

APPLIED MATHEMATICS, ENGINEERING, AND PHYSICS, B.S. AMEP

This four-year degree program in the interdisciplinary physical sciences offers a strong foundation in related areas of engineering sciences, mathematics, and physics for professional work in the field of industrial research and technology. It also provides a foundation for graduate degree work in applied mathematics, engineering sciences, and physics.

The AMEP program is an excellent choice for the student with broad interests in mathematics, physics, and engineering. AMEP emphasizes an integrated mathematics and physics curriculum and strives to achieve an optimum balance of breadth and depth in the physical sciences within the confines of a four-year degree.

HOW TO GET IN

DECLARATION REQUIREMENTS

Because admission into AMEP is internal to UW–Madison, a student must be admitted to UW–Madison or already be a UW–Madison student to join AMEP.

The general expectation for admission to the AMEP program is completion of the introductory calculus and physics sequences with appropriate success. Specifically a student must have

- Completed MATH 221, MATH 222, and MATH 234 with at least a 2.75 GPA.
 - MATH 375 and MATH 376 (together) may be substituted for MATH 234.
- Completed PHYSICS 247, PHYSICS 248, PHYSICS 249 with at least a 2.75 GPA.
 - For alternate Introductory Physics courses, see the full program description.

Students who do not meet the above qualifications (transfer students, freshmen with advanced standings, etc.) may be admitted to the program on a probationary basis. However, such students who do not eventually meet the above admission requirement or maintain a 2.0 GPA in quality of work program requirements in their first term at UW–Madison may be reassigned to a standard BA or BS degree.

Finally, students who have accrued 86 or more credits will be admitted to the AMEP program only if

- the student has above a 2.0 in both the general and upper level quality of work requirement (see the full program requirements),
- the student has fewer than 60 outstanding credits needed to complete then degree.

DECLARING APPLIED MATHEMATICS, ENGINEERING, AND PHYSICS UNDERGRADUATE DEGREE PROGRAM (AMEP)

Any student who is interested in the AMEP program should meet with a program advisor as soon as possible. The advisor will help the student negotiate pre-AMEP status and eventually assist in declaration for the program. In general, this should be an AMEP MATH faculty advisor.

Advising information can be found in the Advising and Careers (<https://guide.wisc.edu/undergraduate/letters-science/mathematics/applied-mathematics-engineering-physics-bs-amep/#advisingandcareerstext>) tab.

REQUIREMENTS

UNIVERSITY GENERAL EDUCATION REQUIREMENTS

All undergraduate students at the University of Wisconsin–Madison are required to fulfill a minimum set of common university general education requirements to ensure that every graduate acquires the essential core of an undergraduate education. This core establishes a foundation for living a productive life, being a citizen of the world, appreciating aesthetic values, and engaging in lifelong learning in a continually changing world. Various schools and colleges will have requirements in addition to the requirements listed below. Consult your advisor for assistance, as needed. For additional information, see the university Undergraduate General Education Requirements (<http://guide.wisc.edu/undergraduate/#requirementsforundergraduatestudytext>) section of the *Guide*.

General Education

- Breadth–Humanities/Literature/Arts: 6 credits
- Breadth–Natural Science: 4 to 6 credits, consisting of one 4- or 5-credit course with a laboratory component; or two courses providing a total of 6 credits
- Breadth–Social Studies: 3 credits
- Communication Part A & Part B *
- Ethnic Studies *
- Quantitative Reasoning Part A & Part B *

* The mortarboard symbol appears before the title of any course that fulfills one of the Communication Part A or Part B, Ethnic Studies, or Quantitative Reasoning Part A or Part B requirements.

COLLEGE OF LETTERS & SCIENCE DEGREE REQUIREMENTS: BACHELOR OF SCIENCE–APPLIED MATHEMATICS, ENGINEERING, AND PHYSICS (B.S.–AMEP)

Students pursuing a Bachelor of Science–Applied Mathematics, Engineering, and Physics degree in the College of Letters & Science must complete all of the requirements below. The B.S.–AMEP is a special

degree program; it is not considered a major. The B.S.–AMEP degree is not available to students who intend to earn a degree outside the College of Letters & Science.

BACHELOR OF SCIENCE – AMEP DEGREE REQUIREMENTS

Mathematics Complete the University General Education Requirements for Quantitative Reasoning A (QR-A) and Quantitative Reasoning B (QR-B) coursework.

Foreign Language Complete the second unit of a foreign language.

Liberal Arts and Science Requirement Complete a minimum of 20 credits in Liberal Arts and Science (LAS) coursework outside the physical and mathematical sciences, including:

- at least of 12 credits of Humanities and/or Social Science, including at least 6 credits in Humanities and at least 3 credits of Social Science
- a maximum of 8 credits of Biological Science
- additional eligible coursework to reach 20 total credits.

Courses that carry the Physical Science breadth designation, or are listed (or cross-listed) in the MATH or COMP SCI subjects, are not eligible.

Total Credits Complete at least 125 credits.

UW–Madison Experience Complete both:

- 30 credits in residence, overall, and
- 30 credits in residence after the 90th credit.

Quality of Work • 2.000 in all coursework at UW–Madison

REQUIREMENTS FOR THE PROGRAM

A total of at least 125 credits with a minimum GPA of 2.000 is required for this degree plan. Of these credits, at least 82 must be devoted to Mathematics, Physics, Engineering, and Chemistry requirements; 20 must be devoted to University General Education requirements; and the balance may be from electives.

Code Title Credits

FOUNDATION: Mathematics 13-19

Single Variable Calculus. Completed with credit for both of the following courses:

| | |
|----------|----------------------------------|
| MATH 221 | Calculus and Analytic Geometry 1 |
| MATH 222 | Calculus and Analytic Geometry 2 |

Multivariable calculus. Completed with credit for one of the following two options:

| | |
|---------------------|--|
| MATH 234 | Calculus--Functions of Several Variables |
| MATH 375 & MATH 376 | Topics in Multi-Variable Calculus and Linear Algebra and Topics in Multi-Variable Calculus and Differential Equations ¹ |

FOUNDATION: Physics 11-14

First Introductory course

| | |
|----------------|----------------------------------|
| PHYSICS 247 | A Modern Introduction to Physics |
| or PHYSICS 207 | General Physics |
| or PHYSICS 201 | General Physics |

| | |
|--------------|----------|
| or E M A 202 | Dynamics |
| or M E 240 | Dynamics |

Second Introductory course

| | |
|----------------|----------------------------------|
| PHYSICS 248 | A Modern Introduction to Physics |
| or PHYSICS 208 | General Physics |
| or PHYSICS 202 | General Physics |

Third Introductory course

| | |
|-----------------------|---|
| PHYSICS 249 | A Modern Introduction to Physics |
| or PHYSICS 241 | Introduction to Modern Physics |
| or PHYSICS 205 | Modern Physics for Engineers |
| or PHYSICS/ E C E 235 | Introduction to Solid State Electronics |

CHEMISTRY. Completed with credit for one of the following options. 5-9

| | |
|---------------------|--|
| CHEM 109 | Advanced General Chemistry |
| CHEM 103 & CHEM 104 | General Chemistry I and General Chemistry II |
| CHEM 115 | Chemical Principles I |

MATHEMATICS. Completed with at least six courses for 18 credits. 18

Core: Linear Algebra

| | |
|-------------|--|
| MATH 320 | Linear Algebra and Differential Equations ² |
| or MATH 340 | Elementary Matrix and Linear Algebra |
| or MATH 341 | Linear Algebra |
| or MATH 375 | Topics in Multi-Variable Calculus and Linear Algebra |

Core: Differential Equations

| | |
|-------------|--|
| MATH 320 | Linear Algebra and Differential Equations ² |
| or MATH 319 | Techniques in Ordinary Differential Equations |
| or MATH 376 | Topics in Multi-Variable Calculus and Differential Equations |

Core: Applied Analysis. Complete both courses.

| | |
|----------|-------------------------------|
| MATH 321 | Applied Mathematical Analysis |
| MATH 322 | Applied Mathematical Analysis |

MATH electives.³

Completed with at least three courses for nine credits. Select from:

| | |
|-------------------|---|
| MATH 415 | Applied Dynamical Systems, Chaos and Modeling |
| MATH 421 | The Theory of Single Variable Calculus |
| MATH/STAT 431 | Introduction to the Theory of Probability |
| or MATH/STAT 309 | Introduction to Probability and Mathematical Statistics I |
| MATH 443 | Applied Linear Algebra |
| MATH/COMP SCI 513 | Numerical Linear Algebra |
| MATH/COMP SCI 514 | Numerical Analysis |
| MATH 519 | Ordinary Differential Equations |
| MATH 521 | Analysis I |

| | |
|------------------------|--|
| MATH 522 | Analysis II |
| MATH 531 | Probability Theory |
| MATH 561 | Differential Geometry |
| MATH 619 | Analysis of Partial Differential Equations |
| MATH 623 | Complex Analysis |
| MATH 627 | Introduction to Fourier Analysis |
| MATH/ISYE/OTM/STAT 632 | Introduction to Stochastic Processes |

PHYSICS. Completed with at least 5 courses for 15 credits.

Core Physics. Complete both:

| | |
|-------------|------------------------|
| PHYSICS 311 | Mechanics |
| PHYSICS 322 | Electromagnetic Fields |

Physics electives:⁴

Remaining courses/credits from any PHYSICS course numbered 307 and above.

ENGINEERING

21 credits in Engineering courses with the following conditions:⁵

- Courses must be numbered 300 or above.
- Courses must be distinct from any used to fulfill math and physics requirements above.

LABORATORY EXPERIENCE. Minimum of three credits selected from the options below.⁶

The following course applies as three credits of lab:

| | |
|-----------|------------------|
| E M A 522 | Aerodynamics Lab |
|-----------|------------------|

The following courses apply as two credits of lab each:

| | |
|-------------|--|
| PHYSICS 307 | Intermediate Laboratory-Mechanics and Modern Physics |
| PHYSICS 321 | Electric Circuits and Electronics |
| PHYSICS 325 | Optics |
| PHYSICS 407 | Advanced Laboratory |
| PHYSICS 623 | Electronic Aids to Measurement |
| PHYSICS 625 | Applied Optics |

The following courses apply as one credit of lab each:

| | |
|---------------|----------------------------|
| E C E 270 | Circuits Laboratory I |
| E M A/M E 307 | Mechanics of Materials Lab |

Computational Experience.⁶

Select one:

| | |
|-------------------|--|
| COMP SCI 412 | Introduction to Numerical Methods |
| E P/E M A 471 | Intermediate Problem Solving for Engineers |
| MATH/COMP SCI 513 | Numerical Linear Algebra |
| MATH/COMP SCI 514 | Numerical Analysis |

Bachelor of Science General Education Requirements

Electives to Reach 125 Credits

Total Credits

RESIDENCE AND QUALITY OF WORK

- Minimum 2.000 GPA in AMEP program courses.⁷
- Minimum 2.000 GPA and 15 upper-level AMEP program credits, taken in residence.^{7,8}
- 15 credits in AMEP program courses, taken on the UW-Madison campus.⁷

HONORS IN THE MAJOR

Honors in the Major is not available in Applied Mathematics, Engineering, and Physics.

FOOTNOTES

1

MATH 375 may also be used to fulfill the Linear Algebra requirement below. MATH 376 may be used to fulfill the Differential Equations requirement below.

2

MATH 320 fulfills both the Linear Algebra and Differential Equations requirement. AMEP students are encouraged to consider the honors version of the course which is taught by AMEP faculty.

3

A default plan may include MATH 415, MATH/STAT 431, and MATH/COMP SCI 514.

4

A default plan might include courses selected from PHYSICS 307, PHYSICS 321, PHYSICS 325, PHYSICS 415, PHYSICS 448, and PHYSICS 449.

5

Work with an AMEP Engineering advisor to construct a progressive and cohesive sequence of courses. We recommend you begin enrolling in engineering courses at or near the completion of your MATH and PHYSICS core requirements.

6

Course used to fulfill this requirement need not be distinct from courses used to fulfill Mathematics, Physics, and Engineering requirements in AMEP.

7

This includes only those courses which may be used to fulfill Mathematics, Physics, Engineering, Chemistry, Laboratory, and Computational requirements described in the tables above.

8

A course numbered 300 or above is considered upper level in the program.

UNIVERSITY DEGREE REQUIREMENTS

Total Degree To receive a bachelor's degree from UW-Madison, students must earn a minimum of 120 degree credits. The requirements for some programs may exceed 120 degree credits. Students should consult with their college or department advisor for information on specific credit requirements.

Residency Degree candidates are required to earn a minimum of 30 credits in residence at UW–Madison. "In residence" means on the UW–Madison campus with an undergraduate degree classification. "In residence" credit also includes UW–Madison courses offered in distance or online formats and credits earned in UW–Madison Study Abroad/Study Away programs.

Quality of Work Undergraduate students must maintain the minimum grade point average specified by the school, college, or academic program to remain in good academic standing. Students whose academic performance drops below these minimum thresholds will be placed on academic probation.

LEARNING OUTCOMES

1. State, explain and apply principal theorems and techniques of applied mathematics, including (but not limited to) the subject areas of vector and complex calculus, linear algebra, and differential equations.
2. State, explain and apply theory and methods of classical and modern physics such as mechanics (classical, statistical, quantum), electricity, magnetism, thermodynamics, radiation and atomic physics.
3. Develop strategies to synthesize applied mathematics and physical sciences to address engineering problems, with emphasis on problems of current interest.
4. Design and conduct experiments to explore hypotheses regarding science and/or technology and/or engineering problems, and will use mathematics to help interpret experimental results.
5. Work in multidisciplinary groups of mathematicians, physical scientists, and engineers to formulate and solve STEM problems, which includes the creation and evaluation of models for natural phenomena.
6. Through written and oral presentations, students will communicate technical/scientific ideas and results to experts and non-experts.

FOUR-YEAR PLAN

SAMPLE FOUR-YEAR PLAN

This Sample Four-Year Plan is a tool to assist students and their advisor(s). Students should use it—along with their DARS report, the Degree Planner, and Course Search & Enroll tools—to make their own four-year plan based on their placement scores, credit for transferred courses and approved examinations, and individual interests. As students become involved in athletics, honors, research, student organizations, study abroad, volunteer experiences, and/or work, they might adjust the order of their courses to accommodate these experiences. Students will likely revise their own four-year plan several times during college.

First Year

| Fall | Credits | Spring | Credits |
|--------------------|-----------|----------------------|-----------|
| CHEM 109 | | 5 Communication A | 3 |
| PHYSICS 247 | | 5 MATH 320 | 3 |
| MATH 234 | | 4 PHYSICS 248 | 5 |
| Foreign Language 1 | | 4 Foreign Language 2 | 4 |
| | 18 | | 15 |

Second Year

| Fall | Credits | Spring | Credits |
|-------------|---------|----------------|---------|
| MATH 321 | | 3 INTER-LS 210 | 1 |
| PHYSICS 249 | | 4 PHYSICS 311 | 3 |

| | | |
|---------------------------------------|---|-----------|
| Humanities Breadth | 3 MATH 322 | 3 |
| Core Math Elective 1 | 3 Core Math Elective 2 | 3 |
| Ethnic Studies/Social Science Breadth | 3 Humanities Breadth | 3 |
| | Biological/Social Science or Humanities | 3 |
| | 16 | 16 |

Third Year

| Fall | Credits | Spring | Credits |
|-----------------------------------|-----------|----------------------------|-----------|
| PHYSICS 322 | | 3 Core Physics 2 | 4 |
| Core Math Elective 3 | | 3 Core Physics 3 | 4 |
| Physics Elective 1 | | 4 Computational Experience | 3 |
| Lab Experience | | 2-4 Engineering 1 | 3 |
| Humanities/Social Science Breadth | | 3 | |
| | 16 | | 14 |

Fourth Year

| Fall | Credits | Spring | Credits |
|---------------------|-----------|---------------------------------|-----------|
| Communication B | | 3 Engineering courses | 9 |
| Engineering Courses | | 12 Humanities Breadth Electives | 3 |
| | 15 | | 15 |

Total Credits 125

ADVISING AND CAREERS

For information about advising for the special Letters & Science degree program, students should refer to AMEP Advising (<https://www.math.wisc.edu/amep/advising/>).

RECOMMENDED/SUGGESTED ADVANCED COURSES

A number of intermediate and advanced courses in the Mathematics and Physics Departments are recommended by AMEP advisors for use as electives beyond the core math and physics curricula. Other courses may be approved by AMEP faculty advisors.

| Code | Title | Credits |
|------------------------|---|---------|
| Mathematics | | |
| MATH 415 | Applied Dynamical Systems, Chaos and Modeling | |
| MATH/STAT 431 | Introduction to the Theory of Probability | |
| MATH/COMP SCI 513 | Numerical Linear Algebra (computing elective) | |
| MATH/COMP SCI 514 | Numerical Analysis (computing elective) | |
| MATH 561 | Differential Geometry | |
| MATH/ISYE/OTM/STAT 632 | Introduction to Stochastic Processes | |
| Physics | | |
| PHYSICS 323 | Electromagnetic Fields | |
| PHYSICS 325 | Optics | |

PHYSICS 407 Advanced Laboratory

PHYSICS 415 Thermal Physics

PHYSICS 448 Atomic and Quantum Physics
& PHYSICS 449 and Atomic and Quantum Physics

PHYSICS 531 Introduction to Quantum Mechanics

PHYSICS 551 Solid State Physics

Chemical and Biological Engineering (CBE)

CBE 250 Process Synthesis

CBE 255 Introduction to Chemical Process
Modeling

Computer Engineering (ECE)

E C E/
COMP SCI 352 Digital System Fundamentals

E C E/
COMP SCI 354 Machine Organization and
Programming

Engineering Mechanics and Astronautics (EMA) or Mechanical Engineering (ME)

E M A 303 Mechanics of Materials

M E 306 Mechanics of Materials

E M A/M E 307 Mechanics of Materials Lab

E M A 506 Advanced Mechanics of Materials I

E M A 519 Fracture Mechanics

Electrical Engineering

E C E 210 Introductory Experience in Electrical
Engineering

E C E 230 Circuit Analysis

E C E 270 Circuits Laboratory I

Thermodynamics, Fluids, and Heat Transfer (ME, CBE)

M E 361 Thermodynamics

M E 363 Fluid Dynamics

M E 364 Elementary Heat Transfer

CBE 310 Chemical Process Thermodynamics

CBE 320 Introductory Transport Phenomena

CBE 430 Chemical Kinetics and Reactor
Design

Aerodynamics and Astrodynamics (EMA)

E M A 521 Aerodynamics

E M A 522 Aerodynamics Lab

E M A 523 Flight Dynamics and Control

E M A 542 Advanced Dynamics

E M A/
ASTRON 550 Astrodynamics

Materials Science and Engineering

M S & E 350 Introduction to Materials Science

Plasma Physics and Engineering (ECE/NEEP/PHYS cross-listed)

E C E/N E/
PHYSICS 525 Introduction to Plasmas

E C E/N E/
PHYSICS 527 Plasma Confinement and Heating

Industrial Engineering

I SY E 313 Engineering Economic Analysis

I SY E 323 Operations Research-Deterministic
Modeling

L&S CAREER RESOURCES

Every L&S major opens a world of possibilities. SuccessWorks (<https://successworks.wisc.edu/>) at the College of Letters & Science helps students turn the academic skills learned in their major, certificates, and other coursework into fulfilling lives after graduation, whether that means jobs, public service, graduate school or other career pursuits.

In addition to providing basic support like resume reviews and interview practice, SuccessWorks offers ways to explore interests and build career skills from their very first semester/term at UW all the way through graduation and beyond.

Students can explore careers in one-on-one advising, try out different career paths, complete internships, prepare for the job search and/or graduate school applications, and connect with supportive alumni and even employers in the fields that inspire them.

- SuccessWorks (<https://careers.ls.wisc.edu/>)
- Set up a career advising appointment (<https://successworks.wisc.edu/make-an-appointment/>)
- Enroll in a Career Course (<https://successworks.wisc.edu/career-courses/>) - a great idea for first- and second-year students:
 - INTER-LS 210 L&S Career Development: Taking Initiative (1 credit)
 - INTER-LS 215 Communicating About Careers (3 credits, fulfills Comm B General Education Requirement)
- Learn about internships and internship funding (<https://successworks.wisc.edu/finding-a-job-or-internship/>)
 - INTER-LS 260 Internship in the Liberal Arts and Sciences
- Activate your Handshake account (<https://successworks.wisc.edu/handshake/>) to apply for jobs and internships from 200,000+ employers recruiting UW-Madison students
- Learn about the impact SuccessWorks has on students' lives (<https://successworks.wisc.edu/about/mission/>)