

## HONORS IN UNDERGRADUATE RESEARCH

Qualified undergraduates may earn an Honors in Research designation on their transcript and diploma by completing 8 credits of undergraduate honors research, including a senior thesis. Further information is available in the department office.

For information on credit load, adding or dropping courses, course substitutions, pass/fail, auditing courses, dean's honor list, repeating courses, probation, and graduation, see the College of Engineering Official Regulations (<http://guide.wisc.edu/undergraduate/engineering/#policiesandregulationstext>).

## FOUR-YEAR PLAN

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#### ASTRONAUTICS OPTION IN ENGINEERING MECHANICS

##### Example Four-Year Plan

##### First Year

Fall	Credits Spring	Credits
CHEM 109 <sup>1</sup>	5 E M A 201 <sup>3</sup>	3
MATH 221	5 MATH 222	4
Communications A	3 M E 231	3
INTEREGR 170 <sup>2</sup>	3 Liberal Studies Elective or	3
or Liberal Studies Elective	INTEREGR 170 <sup>2</sup>	
	Liberal Studies Elective	3
<b>Total Credits</b>		<b>16</b>

##### Second Year

Fall	Credits Spring	Credits
MATH 234	4 MATH 320	3
PHYSICS 202	5 Technical Elective	3
E M A 202 <sup>4</sup>	3 M E 361	3
E P 271 or COMP SCI 310	3 E M A 303 <sup>4</sup>	3
INTEREGR 275	2 E M A/M E 307 <sup>4</sup>	1
	Liberal Studies Elective	3
<b>Total Credits</b>		<b>17</b>

##### Third Year

Fall	Credits Spring	Credits
E M A 506	3 E M A 545	3
E M A 405	3 INTEREGR 397	3
E M A 542	3 M E 364	3
M E 363 or CIV ENGR 310	3 STAT 324	3

MATH 321	3 Computing Elective	3
	Experimental Mechanics Course <sup>5</sup>	3
	<b>15</b>	<b>18</b>

**Fourth Year**

<b>Fall</b>	<b>Credits Spring</b>	<b>Credits</b>
E M A 469	3 E M A 569	3
E M A 521 <sup>6</sup>	3 E M A 523 or 524 <sup>7</sup>	3
E C E 376 or PHYSICS 321	3 E M A/ASTRON 550, 610, or 642	3
E C E 332 or M E 446	3 Tech Elective	2
Liberal Studies Elective	4 Liberal Studies Elective	3
	<b>16</b>	<b>14</b>

**Total Credits 128**

<sup>1</sup> It is recommended that students take CHEM 109 Advanced General Chemistry for 5 credits. However, depending on their high school chemistry experience, students may substitute CHEM 103 General Chemistry I and CHEM 104 General Chemistry II for a total of 9 credits.

<sup>2</sup> Students who were not able to take INTEREGR 170 (<https://guide.wisc.edu/search/?P=INTEREGR%20170>) Design Practicum as freshmen may, with the approval of their advisor, substitute a course offered in the College of Engineering or in the departments of Chemistry, Computer Sciences, Mathematics, and Physics.

<sup>3</sup> Students may substitute PHYSICS 201 General Physics , 5 credits, for E M A 201 Statics, 3 credits, with the approval of their advisor.

<sup>4</sup> After completing E M A 201 Statics, students may take E M A 202 Dynamics and E M A 303 Mechanics of Materials/E M A/M E 307 Mechanics of Materials Lab in either order or concurrently.

<sup>5</sup> E M A 611 Advanced Mechanical Testing of Materials or E M A/M E 540 Experimental Vibration and Dynamic System Analysis or E M A/M E 570 Experimental Mechanics or E M A 522 Aerodynamics Lab. Note that E M A/M E 540 and E M A/M E 570 are typically offered in the fall. E M A 611 and E M A 522 are typically offered in the spring.

<sup>6</sup> M E 563 Intermediate Fluid Dynamics may be substituted for E M A 521 Aerodynamics. Note that M E 563 is offered in the spring semester only.

<sup>7</sup> Before Fall 2020, E M A 524 Rocket Propulsion was offered as E M A 601 Special Topics in Engineering Mechanics with the topic of Rocket Propulsion. It is offered in the fall semester only. E M A 523 Flight Dynamics and Control is offered in the Spring semester only.