

- 3. See page 23
 - 4. MATH120 Calculus I*
 - 5. COSC111 Introduction to Programming*
- Area II Science and Technology*
- 1. *One of the following:*
 - CHEM115/116 Chemistry and Society with lab (4 hrs)
 - CHEM117/118 Fundamentals of Chemistry with lab (4 hrs)
 - CHEM120 Fundamentals of Organic and Biochemistry (4 hrs)
 - CHEM121/122 General Chemistry I with lab (4 hrs)
 - 2. *One of the following:*
 - BIOL105 Introductory Biology for Non-majors (4 hrs)
 - BOTN130 Biology of Plants (4 hrs)
 - ZOOL140 Biology of Animals (4 hrs)
 - 3. *One of the following:*
 - *ASTR205 Principles of Astronomy
 - *PHY223 Mechanics and Sound
- Area III Social Sciences*
- 1. See page 24
 - 2. See page 24
 - 3. See page 24
 - 4. See page 24
- Area IV Arts and Humanities*
- 1. See page 25
 - 2. See page 25
 - 3. See page 25
 - 4. See page 25

Additional Requirements.....18 hours

- *COSC111 Introduction to Programming (3 hrs)
- *MATH120 Calculus I (4 hrs)
- MATH121 Calculus II (4 hrs)
- MATH122 Elementary Linear Algebra (3 hrs)
- MATH223 Multivariable Calculus (4 hrs)

Physical Education/Graduation Requirement2 hours

Major Requirements35 hours

Required Courses 31 hours

- ASTR204 Astronomical Investigations (1 hr)
- *ASTR205 Principles of Astronomy (4 hrs)
- *PHY223 Mechanics and Sound (5 hrs)
- PHY224 Electricity and Light (5 hrs)
- PHY330 Intermediate Mechanics I (3 hrs)
- PHY332 Mechanics Laboratory (1 hr)
- PHY350 Electricity and Magnetism I (3 hrs)
- PHY360 Heat and Thermodynamics (4 hrs)
- PHY370 Introduction to Modern Physics (3 hrs)
- PHY372 Modern Physics Laboratory (1 hr)
- PHY406 Ethical Issues in Physics (1 hr)

Restricted Electives 1-4 hours

- One of the following laboratory courses:*
- PHY436 Vibration and Sound (4 hrs)
 - PHY442 Optics Laboratory (1 hr)
 - PHY444 Applied Optics (2 hrs)
 - PHY456 Electronics for Physicists (4 hrs)

Elective Courses 0-3 hours

Select elective courses in physics and astronomy to complete the 35 hour requirement. Only physics and astronomy undergraduate courses numbered greater than 299 can be used as electives on this major, excluding PHY311 and PHY325 which can never be used on this major.

Professional Studies39 hours

Pre-admission phase: The Learner and the Community8 hours

- EDPS322 Human Development and Learning (4 hrs)
- FETE201 Field Experience I (1 hr)
- SPGN251 Education of Students with Exceptionalities (3 hrs)

The following courses require formal admission to the teacher education program:

Phase I: Curriculum, Assessment and the Social

Context 10 hours

- SOFD328 Schools in a Multicultural Society (3 hrs)
- CURR305 Curriculum and Methods: Secondary (3 hrs)
- FETE302 Field Experience II: Secondary (1 hr)
- EDPS340 Introduction to Assessment and Evaluation (3 hrs)

Phase II: Content Methods, Literacy and

Technology 9 hours

- RDNG311 Teaching Reading in the Secondary School (3 hrs)
- FETE402 Field Experience III: Secondary (1 hr)
- EDMT330 Instructional Applications of Media and Technology (2 hrs)
- PHY325 Methods of Teaching the Physical Sciences (3 hrs)

Phase III: Capstone Experience

12 hours

- EDUC492 Student Teaching (12 hrs)

Minor Requirements 12-24 hours

Select a minor from the approved list of minors for secondary, K-12 and special education-secondary programs (mathematics is highly recommended).

University Elective Courses 0 hours

Program Total 145 hours

PRE-ENGINEERING PROGRAM (PENG)

This program is designed for the student who wishes to transfer to an engineering program at another university. Students are strongly advised to consult with the engineering school to which they plan to transfer for specific requirements. Courses taken may apply to other majors at the University if the student chooses to remain on campus to complete a bachelor's degree.

Department advisers in these areas maintain contact with universities that offer related four-year programs in order to maximize the value of the transfer program of study at the University to other universities. Students planning to transfer to four-year programs should not complete EMU's general education requirements.

Required Courses.....35 hours

- ENGL121 Composition II: Researching the Public Experience (3 hrs)
- MATH120 Calculus I (4 hrs)
- MATH121 Calculus II (4 hrs)
- MATH122 Elementary Linear Algebra (3 hrs)
- MATH223 Multivariable Calculus (4 hrs)
- CHEM121/122 General Chemistry I with lab (4 hrs)
- PHY223 Mechanics and Sound (5 hrs)
- PHY224 Electricity and Light (5 hrs)
- One literature course (3 hrs)

Recommended Courses21 hours

- COSC111 Introduction to Programming (3 hrs)
- CTAS121 Fundamentals of Speech (3 hrs)
- ECON201 Principles of Macroeconomics (3 hrs)
- ECON202 Principles of Microeconomics (3 hrs)
- ENGL225 Intermediate English Composition (3 hrs)
- Second literature course (3 hrs)
- One humanities course (3 hrs)

Optional Courses.....3 hours

- CADM122 Engineering Graphics I (3 hrs)
- CADM223 Engineering Graphics II (3 hrs)

ASTRONOMY GROUP MINOR (ASTR)

This minor is designed to give the student a basic knowledge of astronomy and related fields. It is recommended that students wishing to undertake graduate work in astronomy complete the research major in physics with a minor in either mathematics or astronomy. Electives used to fulfill the astronomy minor cannot be used to complete any other major or minor.

Required Courses..... 11 hours

- ASTR204 Astronomical Investigations (1 hr)
- ASTR205 Principles of Astronomy (4 hrs)
- ASTR315 Observational Astronomy (3 hrs)
- ASTR370 Astrophysical Concepts (3 hrs)

Restricted Elective Courses..... 13 hours

Choose 13 credits from approved courses in physics, astronomy, mathematics or chemistry in consultation with the advising coordinator for astronomy.

Minor Total.....24 hours

GROUP MINOR IN GENERAL SCIENCE (GSC)

A group minor in general science (24 credit hours) must be combined with an academic major in biology, chemistry, earth science, mathematics or physics.

With a **major in biology**, take the following courses:

- ASTR205 Principles of Astronomy (4 hrs)
- CHEM121/122 General Chemistry I with lab (4 hrs)
- ESSC110 The Dynamic Earth System (4 hrs)
- MATH105 College Algebra (3 hrs)
- MATH107 Plane Trigonometry (2 hrs)
- PHY221 Mechanics, Sound and Heat (4 hrs)

Three hours from the following:

- CHEM123 General Chemistry II (3 hrs)
- CHEM124 General Chemistry II Laboratory (1 hr)
- ESSC212 Weather, Climate and the Earth System (3 hrs)
- COSC145 Introduction to FORTRAN Programming (3 hrs)
- PHY222 Electricity and Light (4 hrs)
- Others as approved by general science adviser

With a **major in chemistry**, take the following courses:

- ASTR205 Principles of Astronomy (4 hrs)
- BIOL110 Introductory Biology I (5 hrs)
- ESSC110 The Dynamic Earth System (4 hrs)
- MATH105 College Algebra (3 hrs)
- MATH107 Plane Trigonometry (2 hrs)
- PHY221 Mechanics, Sound and Heat (4 hrs)

Three hours from the following:

- BIOL324 Global Ecology and the Environment (4 hrs)
- ESSC212 Weather, Climate and the Earth System (3 hrs)
- COSC145 Introduction to FORTRAN Programming (3 hrs)
- PHY222 Electricity and Light (4 hrs)
- Others as approved by general science adviser

With a **major in earth science**, a structured general science minor is included in the program.

With a **major in mathematics**, take the following courses:

- ASTR205 Principles of Astronomy (4 hrs)
- BIOL110 Introductory Biology I (5 hrs)
- CHEM121/122 General Chemistry I with lab (4 hrs)
- ESSC110 The Dynamic Earth System (4 hrs)
- PHY221 Mechanics, Sound and Heat (4 hrs)

Four hours from the following:

- BIOL324 Global Ecology and the Environment (4 hrs)
- CHEM123/124 General Chemistry I with lab (4 hrs)
- ESSC212 Weather, Climate and the Earth System (3 hrs)
- PHY222 Electricity and Light (4 hrs)
- Others as approved by general science adviser

With a **major in physics**, take the following courses:

- ASTR205 Principles of Astronomy (4 hrs)
- BIOL110 Introductory Biology I (5 hrs)
- CHEM121/122 General Chemistry I with lab (4 hrs)
- ESSC110 The Dynamic Earth System (4 hrs)

MATH120 Calculus I (4 hrs)

Four hours from the following:

- BIOL324 Global Ecology and the Environment (4 hrs)
- CHEM123/124 General Chemistry I with lab (4 hrs)
- ESSC212 Weather, Climate and the Earth System (3 hrs)
- COSC145 Introduction to FORTRAN Programming (3 hrs)
- Others as approved by general science adviser

Approved Elective Courses

- BIOL324 Global Ecology and the Environment
- CHEM123 General Chemistry II
- CHEM124 General Chemistry II Laboratory
- ESSC212 Weather, Climate and the Earth System
- COSC145 Introduction to FORTRAN Programming
- PHY222 Electricity and Light

This list is not complete; consult with the general science adviser for other possible courses.

Minor Total.....24 hours

PHYSICS MINOR (PHY)

Required Courses.....21 hours

- PHY223 Mechanics and Sound (5 hrs)
- PHY224 Electricity and Light (5 hrs)
- PHY330 Intermediate Mechanics I (3 hrs)
- PHY360 Heat and Thermodynamics (4 hrs)
- PHY370 Introduction to Modern Physics (3 hrs)
- PHY372 Modern Physics Laboratory (1 hr)

Additional Requirements..... 15 hours

- MATH120 Calculus I (4 hrs)
- MATH121 Calculus II (4 hrs)
- MATH122 Elements of Linear Algebra (3 hrs)
- MATH223 Multivariable Calculus (4 hrs)

All students earning a minor in physics must also take, as a minimum, the following courses in mathematics. (These courses may be used on a minor in mathematics.)

Minor Total.....21 hours

PHYSICS MINOR (PHYT)

Secondary, K-12 and Special Education-Secondary Teacher Certification

Successful completion of this minor, in the context of other program requirements, qualifies the student for recommendation for endorsement in physics, certification code DE. The Michigan Test for Teacher Certification (MTTC) covering this field is #19, "Physics."

Required Physics and Astronomy Courses.....21 hours

- PHY223 Mechanics and Sound (5 hrs)
- PHY224 Electricity and Light (5 hrs)
- PHY330 Intermediate Mechanics I (3 hrs)
- PHY360 Heat and Thermodynamics (4 hrs)
- PHY370 Introduction to Modern Physics (3 hrs)
- PHY372 Modern Physics Laboratory (1 hr)

Additional Requirements..... 15 hours

- These courses may be used on a minor in mathematics.*
- MATH120 Calculus I (4 hrs)
- MATH121 Calculus II (4 hrs)
- MATH122 Elementary Linear Algebra (3 hrs)
- MATH223 Multivariable Calculus (4 hrs)

Minor Total.....21 hours