

## MICHIGAN STATE BOARD OF EDUCATION PERIODIC REVIEW/PROGRAM EVALUATION

### SUMMARY OF COURSE REQUIREMENTS FOR SPECIALTY STUDIES PROGRAM

Institution Eastern Michigan University Date: May 2007 from Jan 2005 document

Specialty Studies Program Physical Science

Program Standards Michigan State Board of Education Standards Date: Aug 2002

Program Contact Person(s) Steven Stegink compilation from Wylo/Carroll document

**DIRECTIONS:** On the matrix below, list the required courses for this specialty studies program. Also, indicate the number of electives and any special considerations that apply. In addition to listing the course title, course number, and course semester hours, please indicate whether the course is required for the secondary major or minor, elementary major or minor, the K-12 major, and/or an additional endorsement.

Course Title	Course Number	Sem Hrs*	Secondary Comprehensive Group Major	Secondary Group Major w/			
				Physic s minor	Chem minor	Biol minor	Earth Sci minor
Chem I w/ lab	CHEM 121/122	4	X	X	m <sup>1</sup>	X	X
Chem II w/ lab	CHEM 123/124	4	X	X	m	X	X
Survey Organic Chem w/ lab	CHEM 270/271	5	X	X	m	X	X
Quantitative Analysis	CHEM 281	4	X	X	m	X	X
Foundations of Biochemistry	CHEM 351	4	X	X	m		X
Nature of Science or Ethical Issues in Physics	CHEM 406 or PHY 406	1	X	X	X	X	X
Mechanics, Sound & Heat	PHY 221	4	X	m <sup>1</sup>	X	X	X
Electricity and Light	PHY 222	4	X	m	X	X	X
Modern Physics lab	PHY 372	1	X	m	X	X	X
Relativity, Atomic & Nuclear Physics	PSCI 270	3	X	m	X	X	X
Energy and Society	PSCI 305	3	X	m	X	X	X
Thermal Science & Heat Transfer	PSCI 309	3	X	m	X	X	X

Milestones in Physics & Astronomy	PSCI 340	3	X	X	X	X	X
The Dynamic Earth	ESSC 110	4	X	X	X		
Principle of Astronomy	ASTR 205	4	X	X	X		
Observational Astronomy or The Earth System thru Time	ASTR 315 or ESSC 111	3 or 4	X	X	X and X		
Required cognates:							
Biology for non-majors	BIOL105	4	X	X	X		X
Applied Calculus & Plane Trigonometry or Calculus I	MATH 119 & MATH 107, or MATH 120	3+2 or 4	X	X	X	X	X
Total number of SEMESTER HOURS <b>required</b> for each option offered: * If the institution assigns a different type of credit, please convert to semester hours.			54-55	36-37	33-34	39	43

m<sup>1</sup> = covered in minor program coursework or cognate requirements

Please provide descriptions for all courses contained on the above listing. Descriptions must provide enough information to show that standards could logically be met in these courses.

### PSCI 270 - Relativity, Atomic & Nuclear Phys

This course completes the introductory sequence in college-level, algebra-based physics. Topics include relativity, quantum physics, atomic structure and models, molecules, nuclei, particles, nuclear fusion and cosmology. Applications include lasers, holography, scanning tunneling microscopes, and magnetic resonance imaging. Emphasis is placed on understanding and comprehension as well as the ability to solve relevant mathematical problems.

3.000 Credit Hours  
3.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, Lecture

College of Arts & Sciences College  
Physics and Astronomy Department

### PSCI 305 - Energy and Society

This course is designed particularly for teachers in physical science as an elementary study of energy concepts and the various relationships between energy and society. The focus is on simple experimental projects, followed by class discussions. Most of the apparatus will be made from materials available in the home or at a variety store.

3.000 Credit Hours  
3.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, Lecture

College of Arts & Sciences College  
Physics and Astronomy Department

### **PSCI 309 - Thermal Science&Heat Transfer**

Basic course in the fundamental principles of thermodynamics and heat transfer. Topics include temperature scales, open and closed systems, properties of pure substances, change of state, P-V diagrams, specific heat, enthalpy, entropy, heat engine cycles, heat conduction, convection and radiation. Emphasis is placed on understanding and comprehension as well as the ability to solve relevant mathematical problems.

3.000 Credit Hours

3.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, Lecture

College of Arts & Sciences College  
Physics and Astronomy Department

### **PSCI 340 - Milestones in Phys&Astr Tchrs**

A course designed to give students an understanding of the contributions made by selected male and female scientists, from diverse racial and ethnic backgrounds, to the development of physics and astronomy, and the relationship of ideas to the period in which the scientists lived.

3.000 Credit Hours

3.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, Lecture

College of Arts & Sciences College  
Physics and Astronomy Department

### **ASTR 205 - Principles of Astronomy**

An astronomy course for students desiring a comprehensive introduction to astronomy. Topics discussed in ASTR203 are covered in more detail, and additional topics are introduced. Especially recommended for science students. ASTR204 may be taken concurrently. Not open to students with credit in ASTR203.

4.000 Credit Hours

4.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Lecture](#), [Comb - Lecture](#), [Recitation](#), Recitation

College of Arts & Sciences College  
Physics and Astronomy Department

### **ASTR 315 - Observational Astronomy**

The practical aspects of astronomy emphasizing advanced amateur observational practices such as identification of astronomical objects using charts and references, telescopes, imaging and darkroom techniques, and computer applications.

3.000 Credit Hours

3.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Lecture](#)

College of Arts & Sciences College  
Physics and Astronomy Department

Gen Ed Disciplines-Nat Science

### **CHEM 122 - General Chemistry I Lab**

The laboratory class to accompany CHEM121. Students learn basic techniques employed in a chemistry laboratory, including use of analytical balances, quantitative glassware, spectrophotometry, and computers for data acquisition and analysis. CHEM121 must be taken concurrently to satisfy four credits of the Knowledge of the Disciplines - Natural Science portion of the General Education program. Laboratory: three hours per week.

1.000 Credit Hours

1.000 Lab hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Laboratory](#)

College of Arts & Sciences College  
Chemistry Department

**Course Attributes:**

Gen Ed Disciplines-Nat Science

### **CHEM 123 - General Chemistry II**

"A continuation of the two-semester sequence covering the general principles of chemistry for science majors and others with an interest and background in science. Lecture: three hours per week. Restriction: "C-" or better in CHEM121."

3.000 Credit Hours

3.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Lecture](#)

College of Arts & Sciences College  
Chemistry Department

### **CHEM 124 - General Chemistry II Lab**

"The techniques learned in CHEM122 are reemphasized and supplemented. Laboratory: three hours per week. Restrictions: "C-" or better in CHEM122."

1.000 Credit Hours

1.000 Lab hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Laboratory](#)

College of Arts & Sciences College  
Chemistry Department

### **CHEM 270 - Survey of Organic Chemistry**

A comprehensive one-semester survey course in organic chemistry. Includes aliphatic and aromatic compounds plus functional group chemistry. Chemistry majors and other students requiring a full-year sequence of organic chemistry should enroll in CHEM371 and CHEM372. Lecture: four hours per week.

4.000 Credit Hours

4.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Lecture](#)

College of Arts & Sciences College  
Chemistry Department

### **CHEM 271 - Organic Chemistry Lab**

Instruction in the basic manipulative techniques of experimental organic chemistry and experience with organic chemicals. Laboratory: three hours per week.

1.000 Credit Hours

1.000 Lab hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Laboratory](#)

College of Arts & Sciences College  
Chemistry Department

### **CHEM 281 - Quantitative Analysis**

A lecture and laboratory course treating instrumental, gravimetric, and volumetric analysis, and equilibrium.

Lecture: two hours per week. Laboratory: six hours per week.

0.000 OR 4.000 Credit Hours

0.000 OR 4.000 Lecture hours

0.000 Lab hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Lecture](#), [Laboratory](#), Comb - Lecture, Laboratory

College of Arts & Sciences College  
Chemistry Department

### **CHEM 351 - Foundations of Biochemistry**

Deals with biological structures and the interactions that confer activity upon biological molecules. Metabolism and synthesis of biological molecules, and the controls that integrate the various process at the molecular and cellular level are presented. Bioenergetics, including equilibria, catalysis, and the production/utilization of biological forms of energy, are discussed. Not open to freshman and graduate students.

4.000 Credit Hours

4.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Lecture](#)

College of Arts & Sciences College  
Chemistry Department

### **CHEM 406 - The Nature of Science**

This course examines the nature of scientific evidence, inquiry, hypotheses, models and laws. The development of science is put in the context of the structure and history of the scientific community. Interactions among scientists and between scientists and the rest of society are studied from an ethical perspective.

1.000 Credit Hours

1.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, Lecture

### **MATH 107 - Plane Trigonometry**

An elementary course in plane trigonometry. Students who have good records in high school courses including trigonometric identities, trigonometric equations, and oblique triangles should not take the course.

2.000 Credit Hours

2.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, Lecture

College of Arts & Sciences College

Mathematics Department

### **MATH 119 - Applied Calculus**

Introduction to the concepts and applications of differential and integral calculus: behavior and properties of algebraic, logarithmic and exponential functions, derivatives and rates of change, optimization and definite integral as accumulation. Emphasis on problem setup, interpretation and applications.

3.000 Credit Hours

3.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, Lecture

College of Arts & Sciences College

Mathematics Department

### **MATH 120 - Calculus I**

Calculus of functions of a single variable; differential calculus, including limits, derivatives, techniques of differentiation, the Mean Value Theorem and applications of differentiation to graphing, optimization and rates. Integral calculus, including indefinite integrals, the definite integral, the Fundamental Theorem of Integral Calculus, and applications of integration to area and volume.

4.000 Credit Hours

4.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, Lecture

College of Arts & Sciences College

Mathematics Department

### **Course Attributes:**

Gen Ed Quantve Reasoning

Ed Disciplines-Nat Science

### **ESSC 110 - The Dynamic Earth System**

An introduction to the earth system and its components. Utilizes the scientific method to address composition of the earth system, fundamental processes within the earth system, and linkages between all components of the system. Includes consideration of how humans impact, and are impacted by, the earth system. Lecture: three hours per week; Laboratory; on two-hour period per week.

0.000 OR 4.000 Credit Hours

0.000 OR 4.000 Lecture hours

0.000 Lab hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Lecture](#), [Laboratory](#), Comb - Lecture, Laboratory

College of Arts & Sciences College  
Geography & Geology Department

**Course Attributes:**

Gen Ed Disciplines-Nat Science

### **ESSC 111 - The Earth System Through Time**

The origin, development and succession of earth materials, surface and life forms, culminating in one present scene and organic population. Field trips and reports may be required. Required for geology and earth science majors and minors. Lectures: three hours per week. Laboratory: one two-hour period per week.

0.000 OR 4.000 Credit Hours

0.000 OR 4.000 Lecture hours

0.000 Lab hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Lecture](#), [Laboratory](#), Comb - Lecture, Laboratory

College of Arts & Sciences College  
Geography & Geology Department

### **PHY 221 - Mechanics, Sound & Heat**

The first course of an introductory two course sequence in college-level physics. Topics include particle motion, Newton's laws of motion, conservation laws, gravitation, rotation, harmonic motion, sound, and thermodynamics. Laboratory: two consecutive hours, one day per week. All physics majors, minors, and pre-engineers must elect PHY223.

0.000 OR 4.000 Credit Hours

0.000 OR 4.000 Lecture hours

0.000 Lab hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Lecture](#), [Laboratory](#), Comb - Lecture, Laboratory

College of Arts & Sciences College  
Physics and Astronomy Department

**Course Attributes:**

Gen Ed Disciplines-Nat Science

### **PHY 222 - Electricity & Light**

A continuation of PHY221. Topics include electrostatics, fields, potentials, current, magnetism, DC and AC circuits, and geometrical and physical optics. Laboratory: two consecutive hours, one day per week. All physics majors, minors, and pre-engineers must elect PHY224.

0.000 OR 4.000 Credit Hours  
0.000 OR 4.000 Lecture hours  
0.000 Lab hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Lecture](#), [Laboratory](#), Comb - Lecture, Laboratory

College of Arts & Sciences College  
Physics and Astronomy Department

### **PHY 372 - Modern Physics Lab**

A laboratory course providing experimental studies in such areas as late classical, relativistic, quantum, and nuclear physics. Three hours of laboratory per week.

1.000 Credit Hours  
1.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, Lecture, [Laboratory](#), Comb - Lecture, Laboratory

College of Arts & Sciences College  
Physics and Astronomy Department

### **PHY 406 - Ethical Issues in Physics**

Ethical issues that a career physicist may encounter are studied and discussed. Historical accounts and essays are used to illustrate potential ethical conflicts associated with interactions within the scientific community as well as interactions between the scientific community and society at large.

1.000 Credit Hours  
1.000 Lecture hours

**Levels:** Undergraduate

**Schedule Types:** Distance Ed, Fully Online Lec, Distance Ed, Fully Online Lab, Dist Ed, Fully Online Lec/Lab, Web-Enhanced Lab, Web-Enhanced Lecture, Web Enhanced Lecture/Lab, Hybrid Lab & Online, Hybrid Lecture & Online, Hybrid Lecture/Lab & Online, [Lecture](#)

College of Arts & Sciences College  
Physics and Astronomy Department

### **Course Attributes:**

Approved for Graduate Credit

### **Sequence of Coursework:**

### **Physical Science Comprehensive Major**

A comprehensive secondary physical science endorsement prepares candidates to teach physical science courses as identified in the Michigan Curriculum Framework. A minor is not required in this comprehensive group major. The preparation of physical science teachers includes courses in all the major categories of science with a strong focus on basic chemistry and physics. Candidates who apply for the secondary physical science endorsement must pass the Michigan Test for Teacher Certification in physical science (DP).

Required Physical Science courses

54/55 hrs

- |   |       |
|---|-------|
| 1) CHEM 121/122 General Chemistry I and Lab         | 4 hrs |
| 2) CHEM 123/124 General Chemistry II and Lab        | 4 hrs |
| 3) CHEM 270/271 Survey of Organic Chemistry and Lab | 5 hrs |
| 4) CHEM 281 Quantitative Analysis                   | 4 hrs |
| 5) CHEM 351 Foundations of Biochemistry             | 4 hrs |

- 6) CHEM 406 The Nature of Science  
or PHY 406 Ethical Issues in Physics 1 hr
- 7) PHY 221 Mechanics, Sound, and Heat 4 hrs
- 8) PHY 222 Electricity and Light 4 hrs
- 9) PSCI 270 Relativity, Atomic and Nuclear Physics 3 hrs
- 10) PHY 372 Modern Physics Laboratory 1 hr
- 11) PSCI 305 Energy and Society 3 hrs
- 12) PSCI 309 Thermal Science and Heat Transfer 3 hrs
- 13) PSCI 340 Milestones in Physics and Astronomy 3 hrs
- 14) ESSC 110 The Dynamic Earth System 4 hrs
- 15) ASTR 205 Principles of Astronomy 4 hrs
- 16) ASTR 315 Observational Astronomy OR  
ESSC 111 The Earth System Through Time 3/4 hrs

#### Additional Requirements

- 1) Life Sciences course 4 hrs  
BIOL 105 Introductory Biology for non-majors 4 hrs
- 2) Mathematics course(s) 4-5 hrs  
(MATH 119 Applied Calculus AND 3 + 2 hrs  
MATH 107 Plane Trigonometry)  
OR  
MATH 120 Calculus I 4 hrs

#### Professional Studies (in addition to the normal requirements)

- Under: Phase II Content Methods, Literacy and Technology  
PHY 325 Methods of Teaching the Physical Sciences 3 hrs

#### Physical Science Group major

A secondary physical science endorsement prepares candidates to teach physical science courses as identified in the Michigan Curriculum Framework. The preparation of physical science teachers includes courses in the all major categories of science with a strong focus on basic chemistry and physics. Coupling this group major with a minor in one of the sciences (biology, chemistry, earth science or physics), as required, additionally qualifies a student to apply for certification in that subject at the secondary level. Candidates who apply for the secondary physical science endorsement must pass the Michigan Test for Teacher Certification in physical science (DP).

Option 1: With a Physics teaching minor (PHYT - 21 hrs), complete the following courses,

- |   |           |    |
|---|-----------|----|
| Required Physical Science courses   | 36/37 hrs | 1) |
| CHEM 121/122 General Chemistry I and Lab  | 4 hrs     |    |
| 2) CHEM 123/124 General Chemistry II and Lab                                      | 4 hrs     |    |
| 3) CHEM 270/271 Survey of Organic Chemistry and Lab                               | 5 hrs     |    |
| 4) CHEM 281 Quantitative Analysis   | 4 hrs     |    |
| 5) CHEM 351 Foundations of Biochemistry   | 4 hrs     |    |
| 6) CHEM 406 The Nature of Science<br>or PHY 406 Ethical Issues in Physics         | 1 hr      |    |
| 7) PSCI 340 Milestones in Physics and Astronomy                                   | 3 hrs     |    |
| 8) ESSC 110 The Dynamic Earth System  | 4 hrs     |    |
| 9) ASTR 205 Principles of Astronomy   | 4 hrs     |    |
| 10) ASTR 315 Observational Astronomy OR<br>ESSC 111 The Earth System Through Time | 3/4 hrs   |    |

Additional Requirements

- |  |           |         |
|--|-----------|---------|
| 1) Life Sciences course                      |           | 4 hrs   |
| BIOL 105 Introductory Biology for non-majors | 4 hrs     |         |
| 2) Mathematics course(s)                     |           | 4-5 hrs |
| (MATH 119 Applied Calculus AND               | 3 + 2 hrs |         |
| MATH 107 Plane Trigonometry)                 |           |         |
| OR   |           |         |
| MATH 120 Calculus I                          | 4 hrs     |         |

Professional Studies (in addition to the normal requirements)

- |  |  |       |
|--|--|-------|
| Under: Phase II Content Methods, Literacy and Technology |  |       |
| PHY 325 Methods of Teaching the Physical Sciences        |  | 3 hrs |

Option 2: With a Chemistry teaching minor (CHMT - 24 hrs), complete the following courses,

Required Physical Science courses 37 hrs

- |  |       |
|--|-------|
| 1) PHY 221 Mechanics, Sound, and Heat              | 4 hrs |
| 2) PHY 222 Electricity and Light                   | 4 hrs |
| 3) PSCI 270 Relativity, Atomic and Nuclear Physics | 3 hrs |
| 4) PHY 372 Modern Physics Laboratory               | 1 hr  |
| 5) PSCI 305 Energy and Society                     | 3 hrs |
| 6) PSCI 309 Thermal Science and Heat Transfer      | 3 hrs |
| 7) PSCI 340 Milestones in Physics and Astronomy    | 3 hr  |
| 8) CHEM 406 The Nature of Science                  |       |
| or PHY 406 Ethical Issues in Physics               | 1 hr  |
| 9) ESSC 110 The Dynamic Earth System               | 4 hrs |
| 10) ESSC 111 The Earth System Through Time         | 4 hrs |
| 11) ASTR 205 Principles of Astronomy               | 4 hrs |
| 12) ASTR 315 Observational Astronomy               | 3 hrs |

Additional Requirements

- |  |           |         |
|--|-----------|---------|
| 1) Life Sciences course                      |           | 4 hrs   |
| BIOL 105 Introductory Biology for non-majors | 4 hrs     |         |
| 2) Mathematics course(s)                     |           | 4-5 hrs |
| (MATH 119 Applied Calculus AND               | 3 + 2 hrs |         |
| MATH 107 Plane Trigonometry)                 |           |         |
| OR   |           |         |
| MATH 120 Calculus I                          | 4 hrs     |         |

Professional Studies (in addition to the normal requirements)

- |  |  |       |
|--|--|-------|
| Under: Phase II Content Methods, Literacy and Technology |  |       |
| PHY 325 Methods of Teaching the Physical Sciences        |  | 3 hrs |

Option 3: With a Biology teaching minor (BIOT - 24 hrs), complete the following courses,

Required Physical Science courses 39 hrs

- |   |       |
|---|-------|
| 1) CHEM 121/122 General Chemistry I and Lab         | 4 hrs |
| 2) CHEM 123/124 General Chemistry II and Lab        | 4 hrs |
| 3) CHEM 270/271 Survey of Organic Chemistry and Lab | 5 hrs |
| 4) CHEM 281 Quantitative Analysis                   | 4 hrs |

- 5) CHEM 406 The Nature of Science  
or PHY 406 Ethical Issues in Physics 1 hr
- 6) PHY 221 Mechanics, Sound, and Heat 4 hrs
- 7) PHY 222 Electricity and Light 4 hrs
- 8) PSCI 270 Relativity, Atomic and Nuclear Physics 3 hrs
- 9) PHY 372 Modern Physics Laboratory 1 hr
- 10) PSCI 305 Energy and Society 3 hrs
- 11) PSCI 309 Thermal Science and Heat Transfer 3 hrs
- 12) PSCI 340 Milestones in Physics and Astronomy 3 hrs

Additional Requirements

- 1) Mathematics course(s) 4-5 hrs
  - (MATH 119 Applied Calculus AND 3 + 2 hrs  
MATH 107 Plane Trigonometry)
  - OR MATH 120 Calculus I 4 hrs

Professional Studies (in addition to the normal requirements)

- Under: Phase II Content Methods, Literacy and Technology  
PHY 325 Methods of Teaching the Physical Sciences 3 hrs

Option 4: With an Earth Science teaching minor (ESCT - 21 hrs), complete the following courses,

Required Physical Science courses 43 hrs

- 1) CHEM 121/122 General Chemistry I and Lab 4 hrs
- 2) CHEM 123/124 General Chemistry II and Lab 4 hrs
- 3) CHEM 270/271 Survey of Organic Chemistry and Lab 5 hrs
- 4) CHEM 281 Quantitative Analysis 4 hrs
- 6) CHEM 351 Foundations of Biochemistry 4 hrs
- 7) CHEM 406 The Nature of Science  
or PHY 406 Ethical Issues in Physics 1 hr
- 8) PHY 221 Mechanics, Sound, and Heat 4 hrs
- 9) PHY 222 Electricity and Light 4 hrs
- 10) PSCI 270 Relativity, Atomic and Nuclear Physics 3 hrs
- 11) PHY 372 Modern Physics Laboratory 1 hr
- 12) PSCI 305 Energy and Society 3 hrs
- 13) PSCI 309 Thermal Science and Heat Transfer 3 hrs
- 14) PSCI 340 Milestones in Physics and Astronomy 3 hrs

Additional Requirements

- 1) Life Sciences course 4 hrs
  - BIOL 105 Introductory Biology for non-majors 4 hrs
- 2) Mathematics course(s) 4-5 hrs
  - (MATH 119 Applied Calculus AND 3 + 2 hrs  
MATH 107 Plane Trigonometry)
  - OR
  - MATH 120 Calculus I 4 hrs

Professional Studies (in addition to the normal requirements)

- Under: Phase II Content Methods, Literacy and Technology  
PHY 325 Methods of Teaching the Physical Sciences 3 hrs

## Physical Science Minor

Successful completion of this minor, in the context of other science program requirements, qualifies the student for recommendation for endorsement in physical science at the secondary level. This minor **must** be combined with a secondary teaching major in either Chemistry or Physics. A secondary physical science endorsement prepares candidates to teach physical science courses as identified in the Michigan Curriculum Framework. Candidates who apply for the secondary physical science endorsement must pass the Michigan Test for Teacher Certification in physical science (DP).

With a Physics teaching major (PHYT), complete the following 24 hrs

- 1) CHEM 121/122 General Chemistry I and Lab 4 hrs
- 2) CHEM 123/124 General Chemistry II and Lab 4 hrs
- 3) CHEM 270/271 Survey of Organic Chemistry and Lab 5 hrs
- 4) CHEM 281 Quantitative Analysis 4 hrs
- 5) CHEM 351 Foundations of Biochemistry 4 hrs
- 6) PSCI 340 Milestones in Physics and Astronomy 3 hrs

With a Chemistry teaching major (CHMT), complete the following 26-27 hrs

- 1) PHY 223 Mechanics and Sound 5 hrs
- 2) PHY 222 Electricity and Light 4/5 hrs  
or PHY 224 Electricity and Light
- 3) PSCI 270 Relativity, Atomic and Nuclear Physics 3 hrs
- 4) PHY 372 Modern Physics Laboratory 1 hrs
- 5) PSCI 305 Energy and Society 3 hrs
- 6) PSCI 309 Thermal Science and Heat Transfer 3 hrs
- 7) PSCI 340 Milestones in Physics and Astronomy 3 hrs
- 8) ASTR 205 Principles of Astronomy 4 hrs

A recommended course sequence would have the student begin with their math requirements so they can take their beginning physics courses. Physics and math form a foundation for studying all the other sciences and are recommended before taking chemistry which, in turn, is recommended before biology or the earth/space sciences. However, due to scheduling constraints, students would be advised to take the courses as scheduling allows so as not to delay their graduation. Prerequisites, of course, would be enforced. Course numbers within a department, with few exceptions, indicate recommended sequencing, hierarchy of knowledge, and order of difficulty. As one progresses in each sequence, the material is by nature cumulative and increasingly integrated, e.g. principles of physics are applied in chemistry and earth science and astronomy, as are principles of chemistry and physics in the life sciences.

Following is the professional Studies program in the College of Education.

## Professional Studies (39 hours)

### Pre-admission phase: The Learner and the Community (8 hrs)

EDPS 322 Human Development and Learning (4 hrs)

FETE 201 Field Experience I (1 hr)

SPGN 251 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 hrs)

SOFD 328 Schools in a Multicultural Society (3 hrs)

CURR 305 Curriculum and Methods: Secondary (3 hrs)

FETE 302 Field Experience II: Secondary (1 hr)

EDPS 340 Introduction to Assessment and Evaluation (3 hrs)

### Phase II: Content Methods, Literacy and Technology (9 hrs)

RDNG 311 Teaching Reading in the Secondary School (3 hrs)

FETE 402 Field Experience III: Secondary (1 hr)

EDMT 330 Instructional Applications of Media and Technology (2 hrs)

PHY 325 Methods of Teaching the Physical Sciences (3 hrs) or BIOL 403 Methods and Materials for Teaching Biology or ESSC 347 Teaching Earth Science and Physical Geography or PHY 325 Methods of Teaching Chemistry

**Phase III: Capstone Experience (12 hrs)**

EDUC 492 Student Teaching (12 hrs)