

# PHYSICS

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## BACCALAUREATE DEGREES

Bachelor of Science, Major in Physics  
Bachelor of Science in Education, Major in Physics  
Bachelor of Science in Education, Major in  
Physical Science

## Pre-Engineering Programs and Five Year (3,2) Cooperative Programs

The Department of Physics offers pre-professional work in mechanical engineering, electrical engineering, engineering physics, agricultural engineering, aeronautical engineering, general engineering, and industrial engineering. Details concerning these programs can be obtained from the Department of Physics.

In the same areas, five year (3, 2) programs have been established whereby students can earn a B.S. degree in physics at Pittsburg State University and a second B.S. degree, for example, in nuclear engineering at KSU.

Students majoring in physics may complete the last 34 hours of their degree at an accredited department of engineering provided a cooperative program leading to both a B.S. degree in physics and a B.S. degree in engineering has been established by both schools, see page 33.

## Special Facilities for Undergraduate and Graduate Research

In addition to on-campus laboratory facilities, the Department recently dedicated the PSU-Greenbush Astrophysical Observatory located at the Southeast Kansas Educational Service Center in Greenbush, Kansas. Its central instrument is a 61-cm Cassegrain telescope that was formerly located at the New Mexico Blue Mesa Observatory. The observatory's new location and imaging instrumentation package make it ideal for spectroscopic or observational studies of planets, comets, and asteroids. The telescope is available for majors in physical science, physics, or science education and for graduate student theses and projects.

The Department's primary research focus continues to be in areas related to condensed matter and includes a number of research opportunities in semiconductor technology, thermophotovoltaics (TPV), scanning electron microscopy (SEM), atomic force microscope (AFM), and scanning tunneling microscopy (STM).

## Bachelor of Science Degree with a Major

## in Physics

### A. General Education Component\*

	<i>Hours</i>
Basic Skills**	12
Core Courses	17
Natural Sciences**	3
Languages and Cultures	3
Fine Arts	3
Economy and Society	3
	41

\* See "General Education Degree Requirements" for details and a list of specific course requirements, page 47.

\*\* MATH 150 and PHYS 104/130 required in the professional component partially fulfill General Education requirements.

### B.1 Physics Core Curriculum

(a) Physics	22
PHYS 104/130 Engineering Physics I/Elementary Physics Laboratory I	5
PHYS 105/131 Engineering Physics II/Elementary Physics Laboratory II	5
PHYS 510 Analytical Mechanics	3
PHYS 512 Electricity and Magnetism	3
PHYS 516 Modern Physics	3
PHYS 530 Intermediate Physics Laboratory (____)	3
(b) Chemistry	10
CHEM 215/216 General Chemistry/Laboratory	5
CHEM 225/226 General Chemistry and Qualitative Analysis/Lab- oratory	5
(c) Mathematics	16
MATH 150 Calculus I	5
MATH 155 Calculus II	5
MATH 253 Calculus III	3
MATH 553 Differential Equations	3
	48

### B.2 Emphasis Areas

1. Professional Sequence (for students preparing for Graduate Study)	18
PHYS 500 Mathematical Physics	3
PHYS 518 Physical Optics	3
PHYS 716 Introductory Quantum Mechanics	3
PHYS 714 Statistical Thermodynamics	3
Two additional physics courses with departmental approval	6
2. Applied Sequence - Emphasis in Computational Physics	29
CSIS 240 C++ Programming	3
CSIS 250 Principles of Software Design	3
PHYS 500 Mathematical Physics	3
PHYS 502 Computational Physics	3
MATH 212 Matrix Algebra	2
MATH 569 Numerical Analysis I	3
Four additional physics courses with departmental approval	12
3. Applied Sequence - Emphasis in Polymer Physics	26
PET 180/185 General Plastics/Laboratory	4
CHEM 325/326 Organic Chemistry I/Laboratory	5
CHEM 620/621 Polymer Chemistry/Laboratory	5
PHYS 714 Statistical Thermodynamics	3
PHYS 750 Surface Physics	3
Two additional physics courses with departmental approval	6
4. Applied Sequence - Emphasis in Pre-Medical Studies	35
CHEM 325/326 Organic Chemistry I/Laboratory	5
CHEM 335/336 Organic Chemistry II/Laboratory	5
BIOL 105/205 Pre-Med Orientation I	1
BIOL 215 General Zoology	4
BIOL 311 Cell Biology	3
BIOL 371/372 General Microbiology/Laboratory	5
Four additional physics courses with departmental approval	12
5. Applied Sequence - Emphasis in Solid State Electronic Devices	18
PHYS 502 Computational Physics	3
PHYS 504 Solid State Electronic Devices	3
PHYS 532 Electronic Circuits I	3
PHYS 533 Electronic Circuits II	3
PHYS 716 Introductory Quantum Mechanics	3
PHYS 742 Solid State Physics	3
6. Applied Sequence - Emphasis in Surface Physics	18
PHYS 504 Solid State Electronic Devices	3
PHYS 532 Electronic Circuits I	3
PHYS 742 Solid State Physics	3
PHYS 744 X-Rays	3
PHYS 750 Surface Physics	3
PHYS 754 Vacuum Systems and Thin Films	3
7. Applied Sequence - Customized Emphasis	18
Six additional courses selected with approval of the department from physics, chemistry or technology as appropriate to student's career plans.	

### C. Minor Requirements

A minor consists of 20 hours of course work in a field different from the major field of study. Physics students customarily minor in chemistry or mathematics, but may want to select other minors as a way to improve employment options.

# Bachelor of Science in Education Degree with a Major in Physics

## A. General Education Component

(Courses underlined are general education core curriculum courses. A 2.75 GPA is required on the 36 hour general education core curriculum for admission to teacher education.)

	Hours
Basic Skills .....	10
ENGL 101 <u>English Composition*</u> .....	3
ENGL 103 <u>English Composition* or</u>	
ENGL 299 <u>Introduction to Research Writing*</u> .....	3
COMM 207 <u>Speech Communication*</u> .....	3
MATH 113* (satisfied by MATH 150 and 155 requirement	
listed in content area) .....	0
CSIS (satisfied by CSIS 121 or 225 requirement	
listed in content area) .....	0
HPER 150 <u>Lifetime Fitness Concepts</u> .....	1

\*Must have a grade of "C" or better in each of the basic skills courses.

Core Courses .....	17
ENGL 113 <u>General Literature**</u> .....	3
HIST 201 <u>American History or</u>	
HIST 202 <u>American History</u> .....	3
PSYCH 155 <u>General Psychology</u> .....	3
SOSCI 100 <u>Introduction to Sociology***</u> .....	3
SOSCI 101 <u>American Government***</u> .....	3
GT 190 <u>Introduction to Technological Systems</u> .....	2

Natural Sciences**** .....	0
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Languages and Cultures (choose one) .....	3
FLANG 124 <u>French I</u> .....	5
FLANG 134 <u>German I</u> .....	5
FLANG 154 <u>Spanish I</u> .....	5
SOSCI 103 <u>Basic Philosophy</u> .....	3
SOSCI 105 <u>Ethics</u> .....	3
SOSCI 106 <u>World Regional Geography I***</u> .....	3
SOSCI 107 <u>World Regional Geography II***</u> .....	3
WOMEN 200 <u>Introduction to Women in Society</u> .....	3
WOMEN 299 <u>Issues in Women's Studies</u> .....	3

Fine Arts (choose one) .....	3
ART 102 <u>Introduction to Art Concepts ( )**</u> .....	3
ART 103 <u>Introduction to Art Studio ( )</u> .....	3
COMM 105 <u>Performance Appreciation**</u> .....	3
COMM 205 <u>Performance Studies I</u> .....	3
MUSIC 120 <u>Music Appreciation ( )**</u> .....	3

Economy and Society (choose one) .....	3
ACCTG 201 <u>Financial Accounting</u> .....	3
ECON 191 <u>Issues in Today's Economy</u> .....	3
FCS 230 <u>Consumer Education</u> .....	3
MGMKT 101 <u>Introduction to Business</u> .....	3

TOTAL GENERAL EDUCATION REQUIREMENTS .....	36
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\*\*One of these courses (ART 102, ENGL 113, COMM 105, MUSIC 120) is required for general education core curriculum GPA calculation.

\*\*\*Two of these courses (SOSCI 100, SOSCI 101, SOSCI 106 or SOSCI 107) are required for general education core curriculum GPA calculation.

\*\*\*\*Natural Sciences satisfied by BIOL 111/112 and PHYS 104/130 courses listed in content area.

## B. Professional Studies Component

In addition to the professional education courses listed in (1) below, the student must complete the courses for the teaching specialty listed in (2).

1. Teaching and Learning Theory with Laboratory and Clinical Experience .....	2
CURIN 305 <u>Explorations in Education***</u> .....	2
CURIN 306 <u>Pre-Professional Laboratory I***</u> .....	1
PSYCH 263 <u>Developmental Psychology</u> .....	3
PSYCH 357 <u>Educational Psychology</u> .....	3
PHYS 479 <u>Techniques for Teaching Physics</u> .....	3
SLS 510 <u>Overview of Education for Exceptional Students</u> .....	3
CURIN 520 <u>Middle and Secondary Reading</u> .....	3

Professional Semester .....	17
CURIN 458 <u>Methods and Curriculum</u> .....	3
CURIN 462 <u>Secondary and Middle Level Education</u> .....	2
CURIN 464 <u>Foundations of Measurement and Evaluation</u> .....	2
CURIN 480 <u>Supervised Teaching in the Secondary School</u> .....	3
CURIN 482 <u>Supervised Teaching in the Secondary School</u> .....	5
PHYS 579 <u>Supervised Student Teaching and Follow-Up of Teachers</u> .....	2

\*\*\* Concurrent enrollment required in CURIN 305 and 306.

### 2. Content for the Teaching Specialty: Physics

(a) Physics .....	30
PHYS 104/130 <u>Engineering Physics I/Elementary Physics</u>	
Laboratory I .....	5
PHYS 105/131 <u>Engineering Physics II/Elementary Physics</u>	

Laboratory II .....	5
PHYS 175 <u>Descriptive Astronomy or</u>	
PHYS 575 <u>Introductory Astrophysics</u> .....	3
PHYS 516 <u>Modern Physics</u> .....	3
PHYS 530 <u>Intermediate Physics Laboratory ( )</u> .....	3
PHYS 532 <u>Electronic Circuits I</u> .....	3
PHYS 569 <u>Laboratory Assistant Practicum</u> .....	2
PHYS 781 <u>Principles of Technology Methods I</u> .....	3
PHYS 782 <u>Principles of Technology Methods II</u> .....	3
(b) Chemistry .....	10
CHEM 215/216 <u>General Chemistry/Laboratory</u> .....	5
CHEM 225/226 <u>General Chemistry and Qualitative</u>	
<u>Analysis/Laboratory</u> .....	5
(c) Mathematics .....	10
MATH 150 <u>Calculus I</u> .....	5
MATH 155 <u>Calculus II</u> .....	5
(d) BIOL 111/112 <u>General Biology/Laboratory</u> .....	5
(e) CSIS 121 <u>Programming in BASIC or</u>	
CSIS 225 <u>Computer Applications for Science and Technology</u> .....	3
(f) PHYS 160 <u>Physical Geology</u> .....	3
	61

Students planning to teach should become familiar with the current regulations for certification of school personnel prepared by the State Board of Education. Information concerning these regulations may be obtained from the Director of Teacher Education, 117 Hughes Hall, Pittsburg State University.

# Bachelor of Science in Education Degree with a Major in Physical Science

## A. General Education Component

(Courses underlined are general education core curriculum courses. A 2.75 GPA is required on the 36 hour general education core curriculum for admission to teacher education.)

	Hours
Basic Skills .....	10
ENGL 101 <u>English Composition*</u> .....	3
ENGL 103 <u>English Composition* or</u>	
ENGL 299 <u>Introduction to Research Writing*</u> .....	3
COMM 207 <u>Speech Communication*</u> .....	3
MATH 113* (satisfied by MATH 150 and 155 requirement	
listed in content area) .....	0
CSIS (satisfied by CSIS 121 requirement listed	
in content area) .....	0
HPER 150 <u>Lifetime Fitness Concepts</u> .....	1

\*Must have a grade of "C" or better in each of the basic skills courses.

Core Courses .....	17
ENGL 113 <u>General Literature**</u> .....	3
HIST 201 <u>American History or</u>	
HIST 202 <u>American History</u> .....	3
PSYCH 155 <u>General Psychology</u> .....	3
SOSCI 100 <u>Introduction to Sociology***</u> .....	3
SOSCI 101 <u>American Government***</u> .....	3
GT 190 <u>Introduction to Technological Systems</u> .....	2

Natural Sciences (one course must include a laboratory) .....	3
BIOL 111 <u>General Biology</u> .....	3
<u>and</u>	
PHYS 171 <u>Physical Science****</u> .....	0
PHYS 172 <u>Physical Science Laboratory****</u> .....	0

Languages and Cultures (choose one) .....	3
FLANG 124 <u>French I</u> .....	5
FLANG 134 <u>German I</u> .....	5
FLANG 154 <u>Spanish I</u> .....	5
SOSCI 103 <u>Basic Philosophy</u> .....	3
SOSCI 105 <u>Ethics</u> .....	3
SOSCI 106 <u>World Regional Geography I***</u> .....	3
SOSCI 107 <u>World Regional Geography II***</u> .....	3
WOMEN 200 <u>Introduction to Women in Society</u> .....	3
WOMEN 299 <u>Issues in Women's Studies</u> .....	3

Fine Arts (choose one) .....	3
ART 102 <u>Introduction to Art Concepts ( )**</u> .....	3
ART 103 <u>Introduction to Art Studio ( )</u> .....	3
COMM 105 <u>Performance Appreciation**</u> .....	3
COMM 205 <u>Performance Studies I</u> .....	3
MUSIC 120 <u>Music Appreciation ( )**</u> .....	3

Economy and Society (choose one) .....	3
ACCTG 201 <u>Financial Accounting</u> .....	3

ECON 191 Issues in Today's Economy.....	3
FCS 230 Consumer Education.....	3
MGMKT 101 Introduction to Business .....	3

TOTAL GENERAL EDUCATION REQUIREMENTS.....39

\*\*One of these courses (ART 102, ENGL 113, COMM 105, MUSIC 120) is required for general education core curriculum GPA calculation.

\*\*\*Two of these courses (SOSCI 100, SOSCI 101, SOSCI 106 or SOSCI 107) are required for general education core curriculum GPA calculation.

\*\*\*\*PHYS 171/172 satisfied by PHYS 104/130 courses listed in content area.

B. Professional Studies Component

In addition to the professional education courses listed in (1) below, the student must complete the courses for the teaching specialty listed in (2).

1. Teaching and Learning Theory with Laboratory and Clinical Experience	
CURIN 305 Explorations in Education***.....	2
CURIN 306 Pre-Professional Laboratory I****.....	1
PSYCH 263 Developmental Psychology.....	3
PSYCH 357 Educational Psychology.....	3
PHYS 479 Techniques for Teaching Physics.....	3
SSLS 510 Overview of Education for Exceptional Students.....	3
CURIN 520 Middle and Secondary Reading.....	3
Professional Semester.....	17
CURIN 458 Methods and Curriculum.....	3
CURIN 462 Secondary and Middle Level Education.....	2
CURIN 464 Foundations of Measurement and Evaluation .....	2
CURIN 480 Supervised Teaching in the Secondary School.....	3
CURIN 482 Supervised Teaching in the Secondary School.....	5
PHYS 579 Supervised Student Teaching and Follow-Up of Teachers.....	2
	35

\*\*\* Concurrent enrollment required in CURIN 305 and 306.

2. Content for the Teaching Specialty: Physical Science	
(a) Physics.....	30
PHYS 104/130 Engineering Physics I/Elementary Physics Laboratory I.....	5
PHYS 105/131 Engineering Physics II/Elementary Physics Laboratory II.....	5
PHYS 160/165 Physical Geology/Laboratory.....	5
PHYS 162 Physical Oceanography.....	3
PHYS 166 Meteorology.....	3
PHYS 516 Modern Physics.....	3
PHYS 530 Intermediate Physics Laboratory (____) or.....	3
PHYS 532 Electronic Circuits I.....	3
PHYS 175 Descriptive Astronomy or.....	3
PHYS 575 Introductory Astrophysics .....	3
(b) Chemistry.....	15
CHEM 215/216 General Chemistry/Laboratory .....	5
CHEM 225/226 General Chemistry and Qualitative Analysis/Laboratory.....	5
CHEM 320/326 Introductory Organic Chemistry/Laboratory .....	5
(c) Mathematics.....	10
MATH 150 Calculus I.....	5
MATH 155 Calculus II.....	5
(d) CSIS 121 Programming in BASIC.....	3
	58

(NOTE: The general education degree requirement in biological science for students wishing to certify for a second teaching option in physical science must be met with BIOL 111/112 General Biology/Laboratory.)

Students planning to teach should become familiar with the current regulations for certification of school personnel prepared by the State Board of Education. Information concerning these regulations may be obtained from the Certification Officer in the College of Education, 115 Hughes Hall.

(NOTE: No courses shall be counted toward science certification other than those offered in a science department, e.g., biology, botany, zoology, chemistry, physics, geology, etc.)

C. Minor Requirements

Students preparing to teach physics or physical science should select a minor.

Minor in Physics

PHYS 104Engineering Physics I.....	4
PHYS 130Elementary Physics Laboratory I .....	1
PHYS 105Engineering Physics II .....	4
PHYS 131Elementary Physics Laboratory II.....	1
PHYS 516Modern Physics.....	3
Electives in physics* .....	9
	22

This minor does not qualify students for certification to teach physics. Students interested in physics as a second teaching option should refer to section below, "Second Teaching Options."

\*The following courses cannot be used to satisfy electives in physics: PHYS 160/165 Physical Geology/Laboratory, PHYS 162 Physical Oceanography, PHYS 166 Meteorology, PHYS 171/172 Physical Science/Laboratory, PHYS 260 Historical Geology, PHYS 264 Environmental Geology, PHYS 371 The Physical World, PHYS 479 Techniques for Teaching Physics, PHYS 542 Topics in Earth Science (\_\_\_\_), PHYS 560 Field Studies in Earth and Space Science, PHYS 741 Special Topics (\_\_\_\_), PHYS 781 Principles of Technology Methods I, PHYS 782 Principles of Technology Methods II, PHYS 785 Principles of Technology Methods III and PHYS 579 Supervised Student Teaching and Follow-up of Teachers.

Minor in Physical Science

Twenty hours selected from both physics\* and chemistry. This minor does not qualify students for certification to teach physical science. Students interested in physical science as a second teaching option should refer to section below, "Second Teaching Options." The physical science minor is not available to students who major in physics or chemistry.

\*The following courses in physics cannot be applied toward the physical science minor: PHYS 001 Physics Concepts, PHYS 171/172 Physical Science/Laboratory, PHYS 371 The Physical World, PHYS 479 Techniques for Teaching Physics, PHYS 569 Laboratory Assistant Practicum, PHYS 579 Supervised Student Teaching and Follow-up of Teachers and all 700 level courses.

Second Teaching Options

Those persons interested in physics, physical science, earth and space science, or principles of technology as a second teaching option should contact the chairperson of the Department of Physics or the Certification Officer in the College of Education, 115 Hughes Hall, for specific requirements.

GRADUATE DEGREES

Master of Science

The M.S. degree program in physics consists of a core of three courses, PHYS 810 Classical Mechanics, PHYS 812 Electromagnetic Theory, and PHYS 816 Quantum Mechanics, plus electives appropriate to the student's plans for employment in physics or related fields, further graduate study, or teaching physics or the physical sciences.

Elective courses, subject to approval of the department, are usually selected from physics, chemistry, mathematics, or biology. Qualifying examinations on undergraduate physics are required no later than the first semester of enrollment without deficiencies.

## Option I

### Professional Physics Emphasis

For students preparing for further graduate study or for physics or physics-related employment. Thirty semester hours, including 6 hours PHYS 890 Research and Thesis, are required. Concentration on a selected physics or interdisciplinary specialty is possible through a combination of listed courses and PHYS 890 Research and Thesis, which may cover areas as diverse as solid state chemistry, materials science, surface physics, or radiation effects.

## Option II

### Applied Physics Emphasis

For students preparing for physics or physics-related employment. Thirty-two semester hours, including three to six hours PHYS 891 Research Problem, are required.

### Teaching Emphasis

For students preparing to teach physics or physical science at high school or junior college level. Elective courses may include up to nine hours professional education. Thirty-two semester hours including three to six hours PHYS 891 Research Problem are required, which may substitute for one of the core courses, with department approval.

## DESCRIPTION OF COURSES

### UNDERGRADUATE

**PHYS 001. Physics Concepts.** 3 hours. A beginning course in physical science to help students prepare for a physics course sequence, either PHYS 104 Engineering Physics I/PHYS 105 Engineering Physics II or PHYS 100 College Physics I/PHYS 101 College Physics II. Offered on a Pass-Fail basis only. Not counted toward total hours required for a degree.

**PHYS 100. College Physics I.** 4 hours. Mechanics; heat; sound. Prerequisite: MATH 113 College Algebra or MATH 110 College Algebra with Review or MATH 126 Pre-Calculus. Concurrent enrollment required in PHYS 130 Elementary Physics Laboratory I. Closed to students with credit in PHYS 104 Engineering Physics I.

**PHYS 101. College Physics II.** 4 hours. Electricity; magnetism; optics. Prerequisite: PHYS 100 College Physics I. Concurrent enrollment required in PHYS 131 Elementary Physics Laboratory I. Closed to students with credit in PHYS 105 Engineering Physics II.

**PHYS 102. What's New in Physics Research.** 1 hour. Survey of current research areas in physics and related technologies with emphasis on local research activities. Recommended especially for physics and pre-engineering majors planning to take PHYS 104/105 Engineering Physics I and II.

**PHYS 104. Engineering Physics I.** 4 hours. Mechanics; heat; sound. For science, engineering, and engineering technology students. Prerequisite: MATH 150 Calculus I. Concurrent enrollment required in PHYS 130 Elementary Physics Laboratory I. Closed to students with credit in PHYS 100 College Physics I.

**PHYS 105. Engineering Physics II.** 4 hours. Electricity; magnetism; optics. For science, engineering, and engineering technology students. Prerequisite: PHYS 104 Engineering Physics I or PHYS 100 College Physics and MATH 150 Calculus I. Concurrent enrollment required in PHYS 131 Elementary Physics Laboratory II. Closed to students with credit in PHYS 101 College Physics II.

**PHYS 130. Elementary Physics Laboratory I.** 1 hour. Experiments in mechanics; heat; sound. Concurrent enrollment required in PHYS 100 College Physics I or PHYS 104 Engineering Physics I.

**PHYS 131. Elementary Physics Laboratory II.** 1 hour. Experiments in electricity; magnetism; optics. Concurrent enrollment required in PHYS 101 College Physics II or PHYS 105 Engineering Physics II.

**PHYS 160. Physical Geology.** 3 hours. Introduction to earth materials, minerals, and rock of earth's surface and interior. Dynamic geological processes including plate tectonics, volcanism and mountain building, glaciation and other gradational processes, weathering and erosion.

**PHYS 162. Physical Oceanography.** 3 hours. A descriptive study of ocean

currents and circulation, structure and composition of sea water, ocean floor morphology and sedimentation, tides, waves, and coastal processes.

**PHYS 165. Physical Geology Laboratory.** 2 hours. Examination of mineral properties and rock identification, study of landforms and structural geology, seismic data manipulation, and interpretation of geologic, aerial, and topographic maps.

**PHYS 166. Meteorology.** 3 hours. A descriptive survey of atmospheric science integrating the concepts of weather patterns, climate, atmospheric composition and structure, pressure, wind, and impact of pollution.

**PHYS 175. Descriptive Astronomy.** 3 hours. The solar system, stellar astronomy, the galaxy, cosmology.

**PHYS 220. Engineering Mechanics I-Statics.** 3 hours. Study of forces, couples, vector mathematics, rigid body equilibrium, structures, distributed forces, geometric properties, beam analysis, friction, virtual work and stability of equilibrium. Prerequisites: MECET 121 Engineering Graphics I, MATH 150 Calculus I, (or concurrent) and PHYS 104 Engineering Physics I.

**PHYS 240. Introductory Physics Topics.** 3 hours. Lecture or seminar in selected introductory topics of physics.

**PHYS 260. Historical Geology.** 5 hours. Lecture/Laboratory. Introduction to the geologic evidence of the history of life on Earth. Topics include: Geologic time, paleontology and the fossil record, stratigraphy and the major tectonic and rock-forming events. Prerequisites: PHYS 160/165 Physical Geology/Laboratory.

**PHYS 264. Environmental Geology.** 4 hours. Lecture/Laboratory. Mechanisms and consequences of natural disasters, human interaction with the environment particularly with respect to natural resource exploitation. Prerequisites: PHYS 160/165 Physical Geology/Laboratory.

**PHYS 371. The Physical World.** 5 hours. Basics of the physical sciences and their role in our daily lives. A laboratory science course. Closed to students majoring or minoring in the physical sciences or having had PHYS 171 Physical Science.

**PHYS 479. Techniques for Teaching Physics.** 3 hours. Techniques, methods, and course content used in teaching physics in the secondary school. Offered by the Department of Physics. To be taken before the professional semester. Prerequisites: Admission to teacher education and PSYCH 357 Educational Psychology.

**PHYS 500. Mathematical Physics.** 3 hours. Mathematical methods in classical and modern physics. Prerequisites: MATH 253 Calculus III and PHYS 105 Engineering Physics II. May be taken for honors.

**PHYS 502. Computational Physics.** 3 hours. Use of computational techniques in solving problems in mechanics, electricity and magnetism, electronic circuits, optics and modern physics. Prerequisites: PHYS 105 Engineering Physics II and MATH 253 Calculus III. May be taken for honors.

**PHYS 504. Solid State Electronic Devices.** 3 hours. Electronic conduction in metals and semiconductors, the pn junction, ohmic and rectifying contacts, zener diodes, tunnel diodes, bipolar transistors, multijunction devices, field effect transistors, introduction to integrated circuits. Prerequisites: PHYS 105 Engineering Physics II and MATH 253 Calculus III. May be taken for honors.

**PHYS 510. Analytical Mechanics.** 3 hours. Newtonian mechanics of particles; potential functions; central force motion; introduction to Lagrangian mechanics. Prerequisites: MATH 253 Calculus III and PHYS 105 Engineering Physics II. May be taken for honors.

**PHYS 512. Electricity and Magnetism.** 3 hours. Electrostatic and Magnetostatic fields; scalar electric potential; Laplace and Poisson equations; vector magnetic potential; vector Poisson equation; energy, force, and torque; Maxwell equations; time varying fields; propagation and reflection of EM waves. Prerequisites: MATH 253 Calculus III and PHYS 105 Engineering Physics II. May be taken for honors.

**PHYS 514. Applied Thermodynamics.** 3 hours. Heat, temperature, laws of thermodynamics and their applications. Prerequisite: PHYS 105 Engineering Physics II. May be taken for honors.

**PHYS 516. Modern Physics.** 3 hours. Relativity, atomic, nuclear, high energy, solid state physics. Prerequisites: MATH 155 Calculus II and PHYS 105 Engineering Physics II. May be taken for honors.

**PHYS 518. Physical Optics.** 3 hours. Huygen's principle; interference; diffraction; polarization and crystal optics; electromagnetic theory of light. Prerequisites: MATH 253 Calculus III and PHYS 105 Engineering Physics II. May be taken for honors.

**PHYS 522. Engineering Mechanics II--Dynamics.** 3 hours. Principles of dynamics. Particle mechanics, equations of motion, displacement, velocity, acceleration, dynamics of rigid bodies, dynamics of machines. Prerequisite: PHYS 220 Engineering Mechanics I--Statics.

**PHYS 530. Intermediate Physics Laboratory (\_\_\_\_).** 3 hours. Experiments in electricity and magnetism; thermodynamics; atomic and nuclear physics; optics. Prerequisite: PHYS 105 Engineering Physics II. May be repeated if subject matter is different each time. May be taken for honors.

**PHYS 532. Electronic Circuits I.** 3 hours. A.C., D.C. circuitry, diode and transistor theory, transistor amplifiers, amplifier and feedback circuits, oscillators, digital electronics, microprocessors. Prerequisite: PHYS 105 Engineering Physics II. May be taken for honors.

**PHYS 533. Electronic Circuits II.** 3 hours. Digital to analog and analog to digital converters, transducers and applications to computer interfacing, feed-back and

control by computers. Prerequisite: PHYS 532 Electronic Circuits I. May be taken for honors.

**PHYS 540. Topics in Physics (\_\_\_\_).** 3 hours. Lecture or seminar in specialized area of physics. Prerequisites: MATH 553 Differential Equations and PHYS 105 Engineering Physics II. May be repeated if subject matter is different. May be taken for honors.

**PHYS 542. Topics in Earth Science (\_\_\_\_).** 1-3 hours. Lecture, seminar, laboratory, and/or field studies in a specialized area of Earth Science. May be repeated if subject matter is different. Prerequisites: PHYS 160/165 Physical Geology/Laboratory.

**PHYS 560. Field Studies in Earth and Space Science.** 2-3 hours. Lecture/Laboratory. Measuring and describing orientation of rocks and their relationship to the environment. Include meteorological and astronomical measurements. Prerequisites: PHYS 160/165 Physical Geology/Laboratory.

**PHYS 569. Laboratory Assistant Practicum.** 2 hours. For students intending to teach physics or general science in secondary schools. Assisting in preparation and instruction in one of several physics or physical science laboratories. A minimum of four hours assisting per week is required. Prerequisite: Students must be enrolled in the teacher education curriculum; permission of instructor.

**PHYS 575. Introductory Astrophysics.** 3 hours. Celestial mechanics, photometry, stellar and planetary astronomy, radio and space probe astronomy. Prerequisite: PHYS 101 College Physics II or PHYS 105 Engineering Physics II. May be taken for honors.

**PHYS 579. Supervised Student Teaching and Follow-Up of Teachers.** 2 hours. Departmental representatives will visit each student teacher during the professional semester. Additionally, departmental representatives will follow up with each area student during the first year of teaching with assistance and support. Concurrent enrollment in the professional semester is required. Offered on a Pass-Fail basis only.

**PHYS 591. Physics Project.** 1-3 hours. Project in classical or modern physics. Prerequisite: Permission of instructor. May be repeated. May be taken for honors.

#### SENIOR-GRADUATE

**PHYS 714. Statistical Thermodynamics.** 3 hours. Distribution functions; statistical methods applied to radiation and matter. Prerequisite: PHYS 514 Applied Thermodynamics or CHEM 593 Physical Chemistry I.

**PHYS 716. Introductory Quantum Mechanics.** 3 hours. Atomic spectra, special theory of relativity and the origins of quantum theory. Wave mechanics, the square well, barrier potentials, harmonic oscillator, and hydrogen atom. Prerequisite: Permission of instructor. May be taken for honors.

**PHYS 730. Advanced Physics Laboratory (\_\_\_\_).** 3 hours. Experiments in: Atomic and nuclear physics; x-rays; solid state physics; electromagnetic phenomena. Prerequisite: PHYS 530 Intermediate Physics Laboratory or other junior-senior level laboratory work. May be repeated if subject matter is different each time. May be taken for honors.

**PHYS 740. Advanced Topics in Physics (\_\_\_\_).** 3 hours. Lecture or seminar in specialized areas of physics. May be repeated if subject matter is different each time. May be taken for honors.

**PHYS 741. Special Topics (\_\_\_\_).** 1-3 hours. Selected topics in the physical sciences. Primarily for education majors. May be repeated if subject matter is different.

**PHYS 742. Solid State Physics.** 3 hours. Theoretical and experimental aspects of solid state physics. Prerequisite: Permission of instructor. May be taken for honors.

**PHYS 744. X-Rays.** 3 hours. Diffraction methods for crystal structure; general scattering theory and scattering from gases, liquids, and amorphous solids. Extensions to small angle x-ray methods, light, and neutron scattering. Prerequisite: Permission of instructor. May be taken for honors.

**PHYS 746. Solar Energy.** 3 hours. Basic concepts of solar energy including theoretical and experimental aspects of photo voltaics and solar cell design. Prerequisite: Permission of instructor. May be taken for honors.

**PHYS 750. Surface Physics.** 3 hours. Fundamental principles and applications of Scanning Electron, Atomic Force, Scanning Tunneling, and Auger microscopies. Prerequisite: PHYS 516 Modern Physics.

**PHYS 754. Vacuum Systems and Thin Films.** 3 hours. Laboratory. Basic concepts of vacuum gauges and chamber design, including introduction to physical vapor deposition using thermal and electron beam sources. May be taken for honors.

**PHYS 781. Principles of Technology Methods I.** 3 hours. Strategies for teaching Principles of Technology Units 1-7 using primarily hands-on practice using actual course materials, laboratory equipment, instructional videos, and technical manuals of the selected units. Workshop format. Prerequisites: PHYS 101/131 College Physics II/Elementary Physics Laboratory II or PHYS 105/131 Engineering Physics II/Elementary Physics Laboratory II.

**PHYS 782. Principles of Technology Methods II.** 3 hours. Strategies for teaching Principles of Technology Units 8-15 using primarily hands-on practice using actual course materials, laboratory equipment, instructional videos, and technical manuals of the selected units. Workshop format. Prerequisite: PHYS 781 Principles of Technology Methods I.

**PHYS 785. Principles of Technology Methods III.** 3 hours. Review and synthesis of teaching techniques and units covered in PHYS 781 Principles of

Technology Methods I and PHYS 782 Principles of Technology Methods II with opportunity for remediation or enrichment in areas of assessed weakness. Prerequisite: PHYS 782 Principles of Technology Methods II.

#### GRADUATE

**PHYS 810. Classical Mechanics.** 3 hours. Lagrangian, Hamiltonian, and Poisson formulation of mechanics.

**PHYS 812. Electromagnetic Theory.** 3 hours. Electrostatics, magnetostatics, time-varying fields. Maxwell's equations, electromagnetic wave propagation.

**PHYS 816. Quantum Mechanics.** 3 hours. Non-relativistic quantum theory; operator formalism; perturbation and variational methods.

**PHYS 830. Graduate Physics Laboratory.** 3 hours. Selected experiments in modern physics.

**PHYS 840. Graduate Topics in Physics (\_\_\_\_).** 3 hours. Lecture or seminar in specialized areas of physics. May be repeated if subject matter is different each time.

**PHYS 881. Orientation to College Teaching.** 3 hours. Laboratory work in the classroom situation; work with instrumental aids; involvement in curriculum development, test construction, and classroom instruction.

**PHYS 890. Research and Thesis.** 1-6 hours each semester. May be repeated. No more than 6 hours applies toward the master's degree.

**PHYS 891. Research Problem.** 1-6 hours each semester. May be repeated. No more than 6 hours applies toward the master's degree.

#### GENERAL EDUCATION

These courses have no prerequisites and customarily are taken by students whose degree programs do not call for specific physics or chemistry courses.

**PHYS 171. Physical Science.** 3 hours. The principles of mechanics, electricity and magnetism, and atomic science; also the application of these principles to such topics as energy, household electricity, earth science and space science. Students needing a laboratory science should enroll concurrently in PHYS 172 Physical Science Laboratory. Closed to students majoring or minoring in the physical sciences or having had PHYS 371 The Physical World.

**PHYS 172. Physical Science Laboratory.** 2 hours. Laboratory for PHYS 171 Physical Science.