Applied Mathematics Upper-Division Electives
2023 - 2024

Students are required to take three upper-division elective courses from the following list of possible electives. *Note that many of these electives have lower-division prerequisites.* Students should plan carefully which ones to take to ensure they are prepared for their selected upper-division electives. Also note that enrollment in the graduate courses is by permission of the instructor, who will verify adequate preparation.

All students, but especially those doing a double major or a major-minor combination, may also petition to count courses that are not already on the list as electives, subject to approval.

**Applied Mathematics (AM) Electives**

- Any 5-credit upper-division AM course that is not already a core course.
- Any 5-credit graduate AM course with the exception of AM 200, AM 211, AM 212A and AM 214.

**Astronomy And Astrophysics (ASTR) Electives**

- ASTR 112 Physics of Stars
- ASTR 113 Introduction to Cosmology
- ASTR 119 Introduction to Scientific Computing

**Biomolecular Engineering (BME) Elective**

- BME 160 Research Programming in the Life Sciences

**Computer Science and Engineering (CSE) Electives**

Note that many require lower-division CSE courses. Lecture-lab combinations count as one course.

- CSE 101 Introduction to Data Structures and Algorithms
- CSE 102 Introduction to Analysis of Algorithms
- CSE 104 Computability and Computational Complexity
- CSE 106 Applied Graph Theory and Algorithms
- CSE 108 Algorithmic Foundations of Cryptography
- CSE 109 Quantum Computing
- CSE 113 Parallel and Concurrent Programming
- CSE 140 Artificial Intelligence
- CSE 142 Machine Learning
- CSE 144 Applied Machine Learning
- CSE 160 Introduction to Computer Graphics and Laboratory
- CSE 161/L Introduction to Data Visualization and Laboratory
- CSE 162/L Advanced Computer Graphics and Animation and Laboratory

➢ Note that most of these courses require CSE 101 as a prerequisite and that enrollment restrictions vary and might apply to any of the CSE courses listed here on short notice. CSE 101, CSE 102, CSE 140, CSE 142, CSE 144 are courses for which enrollment restrictions may apply, and that may only be appropriate for double-majors (or major-minor combinations).

➢ CSE 162/L is a course that has more than one upper-division prerequisite beyond those that are already part of the core requirements. This course may only be appropriate for double-majors (or major-minor combinations).

Students who plan on taking CSE Upper Division Electives are strongly encouraged to identify alternate options in case they are not able to enroll in the CSE classes.

Earth Sciences (EART) Electives

Note that many require lower-division PHYS or CHEM courses:

- EART 112 Geophysical Data Science
- EART 118 Seismotectonics
- EART 119A Introduction to Scientific Programming
- EART 121 The Atmosphere
- EART 124 Modeling Earth’s Climate
- EART 160 Planetary Science
- EART 162 Planetary Interiors
- EART 163 Planetary Surfaces
- EART 164 Planetary Atmospheres
- EART 125 OR EART 225 Statistics and Data Analysis in the Geosciences
- EART 172/OCEA 172 OR EART 272/OCEA 272 Geophysical Fluid Dynamics
Electrical and Computer Engineering (ECE) Electives

Lecture-lab combinations count as one course.

- ECE 101/L Introduction to Electronic Circuits and Laboratory
- ECE 103 Signals and Systems
- ECE 115 Introduction to Solid Mechanics
- ECE 135/L Electromagnetic Fields and Waves and Laboratory
- ECE 136 Engineering Electromagnetics
- ECE 141 Feedback Control Systems
- ECE 145 Estimation and Introduction to Control of Stochastic Processes
- ECE 149 Introduction to Cyber-physical Systems
- ECE 151 Communications Systems
- ECE 153 Digital Signal Processing
- ECE 163 Introduction to Small-Scale UAV Theory and Practice
- ECE 179 Decision Analysis in Management

➢ Note that most of these courses require ECE 101/L as a prerequisite.

➢ ECE 141 and ECE 153 are courses that have more than one upper-division prerequisite beyond those that are already part of the core requirements. These courses may only be appropriate for double majors (or major-minor combinations).

Economics (ECON) Electives

Note that many require ECON lower-division courses:

- ECON 100A Intermediate Microeconomics
- ECON 100B Intermediate Macroeconomics
- ECON 100M Intermediate Microeconomics, Math Intensive
- ECON 100N Intermediate Macroeconomics, Math Intensive
- ECON 101 Managerial Economics
- ECON 113 Introduction to Econometrics
ECON 114 Advanced Quantitative Methods
ECON 115 Introduction to Management Sciences
ECON 124 Machine Learning for Economists
ECON 166A/CSE 166A Game Theory and Applications I

➢ ECON 166A is a course that has more than one upper-division prerequisite beyond those that are already part of the core requirements. This course may only be appropriate for double-majors (or major-minor combinations).

Mathematics (MATH) Electives

Note that many MATH electives require MATH 100 as a prerequisite.

• MATH 105A Real Analysis
• MATH 105B Real Analysis
• MATH 105C Real Analysis
• MATH 110 Introduction to Number Theory
• MATH 111A Algebra
• MATH 111T Algebra
• MATH 114 Introduction to Financial Mathematics
• MATH 115 Graph Theory
• MATH 116 Combinatorics
• MATH 117 Advanced Linear Algebra
• MATH 118 Advanced Number Theory
• MATH 120 Coding Theory
• MATH 121A Differential Geometry
• MATH 121B Differential Geometry and Topology
• MATH 124 Introduction to Topology
• MATH 134 Cryptography
• MATH 140 Industrial Math
• MATH 152 Programming for Mathematics
Ocean Sciences (OCEA) Electives

Some OCEA Electives require lower-division PHYS electives, or upper-division ESCI electives:

- OCEA 260/EART 260 Introductory Data Analysis in the Ocean and Earth Sciences
- OCEA 286 Introduction to Ocean Modeling
- OCEA 100 OR OCEA 200 Physical Oceanography
- OCEA 111 OR OCEA 211 Climate Dynamics

Physics (PHYS) Electives

Many PHYS electives require lower-division PHYS courses as prerequisites.

- PHYS 105 Mechanics
- PHYS 110A Electricity, Magnetism, and Optics
- PHYS 110B Electricity, Magnetism, and Optics
- PHYS 139A Quantum Mechanics I
- PHYS 139B Quantum Mechanics II
- PHYS 150 / CSE 109 Quantum Computing
- PHYS 171/ASTR 171 General Relativity, Black Holes, and Cosmology

➢ The prerequisites of PHYS 116A and PHYS 116C are waived for students who have taken AM 100 and AM 112.

➢ PHYS 139A, PHYS 139B, and PHYS 171 are courses that have more than one upper-division prerequisite beyond those that are already part of the core requirements. These courses may only be appropriate for double majors (or major-minor combinations).

Statistics (STAT) Electives

- STAT 108 Linear Regression
- STAT 132 Classical and Bayesian Inference
- STAT 205 Introduction to Classical Statistical Learning
- STAT 266A/CSE 266A Data Visualization and Statistical Programming in R
- STAT 266B/CSE 266B Advanced Statistical Programming in R