

ENGINEERING MECHANICS: AEROSPACE ENGINEERING

Engineering mechanics is the home of aerospace engineering at UW–Madison. Some of the most exciting innovations in air and space travel require understanding of the engineering mechanics principles at the heart of this major. Whether there are humans in the cockpit or remote-controlled drones, the interaction of an aircraft with its surroundings results in deformation, vibration, and dynamic motions that are all explained by engineering mechanics. Even without the atmosphere experienced by aircraft, spacecraft, and vehicles that explore distant planets must also withstand a variety of forces and be reliable in environments where repair may not be possible. In both cases, there is a premium on reducing weight and expanding capabilities. This makes aerospace engineering a natural extension of engineering mechanics. Following the same fundamental courses as our engineering mechanics major, students in the aerospace engineering option will apply their education in structural analysis, material science, advanced dynamics, and vibrations to specific courses on aerodynamics, flight dynamics, orbital mechanics, and propulsion. A highlight of this program is the aerodynamics laboratory where students conduct field experiments on the UW–Madison wind tunnel. Talk to your academic advisor about declaring this option.

REQUIREMENTS

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The following curriculum applies to students admitted to the engineering mechanics degree program and declare the aerospace option.

SUMMARY OF REQUIREMENTS

Code	Title	Credits
	Mathematics and Statistics ¹	22
	Science ¹	10
	Engineering Science	28
	Engineering Mechanics/Aerospace Engineering Core	40
	Technical Electives	5
	Communication Skills	8
	Liberal Studies	15
	Total Credits	128

¹ If the Mathematics and Statistics and the Science requirements are fulfilled with fewer than 30 credits combined, additional math/science credits will be needed to meet the math/science auxiliary credit condition.

MATHEMATICS AND STATISTICS

Code	Title	Credits
MATH 221	Calculus and Analytic Geometry 1	5
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 1: Vector and Complex Calculus	3
STAT 324	Introduction to Statistics for Science and Engineering	3
	Total Credits	22

SCIENCE

Code	Title	Credits
Select one of the following:		5-9
CHEM 109	Advanced General Chemistry ¹	
CHEM 103 & CHEM 104	General Chemistry I and General Chemistry II	
PHYSICS 202	General Physics	5
	Total Credits	10-14

¹ It is recommended that students take CHEM 109 Advanced General Chemistry (5 cr). 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.

ENGINEERING SCIENCE

Code	Title	Credits
E M A 200	Introduction to Mechanics and Aerospace	3
	or M E 201 Introduction to Mechanical Engineering	
M E 231	Geometric Modeling for Design and Manufacturing	3
COMP SCI 220	Data Science Programming I ¹	4
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	
	or E C E 230 Circuit Analysis	
M E 364	Elementary Heat Transfer	3
M E 446	Introduction to Feedback Control	3
	or E C E 332 Feedback Control Systems	
	Computing Elective (select one)	3
E M A/E P 471	Intermediate Problem Solving for Engineers (preferred, only offered in the Spring)	
	or COMP SCI 41: Introduction to Numerical Methods	
	or M E 459 Computing Concepts for Applications in Engineering	
	or COMP SCI 32 Data Science Programming II	
	or E P/ E M A 476 Introduction to Scientific Computing for Engineering Physics	
	Total Credits	28

¹ COMP SCI 220 Data Science Programming I is the preferred required computer science course. If a student needs to take COMP SCI 300

Programming II to satisfy requirements for another major or certificate, COMP SCI 300 Programming II can count for this computer science requirement.

ENGINEERING MECHANICS/AEROSPACE ENGINEERING CORE

Code	Title	Credits
E M A 201	Statics (with a grade of C or better) ¹	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
Experimental Mechanics Elective (select one)		3
E M A/M E 540	Experimental Vibration and Dynamic System Analysis	
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
Spacecraft & Structural Dynamics Elective (select one)		3
E M A/ ASTRON 550	Astrodynamics	
E M A 610	Structural Finite Element Model Validation	
E M A 642	Satellite Dynamics	
Aerospace Fluid Mechanics Elective (select one)		3
E M A 523	Flight Dynamics and Control	
E M A 524	Rocket Propulsion	
Total Credits		40

¹ Students may substitute PHYSICS 201 General Physics (5 cr) for E M A 201 Statics (3 cr), with the approval of their advisor.

TECHNICAL ELECTIVES

Code	Title	Credits
Choose five credits from:		5
E M A 1	Cooperative Education Program (no more than 3 credits)	
Courses numbered 300+ in the CoE except for E P D/ INTEREGR		
Up to 3 credits of independent study such as E M A 599; independent study from other engineering subjects may be approved on an individual basis		
Courses numbered 300+ MATH, PHYSICS, COMP SCI, STAT (except STAT 301), ASTRON, MED PHYS, and CHEM departments		
PHYSICS 205	Modern Physics for Engineers	

or PHYSICS 241 Introduction to Modern Physics

Students may also propose any class that they feel will benefit their education path with pre-requisite of two physics or calculus classes. For these courses the advisor will review the request and if approved, recommend a DARS substitution.

Total Credits **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

Total Credits **8**

LIBERAL STUDIES

Code	Title	Credits
College of Engineering Liberal Studies Requirements		
Complete Requirements (https://guide.wisc.edu/undergraduate/engineering/#requirementstext) ¹		15
Total Credits		15

¹ Students must take 15 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.

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>). (<https://intranet.engineering.wisc.edu/undergraduate-students/undergraduate-rules-and-regulations/>)

HONORS IN UNDERGRADUATE RESEARCH

Qualified undergraduates may earn an Honors in Research designation on their transcript and diploma by completing 6 credits of undergraduate

honors research, including a senior thesis. Further information is available in the department office.

FOUR-YEAR PLAN

FOUR-YEAR PLAN EXAMPLE FOUR-YEAR PLAN

First Year

Fall	Credits Spring	Credits
CHEM 109 ¹	5 E M A 201 ³	3
MATH 221	5 MATH 222	4
Communications A	3 M E 231	3
E M A 200 or M E 201 ²	3 M E 201 ²	3
or Liberal Studies Elective	or Liberal Studies Elective	
	Liberal Studies Elective	3
	16	16

Second Year

Fall	Credits Spring	Credits
MATH 234	4 MATH 320	3
PHYSICS 202	5 STAT 324	3
E M A 202 ⁴	3 M E 361	3
COMP SCI 220	4 E M A 303 ⁴	3
INTEREGR 275 (was EPD 275)	2 E M A/M E 307 ⁴	1
	Liberal Studies Elective	3
	18	16

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 E C E 376, PHYSICS 321, or E C E 230	3
MATH 321	3 E M A/E P 471	3
Technical Elective	3	
	18	15

Fourth Year

Fall	Credits Spring	Credits
E M A 469	3 E M A 569	3
E M A 521 ⁶	3 E M A 523 or 524 ⁷	3
M E 446 or E C E 332	3 E M A/ASTRON 550, 610, or 642	3
Experimental Mechanics Course ⁵	3 Tech Elective	2
Liberal Studies Elective	3 Liberal Studies Elective	3
	15	14

Total Credits 128

² E M A 200 or M E 201 are preferred introduction to engineering options. E M A 200 is offered in the fall only. M E 201 can be taken in the first or second semester. If a student begins in another engineering major, other introduction to engineering courses can count for the introduction to engineering requirement.

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

⁴ 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.

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

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

⁷ E M A 523 Flight Dynamics and Control is typically offered in the Spring semester only. E M A 524 Rocket Propulsion is typically offered in the Fall semester only.

¹ 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.