Physics, Nuclear and Electrical Engineering

Physics

Students who wish to major in physics will take courses which will prepare them for industrial or governmental positions or for graduate study in physics or allied fields.

The department offers two undergraduate degree programs as well as a minor in physics. The Bachelor of Arts and the minor are designed for students who desire a flexible program so they can develop interdisciplinary competence. The Bachelor of Science degree places greater emphasis on physics and is designed to prepare students for careers in physics or a closely allied profession. These programs consist of a set of required core courses plus a selection of courses in a particular field. The core courses include the basic physics and mathematics courses which serve as a foundation for more advanced study. A student planning to do graduate work in physics should elect to complete the Bachelor of Science in Physics.

The common objectives for students of our undergraduate programs in physics include developing: (1) broad, fundamental technical skills and knowledge, (2) strong communication skills, and (3) the capability to think critically and work independently. Each of these objectives has a “level” that is appropriate for the degree.

For the B.A. degree in physics, the technical objectives are mastery of calculus, ordinary differential equations, linear algebra, general physics, modern physics, and student-selected areas of classical mechanics, quantum mechanics, electromagnetism and methods of nuclear measurements. For the B.S. degree in physics, the technical objectives are the learning goals of the B.A. degree, plus additional hands-on research laboratory experience and further knowledge in solid-state physics, statistical physics, nuclear physics, optics and the conduct of research. The communication objectives at the B.A. and B.S. levels are writing and speaking skills that are sufficient to represent themselves and their organizations at regional or national scientific meetings. Our expectations are that these students will obtain critical thinking skills and an ability to work independently at a level that will require minimal or modest supervision of either management or a more senior scientist.

Nuclear Engineering

ISU offers a B.S. degree in Nuclear Engineering and M.S. and Ph.D. degrees in Nuclear Science and Engineering. The field of nuclear engineering involves harnessing the energy of the atomic nucleus for many productive applications, such as electricity production in nuclear power plants and medical diagnostics and treatment using radiation from the nucleus. The B.S. degree coursework plan provides for development of a strong foundation in mathematics and the physical sciences in the first few semesters. Upon this foundation are built the key components of nuclear engineering: nuclear radiation, radiation detection and measurement, reactor physics and kinetics, nuclear power production and the nuclear fuel cycle.

The B.S. degree in nuclear engineering will prepare the student for work in industry, government, and university settings in areas such as nuclear facility operations and support, reactor design and development, radioactive waste management, and nuclear security and safeguards.

Educational Objectives for the Degree Program in Nuclear Engineering

- Our graduates will be active in the nuclear industry or related fields, making contributions to its advancement, either in industry, research, or academics.
- Our graduates will have a record of accomplishment in the nuclear industry.
- Our graduates will engage in lifelong learning, keeping abreast of advancements in their fields.

Health Physics

ISU offers the A.S., B.S., and M.S. options in Health Physics. Health Physics, an applied science, is concerned with the protection of humans and their environment from the possible harmful effects of radiation while providing for its beneficial uses. Health Physics is a multi-disciplined profession that incorporates aspects of both the physical and biological sciences. The B.S. option in Health Physics will prepare the student for work in government, university, medical or industrial settings dealing with such areas as operational radiation safety, regulatory issues and environmental quality. Successful B.S. students receive a Bachelor of Science in Health Physics.

To declare a major in Health Physics, a student must have completed at least 24 semester hours and not be on probation. Declaration of major should be done as soon as possible in the student's program. For further details, please consult staff of the Department of Nuclear Engineering and Health Physics.

Accreditation

The Bachelor of Science (B.S.) and Master of Science (M.S.) programs in Health Physics are accredited by the Applied Sciences Accreditation Commission of ABET, http://www.abet.org. Students may enter the M.S. program in Health Physics from several undergraduate majors including health physics, physics, chemistry, biology, and other science or engineering majors. Additional course work to correct deficiencies may be necessary.

The Idaho State University Health Physics program is evaluated by periodically monitoring a series of programmatic outcomes which are used to indicate the extent to which our objectives are being accomplished and to provide information by which the program may be modified to optimize accomplishing these objectives.

Educational Objectives for the Degree Program in Health Physics

The objective of the Idaho State University Health Physics program is to produce Health Physicists with:

- Fundamental technical knowledge,
- Strong written and verbal communication skills,
- Well-developed professional judgment with the capability to think critically,
- Capability for solving applied health physics problems,
- The ability to work independently, and
- A thorough understanding of professional ethics

Students earning either degree in the Health Physics program must complete 8 of the 9 University General Education Objectives (a minimum of 36 credits - see the General Education Requirements (http://coursecat.isu.edu/undergraduate/academicinformation/generaleducation) described in the Academic Information section of this catalog). Some of the courses listed as degree requirements will also satisfy or partially satisfy General Education Objectives, as noted.
Electrical Engineering

General Information

Idaho State University electrical engineering graduates are successfully employed in many areas. Many have chosen to continue advanced studies in a variety of specialized engineering disciplines throughout the region and nation. Every student entering electrical engineering is assigned a faculty advisor to guarantee an appropriate plan of study and to insure continuity throughout the program. Each student completes university general education courses and electrical engineering program requirements. A student who pursues a double major should regularly consult a faculty member from each of the two major programs.

Students entering electrical engineering should have adequate preparation in algebra and trigonometry or higher to enter the calculus sequence. Students not entering at the calculus level will not be eligible to register for electrical engineering courses until meeting the mathematics requirements. This may result in a delay in graduation from the program. Other academic opportunities available include a combined MBA/BSEE degree program, as well as a BSEET degree in electrical engineering technology. Students who are interested in these degree programs should consult the Electrical Engineering Program Director for further details.

General Education Requirements

Students working toward the Bachelor of Science degree must complete 8 of the 9 General Education Objectives (a minimum of 36 credits). See the General Education Requirements in the Academic Information section of the catalog.

Fundamentals of Engineering (FE) Exam

Electrical engineering students are encouraged to take the Fundamentals of Engineering (FE) exam during their senior year, while the breadth of the engineering material covered on the examination is still fresh in their minds. This exam is considered the first step in professional licensure for engineers.

Electrical Engineering Academic Rules and Policies

A current Idaho State University electrical engineering major student who intends to transfer an engineering course to Idaho State University must obtain prior approval for the transfer either via transfer credit review (petition process) or through existing program articulation.

Transfer credits must be posted to the student’s ISU transcript prior to registering for any course that has the transfer course credits as a prerequisite or co-requisite.

To maintain “academic satisfactory progress” and avoid academic probation and/or academic dismissal, undergraduate students must maintain a cumulative Idaho State University GPA of 2.0 or higher every semester.

Accreditation

The Bachelor of Science (B.S.) program in Electrical Engineering (EE) is accredited by the Engineering Accreditation Commission of ABET, http://www.abet.org.

Educational Objectives

- **PEO1 Depth and Breadth:** Produce graduates who demonstrate broad and in-depth knowledge in the practice of, or advanced study of, electrical engineering.
- **PEO2 Career Development:** Produce graduates who will demonstrate and maintain the necessary knowledge and skills throughout their careers to solve problems in the complex modern work environment.
- **PEO3 Professionalism:** Produce graduates who demonstrate professional responsibilities.

Student Outcomes

Idaho State University’s Electrical Engineering program has the following Student Outcomes:

a. An ability to apply knowledge of mathematics, science, and engineering
b. An ability to design and conduct experiments, as well as to analyze and interpret data
c. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
d. An ability to function on multidisciplinary teams
e. An ability to identify, formulate, and solve engineering problems
f. An understanding of professional and ethical responsibility
g. An ability to communicate effectively
h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
i. A recognition of the need for, and an ability to engage in, life-long learning
j. A knowledge of contemporary issues
k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Declaring an Electrical Engineering Major

To declare an Electrical Engineering major, a student must meet with an EE faculty advisor to develop a plan of study leading to degree completion. Declaration of major should be done as soon as possible upon consultation with the program staff.

Faculty

**DEPARTMENT OF PHYSICS, NUCLEAR AND ELECTRICAL ENGINEERING**

Chair

Vacant

**PHYSICS**

Program Director and Professor


Professors


Research Professor

Associate Professors


Assistant Lecturer

Adjunct Faculty
Franckowiak, Robert
Hoskins, Anna
Millward, Steven

Affiliate Faculty
Khandaker, Mahbub
Wells, Doug

Emeriti
Cole, Philip L.,* Professor, Physics. 2004-2018

Harmon, J. Frank. Director and Research Professor, Idaho Accelerator Center; Professor, Physics. 1969-2008

Parker, Barry R. Professor, Physics. 1967-1997

NUCLEAR ENGINEERING AND HEALTH PHYSICS
Program Director and Associate Professor

Professors
Brey, Richard R.,* Associate Vice President for Academic Affairs; Transitional Director of Technical Safety; Program Director and Professor, Health Physics. B.S. 1988, M.S. 1990, Ph.D. 1994, Purdue University. (1994)


Associate Professor

Research Professors
Schultz, Richard. Research Professor, Nuclear Engineering, Ph.D. Idaho State University (2013)

Kerby, Leslie. Research Assistant Professor, Nuclear Engineering, Ph.D. University of Idaho (2015)

ELECTRICAL ENGINEERING
Program Director and Associate Professor

Associate Program Director and Professor
Mousavinezhad, Seyed Hossein,* Professor, Electrical Engineering. B.S. 1972, National Taiwan University; M.S. 1973, Ph.D. 1977, Michigan State University. (2007)

Professor

Associate Professors
Ellis, Mikle V.,* Associate Professor, Electrical Engineering. B.S. 1983, Brigham Young University; M.S. 1984, Rensselaer Polytechnic Institute; Ph.D. 1994, Virginia Polytechnic and State University. (1999)


Visiting Faculty
Baldwin, Thomas L., Visiting Professor, Electrical Engineering.

Emeritus
Naidu, Subbaram D., Associate Dean and Professor, Electrical Engineering. 1988-2014.

Bachelor of Arts in Physics
In addition to degree requirements listed below, students must satisfy 8 of the 9 General Education Objectives (a minimum of 36 credits—see the General Education Requirements (http://coursecat.isu.edu/undergraduate/academicinformation/generaleducation) in the Academic Information section of this catalog). Of the courses below, MATH 1170 will satisfy General Education Objective 3, while together, any of the lower-division PHYS choices below will partially satisfy General Education Objective 5.

MATH 1170 Calculus I 4
MATH 1175 Calculus II 4
MATH 2275 Calculus III 4
MATH 3360 Differential Equations 3
At least 24 credits of Physics, including: 24

PHYS 2211 & PHYS 2212 Engineering Physics I and Engineering Physics II 6-8
or PHYS 2211 & PHYS 2212 General Physics
or PHYS 2211 & PHYS 2212 General Physics II

PHYS 2213 & PHYS 2214 Engineering Physics I Laboratory and Engineering Physics II Laboratory 2
or PHYS 2211 & PHYS 2214 General Physics I Laboratory
or PHYS 2211 & PHYS 2214 General Physics II Laboratory

PHYS 3301 Modern Physics 3

11-13 credits of electives (depending upon the introductory sequence) 11-13
with at least 6 credits of 4000-level courses (PHYS 4492 cannot be counted toward the latter requirement).
Bachelor of Science in Physics

In addition to degree requirements below, students must satisfy 8 of the 9 General Education Objectives (a minimum of 36 credits—see the Academic Information section of this catalog). Of the courses below, MATH 1170 will satisfy General Education Objective 5, while together, the CHEM and lower-division PHYS requirements will satisfy General Education Objective 5.

Electives to bring total to 60 cr

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1111 &amp; 1111L</td>
<td>General Chemistry I and General Chemistry I Lab</td>
<td>5</td>
</tr>
<tr>
<td>CHEM 1112 &amp; 1112L</td>
<td>General Chemistry II and General Chemistry II Lab</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1170</td>
<td>Calculus I</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1175</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 2275</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 3360</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>MATH 4421 &amp; MATH 4422</td>
<td>Advanced Engineering Mathematics I and Advanced Engineering Mathematics II</td>
<td>6</td>
</tr>
<tr>
<td>or PHYS 4461 &amp; PHYS 4462</td>
<td>Introduction to Mathematical Physics I and Introduction to Mathematical Physics II</td>
<td></td>
</tr>
<tr>
<td>PHYS 2211 &amp; PHYS 2212</td>
<td>Engineering Physics I and Engineering Physics II</td>
<td>8</td>
</tr>
<tr>
<td>PHYS 2213 &amp; PHYS 2214</td>
<td>Engineering Physics I Laboratory and Engineering Physics II Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 3301</td>
<td>Modern Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 3313</td>
<td>Intermediate Laboratory I</td>
<td>2</td>
</tr>
<tr>
<td>PHYS 4403 &amp; PHYS 4404</td>
<td>Advanced Modern Physics I and Advanced Modern Physics II</td>
<td>6</td>
</tr>
<tr>
<td>PHYS 4414</td>
<td>Electronic Instrumentation and Measurement</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 4415</td>
<td>Statistical Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 4421 &amp; PHYS 4422</td>
<td>Electricity and Magnetism I and Electricity and Magnetism II</td>
<td>6</td>
</tr>
<tr>
<td>PHYS 4483</td>
<td>Theoretical Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 4492</td>
<td>Colloquium in Physics</td>
<td>1</td>
</tr>
<tr>
<td>Plus 5 additional 4000-level PHYS credits</td>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

Total Credits 60

1 The number of credits required for the General Education requirements varies depending on the student’s performance on proficiency or placement tests in English, foreign languages, and mathematics.

Bachelor of Science in Nuclear Engineering

Nuclear engineering is a field with exciting and expanding opportunities. Careers range from operating nuclear power plants to research for the future of nuclear reactor design, nuclear fuels, reprocessing and waste disposal. Other areas include space propulsion, medical treatment and homeland security applications. Job prospects in nuclear engineering are good, with opportunities as close as the Idaho National Laboratory (INL) and spanning across the U.S. and the world. Salaries for nuclear engineers are among the highest for all engineering professions. Graduates with a B.S. may start at an annual income greater than $60,000.

Students earning this degree must complete 8 of the 9 University General Education Objectives (a minimum of 36 credits - see the General Education Requirements (http://coursecat.isu.edu/undergraduate/academicinformation/generaleducation) described in the Academic Information section of this catalog).

The program of study for the Bachelor of Science in Nuclear Engineering degree totals 122 credits (minimum) as follows. Some of the required courses also satisfy or partially satisfy General Education Objectives, as noted.

<table>
<thead>
<tr>
<th>Course</th>
<th>Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 1105</td>
<td>Engineering Graphics</td>
<td>2</td>
</tr>
<tr>
<td>CE/ME 2210</td>
<td>Engineering Statics</td>
<td>3</td>
</tr>
<tr>
<td>CE/ME 2220</td>
<td>Engineering Dynamics</td>
<td>3</td>
</tr>
<tr>
<td>CE/ME 3350</td>
<td>Mechanics of Materials</td>
<td>3</td>
</tr>
<tr>
<td>CE/ME 3341</td>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>CE 3361</td>
<td>Engineering Economics and Management</td>
<td>3</td>
</tr>
<tr>
<td>CHEM 1111 &amp; 1111L</td>
<td>General Chemistry I and General Chemistry I Lab (Partially satisfies General Education Objective 5)</td>
<td>5</td>
</tr>
<tr>
<td>COMM 1101</td>
<td>Principles of Speech (Satisfies General Education Objective 2)</td>
<td>3</td>
</tr>
<tr>
<td>CS 1181</td>
<td>Computer Science and Programming I (Satisfies General Education Objective 7)</td>
<td>3</td>
</tr>
<tr>
<td>EE 2240</td>
<td>Introduction to Electrical Circuits</td>
<td>3</td>
</tr>
<tr>
<td>EE 4416</td>
<td>Applied Engineering Methods</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 1102</td>
<td>Critical Reading and Writing (Partially satisfies General Education Objective 1)</td>
<td>3</td>
</tr>
</tbody>
</table>
Bachelor of Science in Health Physics

The following courses are required in addition to completion of 8 of the 9 General Education Objectives for the B.S. degree (a minimum of 36 credits--see the General Education Requirements (http://coursecat.isu.edu/undergraduate/academicinformation/generaleducation) described in the Academic Information section of this catalog).

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 1101</td>
<td>Biology I and Biology I Lab (Partially satisfies General Education Objective 5)</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 1101L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 3301</td>
<td>Anatomy and Physiology and Anatomy and Physiology Lab</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 3301L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL 3302</td>
<td>Anatomy and Physiology and Anatomy and Physiology Lab</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 3302L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 1102</td>
<td>Introduction to Organic and Biochemistry and Introduction to General Organic and Biochemistry Laboratory (Partially satisfies General Education Objective 5)</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHEM 1103</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 1111</td>
<td>General Chemistry I and General Chemistry I Lab</td>
<td>5</td>
</tr>
<tr>
<td>&amp; 1111L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 1112</td>
<td>General Chemistry II and General Chemistry II Lab</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 1112L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS 1181</td>
<td>Computer Science and Programming I (Satisfies General Education Objective 7)</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 3307</td>
<td>Professional and Technical Writing</td>
<td>3</td>
</tr>
</tbody>
</table>

Associate of Science in Health Physics

Admission to this program requires approval of the Department Chair.

The objective of the Idaho State University program that awards an Associate of Science in Health Physics is to develop an individual to assume the role of a health physics technician (sometimes referred to as Radiological Control Technician or RCT) with the knowledge in radiological and biological sciences appropriate for this career option. That same knowledge serves as the basis for certification by the National Registry of Radiation Protection Technologist (NRRPT). Students completing this program will develop the fundamental skills important to life-long learning and advancing within the discipline of Health Physics.

Students must fulfill 8 of the 9 University General Education Requirements (a minimum of 36 credits--see the General Education Requirements (http://coursecat.isu.edu/undergraduate/academicinformation/generaleducation) described in the Academic Information section of this catalog.)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Credits</th>
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<tbody>
<tr>
<td>BIOL 1101</td>
<td>Biology I and Biology I Lab (Partially Satisfies General Education Objective 5)</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 1101L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIOL/HPHY 3307</td>
<td>Radiobiology</td>
<td>2</td>
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<tr>
<td>BIOI 1111</td>
<td>General Chemistry I and General Chemistry I Lab (Partially Satisfies General Education Objective 5)</td>
<td>5</td>
</tr>
<tr>
<td>&amp; 1111L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CHEM 1112</td>
<td>General Chemistry II and General Chemistry II Lab</td>
<td>4</td>
</tr>
<tr>
<td>&amp; 1112L</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMM 1101</td>
<td>Principles of Speech (Satisfies General Education Objective 2)</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 1102</td>
<td>Critical Reading and Writing (Partially Satisfies General Education Objective 1)</td>
<td>3</td>
</tr>
<tr>
<td>ECON 1100</td>
<td>Economic Issues (Partially Satisfies General Education Objective 6)</td>
<td>3</td>
</tr>
<tr>
<td>MATH 1147</td>
<td>Precalculus</td>
<td>5</td>
</tr>
</tbody>
</table>
| or

**HPHY 4416** Introduction to Nuclear Measurements 3

**HPHY 4431** Radiation Physics I 3

**HPHY 4432** Radiation Physics II 3

**HPHY 4433** External Dosimetry 3

**HPHY 4434** Internal Dosimetry 3

**HPHY 4455** Topics in Health Physics I 2

**HPHY 4456** Topics in Health Physics II 2

**HPHY 4480** Health Physics Capstone Course 3

**HPHY 4488** Advanced Radiobiology 3

**MATH 1170** Calculus I (Satisfies General Education Objective 3) 4

**MATH 1175** Calculus II 4

**MATH 2275** Calculus III 4

**MATH 3350** Statistical Methods 3

**PHYS 2211** Engineering Physics I (Partially satisfies General Education Objective 5) 4

**PHYS 2212** Engineering Physics II 4

**NE 4451** Nuclear Seminar 1

**NE 4457** Nuclear Systems Laboratory 1

**NE 446A** Project Design I 1

**NE 446B** Project Design II 3

**PHYS 2211** Engineering Physics I (Partially satisfies General Education Objective 5) 4

**PHYS 2212** Engineering Physics II 4

**PHYS 2213** Engineering Physics I Laboratory 2

**PHYS 2214** Engineering Physics II Laboratory 2
<table>
<thead>
<tr>
<th>Course</th>
<th>Title and Description</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>MATH 1143 &amp; MATH 1144</td>
<td>College Algebra and Trigonometry</td>
<td>5</td>
</tr>
<tr>
<td>MATH 1153</td>
<td>Introduction to Statistics (Satisfies General Education Objective 3)</td>
<td>3</td>
</tr>
<tr>
<td>PHIL 1101</td>
<td>Introduction to Philosophy (Partially Satisfies General Education Objective 4)</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 1111</td>
<td>General Physics</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 1113</td>
<td>General Physics I Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>PHYS 1112</td>
<td>General Physics II</td>
<td>3</td>
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<tr>
<td>PHYS 1114</td>
<td>General Physics II Laboratory</td>
<td>1</td>
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<tr>
<td>PSYC 1101</td>
<td>Introduction to General Psychology (Partially Satisfies General Education Objective 6)</td>
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<tr>
<td>HPHY 2217</td>
<td>RCT Internship</td>
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<tr>
<td>HPHY 2218</td>
<td>Fundamentals of Radiation Protection Physics</td>
<td>3</td>
</tr>
<tr>
<td>HPHY 2219</td>
<td>RCT Internship II</td>
<td>3</td>
</tr>
<tr>
<td>HPHY 2225</td>
<td>Radiation Protection Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>HPHY 2226</td>
<td>Radiation Protection I</td>
<td>3</td>
</tr>
<tr>
<td>HPHY 2227</td>
<td>Radiation Protection II</td>
<td>3</td>
</tr>
<tr>
<td>HPHY 2228</td>
<td>Health Physics Regulations</td>
<td>3</td>
</tr>
<tr>
<td>HPHY 3300</td>
<td>Medical Electronics</td>
<td>2</td>
</tr>
</tbody>
</table>

**Bachelor of Science in Electrical Engineering**

Including the university's General Education Requirements (a minimum of 36 credits—see the General Education Requirements [http://coursecat.isu.edu/undergraduate/academicinformation.generaleducation](http://coursecat.isu.edu/undergraduate/academicinformation/generaleducation) in the Academic Information section of this catalog), the program of study for the Bachelor of Science in Electrical Engineering degree totals a minimum of 120 credits as follows:

**Required Courses for Electrical Engineering Major:**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title and Description</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 1111</td>
<td>General Chemistry I (Partially Fulfills General Education Objective 5)</td>
<td>4</td>
</tr>
<tr>
<td>CHEM 1111L</td>
<td>General Chemistry I Lab (Partially Fulfills General Education Objective 5)</td>
<td>1</td>
</tr>
<tr>
<td>CE 3361</td>
<td>Engineering Economics and Management</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 3307</td>
<td>Professional and Technical Writing</td>
<td>3</td>
</tr>
<tr>
<td>MATH 1170</td>
<td>Calculus I (Fulfills General Education Objective 3)</td>
<td>4</td>
</tr>
<tr>
<td>MATH 1175</td>
<td>Calculus II</td>
<td>4</td>
</tr>
<tr>
<td>MATH 2240</td>
<td>Linear Algebra</td>
<td>3</td>
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<tr>
<td>MATH 2275</td>
<td>Calculus III</td>
<td>4</td>
</tr>
<tr>
<td>MATH 3360</td>
<td>Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 2211</td>
<td>Engineering Physics I (Partially Fulfills General Education Objective 5)</td>
<td>4</td>
</tr>
<tr>
<td>PHYS 2212</td>
<td>Engineering Physics II (Partially Fulfills General Education Objective 5)</td>
<td>4</td>
</tr>
<tr>
<td>EE 1101</td>
<td>Electrical Engineering and Society</td>
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</tr>
<tr>
<td>EE 2240</td>
<td>Introduction to Electrical Circuits</td>
<td>3</td>
</tr>
<tr>
<td>EE 2274</td>
<td>Introduction to Digital Systems</td>
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</tr>
<tr>
<td>EE 2274L</td>
<td>Introduction to Digital Systems Laboratory</td>
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<tr>
<td>EE 3325</td>
<td>Electromagnetics</td>
<td>3</td>
</tr>
<tr>
<td>EE 3329</td>
<td>Introduction to Electronics</td>
<td>3</td>
</tr>
<tr>
<td>EE 3340</td>
<td>Fundamentals of Electrical Devices</td>
<td>3</td>
</tr>
<tr>
<td>EE 3340L</td>
<td>Fundamentals of Electrical Devices Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EE 3345</td>
<td>Signals and Systems</td>
<td>3</td>
</tr>
<tr>
<td>EE 4400</td>
<td>Senior Seminar</td>
<td>1</td>
</tr>
<tr>
<td>EE 4416</td>
<td>Applied Engineering Methods</td>
<td>3</td>
</tr>
<tr>
<td>EE 4418</td>
<td>Communication Systems</td>
<td>3</td>
</tr>
<tr>
<td>EE 4426</td>
<td>Computer Architecture and Organization</td>
<td>3</td>
</tr>
<tr>
<td>EE 4427</td>
<td>Embedded Systems Engineering</td>
<td>2</td>
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<tr>
<td>EE 4427L</td>
<td>Embedded Systems Engineering Laboratory</td>
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</tr>
<tr>
<td>EE 4429</td>
<td>Advanced Electronics</td>
<td>3</td>
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<tr>
<td>EE 4429L</td>
<td>Advanced Electronics Lab</td>
<td>1</td>
</tr>
<tr>
<td>EE 4472</td>
<td>Electrical Machines and Power</td>
<td>3</td>
</tr>
<tr>
<td>EE 4472L</td>
<td>Electrical Machines and Power Laboratory</td>
<td>1</td>
</tr>
<tr>
<td>EE 4473</td>
<td>Automatic Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>EE 4475</td>
<td>Digital Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>EE 4496</td>
<td>Project Design</td>
<td>3</td>
</tr>
</tbody>
</table>

In Addition:
All students earning a B.S. in Electrical Engineering Technology must complete all of ISU’s General Education requirements. The program requires 54 credits.

Previous graduates of those programs may directly enter the BSEET program.

Bachelor of Science in Electrical Engineering Technology

The Bachelor of Science in Electrical Engineering Technology (BSEET) program is a two-year program intended to supplement the following two-year Associate of Applied Science programs offered by the ISU College of Technology: Energy Systems Electrical Engineering Technology, Energy Systems Instrumentation Engineering Technology, and Energy Systems Wind Engineering Technology.

Previous graduates of those programs may directly enter the BSEET program. All students earning a B.S. in Electrical Engineering Technology must complete all of ISU’s General Education requirements. The program requires 54 credits of core and optional courses plus completion of all of ISU’s General Education requirements.

Core Courses Required for Electrical Engineering Technology Major:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENGL 1102</td>
<td>Critical Reading and Writing (Partially Satisfies General Education Objective 1)</td>
<td>3</td>
</tr>
<tr>
<td>ENGL 3307</td>
<td>Professional and Technical Writing</td>
<td>3</td>
</tr>
</tbody>
</table>

Elective Selections

Consult with your advisor when selecting electives, as there may be other new or special courses available.

Technical Electives: Any upper-division engineering course may be used as a Technical Elective. In addition, the following non-engineering courses are pre-approved:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 3326</td>
<td>Elementary Analysis</td>
<td>3</td>
</tr>
<tr>
<td>MATH 3352</td>
<td>Introduction to Probability</td>
<td>3</td>
</tr>
<tr>
<td>MATH 4450</td>
<td>Mathematical Statistics I</td>
<td>3</td>
</tr>
<tr>
<td>MATH 4451</td>
<td>Mathematical Statistics II</td>
<td>3</td>
</tr>
<tr>
<td>MATH 4465</td>
<td>Partial Differential Equations</td>
<td>3</td>
</tr>
<tr>
<td>PHYS 3301</td>
<td>Modern Physics</td>
<td>3</td>
</tr>
</tbody>
</table>

EE Electives: The following courses are pre-approved: (Note that non-EE courses may have prerequisites that are not part of the EE program.)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EE 4413</td>
<td>Techniques of Computer-Aided Circuit Analysis and Design</td>
<td>3</td>
</tr>
<tr>
<td>EE 4432</td>
<td>Introduction to VLSI Design</td>
<td>3</td>
</tr>
<tr>
<td>EE 4433</td>
<td>Mixed Signal Design</td>
<td>3</td>
</tr>
<tr>
<td>EE 4474</td>
<td>Advanced Circuit Theory</td>
<td>3</td>
</tr>
<tr>
<td>EE 4476</td>
<td>Semiconductor Processing and Fabrication</td>
<td>3</td>
</tr>
<tr>
<td>EE 4478</td>
<td>Semiconductor Devices</td>
<td>3</td>
</tr>
<tr>
<td>EE 4479</td>
<td>Advanced Semiconductor Devices</td>
<td>3</td>
</tr>
<tr>
<td>EE 4482</td>
<td>Principles of Power Electronics</td>
<td>3</td>
</tr>
<tr>
<td>EE 4491</td>
<td>Digital Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>ME 4405</td>
<td>Measurement Systems Design</td>
<td>4</td>
</tr>
<tr>
<td>&amp; ME 4406</td>
<td>and Measurement Systems Laboratory</td>
<td></td>
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<tr>
<td>ME 4425</td>
<td>Mechatronics</td>
<td>3</td>
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</table>

Electronics Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EET 3329</td>
<td>Introduction to Electronics</td>
<td>3</td>
</tr>
<tr>
<td>EET 4429</td>
<td>Advanced Electronics</td>
<td>3</td>
</tr>
</tbody>
</table>

Communications Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EET 3329</td>
<td>Introduction to Electronics</td>
<td>3</td>
</tr>
<tr>
<td>EET 4418</td>
<td>Communication Systems</td>
<td>3</td>
</tr>
</tbody>
</table>

Signal Processing and Control Option

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>EET 4473</td>
<td>Automatic Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>EET 4475</td>
<td>Digital Signal Processing</td>
<td>3</td>
</tr>
</tbody>
</table>

Electrical Eng Tech Courses

**EET 2240 Introduction to Electrical Circuits: 3 semester hours.**

**EET 2274 Introduction to Digital Systems: 3 semester hours.**
Number systems, Boolean algebra fundamentals, system reduction, design and analysis of combinational and sequential logic circuits. PRE-or-COREQ: EET 2275. F

**EET 2275 Introduction to Digital Systems Laboratory: 1 semester hour.**
Number systems, Boolean algebra fundamentals, system reduction, design and analysis of combinational and sequential logic circuits. PRE-or-COREQ: EET 2275. F

**EET 3329 Introduction to Electronics: 3 semester hours.**
Introduction to semiconductor materials and device theory. Diodes, bipolar junction transistors and metal-oxide-semiconductor field effect transistors. Amplifiers and frequency response. PRE-or-COREQ: EET 3340. S
EET 3340 Fundamentals of Electrical Devices: 3 semester hours.

EET 3342 Fundamentals of Electrical Devices Laboratory: 1 semester hour.
Laboratory experience emphasizing basic electrical measurements and methods. CO-or-PREREQ: EET 3340. S

EET 3345 Signals and Systems: 3 semester hours.
Linear time-invariant systems, continuous and discrete. Fourier series, Fourier transforms, Laplace transforms, z-transforms; state-space analysis, discrete Fourier transforms and the FFT. PREREQ: EET 3340. PRE-or-COREQ: MATH 3360. F

EET 4400 Senior Seminar: 1 semester hour.
Current topics in Electrical Engineering Technology. Selection of senior design projects. PREREQ: Permission of instructor. F

EET 4418 Communication Systems: 3 semester hours.
Basic analysis and design principles for modern analog and digital communication systems. PREREQ: EET 3329 and EET 3345. S

EET 4426 Computer Architecture and Organization: 3 semester hours.

EET 4427 Embedded Systems Engineering: 2 semester hours.
Design of real-time and embedded systems for signal processing and control through integration of algorithms, software and hardware. PREREQ: EET 4426 or CS 2275. PRE-or-COREQ: EET 4427L. S

EET 4427L Embedded Systems Laboratory: 1 semester hour.
Laboratory experience in design and implementation of embedded signal processing and control systems through the integration of algorithms, software and hardware. PRE-or-COREQ: EET 4427. S

EET 4429 Advanced Electronics: 3 semester hours.
Introduction to operational amplifiers and their applications, current mirrors, active loads, differential amplifiers, filters, oscillators, Schmitt triggers, power amplifiers and voltage regulators. Feedback and stability. PREREQ: EET 3329. F

EE 3340 Fundamentals of Electrical Devices: 3 semester hours.
Theory and application of electrical machines and transformers. Power and energy relationships. PREREQ: EET 3340 and EET 3342. PRE-or-COREQ: EET 4472L. F

EE 3340L Electrical Machines and Power: 3 semester hours.
Laboratory experience in the study of fundamental physical phenomena and characteristics of transformers, induction motors, synchronous and DC machines. PRE-or-COREQ: EET 4472L. F

EET 4473 Automatic Control Systems: 3 semester hours.
Continuous-time control systems using both frequency-domain and state-space techniques. Topics include design methodology, performance specifications, analysis and design techniques. PREREQ: EET 3345. S

EET 4475 Digital Signal Processing: 3 semester hours.
Discrete, fast Fourier and Z-transforms, correlation, convolution, finite and infinite impulse response digital filter design, spectral analysis and adaptive digital filters. Includes projects. PREREQ: EET 3345. S

EET 4496 Senior Project: 3 semester hours.
Conceptual design of multidisciplinary projects. Design, analysis, and implementation of senior projects proposed and defined in EET 4400. PREREQ: EET 4400. S

EET 4499 Experimental Course: 1-6 semester hours.
The content of this course is not described in the catalog. Title and number of credits are announced in the Class Schedule. Experimental courses may be offered no more than three times with the same title and content. May be repeated.

Electrical Engr Courses

EE 1101 Electrical Engineering and Society: 1 semester hour.
Survey and history of the electrical engineering profession. F

EE 1199 Experimental Course: 1-6 semester hours.
This is an experimental course. The course title and number of credits are announced in the class schedule by the scheduling department. Experimental courses may be offered no more than three times with the same title and content.

EE 2240 Introduction to Electrical Circuits: 3 semester hours.

EE 2274 Introduction to Digital Systems: 3 semester hours.
Number systems; Boolean algebra fundamentals; system reduction, combinational and sequential logic. PREREQ: EE 1101. PRE-or-COREQ: EE 2274L. F

EE 2274L Introduction to Digital Systems Laboratory: 1 semester hour.
Laboratory experience in the construction of basic digital logic circuits and state machines. PRE-or-COREQ: EE 2274. F

EE 3325 Electromagnetics: 3 semester hours.
Vectors and fields, electrostatics, magnetostatics, electrodynamics, Maxwell's equations, boundary value problems, plane and guided waves. PREREQ: EE 3340, MATH 2275, and PHYS 2212; MATH 3360 recommended. F

EE 3329 Introduction to Electronics: 3 semester hours.
Introduction to semiconductor theory, diodes, bipolar junction transistors and amplifiers, metal-oxide-semiconductor field effect transistors and amplifiers, and frequency response. PREREQ: CHEM 1111. PRE-or-COREQ: EE 3340. S

EE 3340 Fundamentals of Electrical Devices: 3 semester hours.

EE 3340L Fundamentals of Electrical Devices Laboratory: 1 semester hour.
Laboratory course emphasizing basic electrical measurements and methods. PRE-or-COREQ: EE 3340. S

EE 3345 Signals and Systems: 3 semester hours.
Linear time-invariant systems, continuous and discrete; Fourier series, Fourier transforms; discrete Fourier transforms; Laplace transforms, z-transforms; state-space analysis. PREREQ: EE 3340. PRE-or-COREQ: MATH 3360. F

EE 4400 Senior Seminar: 1 semester hour.
Current topics in Electrical Engineering. Initial selection of Senior Design projects. PREREQ: Permission of instructor. F

EE 4413 Techniques of Computer-Aided Circuit Analysis and Design: 3 semester hours.
Automatic formulation of equations and fundamental programming techniques pertinent to computer-aided circuit analysis, design, modeling. May include sensitivity calculations, system analogies, optimization. PREREQ: CS 1181, EE 3340, and EE 3342. D

EE 4416 Applied Engineering Methods: 3 semester hours.
Applied discrete and continuous probability, random variables, probability distributions, sampling, data description, parameter estimation, hypothesis testing, inference, correlation and linear and multiple regression. PREREQ: MATH 1175. S
EE 4418 Communication Systems: 3 semester hours.
Basic principles of analysis and design of modern analog and digital communication systems, including transmission and reception. PREREQ: EE 3329 and EE 3345. S

EE 4426 Computer Architecture and Organization: 3 semester hours.
Design, implementation, and performance evaluation of modern computer systems; instruction sets; datapath and control optimizations; single-cycle, multiple-cycle, and pipelined processors; hazard detection and resolution; memory hierarchies; peripheral devices. PREREQ: EE 2274 and EE 2274L. F

EE 4427 Embedded Systems Engineering: 2 semester hours.
Integration of algorithms, software and hardware to design real-time and embedded systems for signal processing and control. PREREQ: EE 4426 or CS 2275. PRE-or-COREQ: EE 4427L. S

EE 4427L Embedded Systems Engineering Laboratory: 1 semester hour.
Design and implement embedded signal processing and control systems through the integration of algorithms, software, and hardware. PREREQ: EE 4426 or CS 2275. PRE-or-COREQ: EE 4427L. S

EE 4429 Advanced Electronics: 3 semester hours.
Introduction to operational amplifiers and their applications, current mirrors, active loads, differential amplifiers, feedback and stability, filters, oscillators, Schmitt triggers, power amplifiers and voltage regulators. PREREQ: EE 3329. PRE-or-COREQ: EE 4429L. F

EE 4429L Advanced Electronics Lab: 1 semester hour.
Transistor biasing, amplifiers and other basic analog circuit designs. PREREQ or COREQ: EE 4429. F

EE 4432 Introduction to VLSI Design: 3 semester hours.
Photolithography, CMOS Fabrication, MOSFET Operation, CMOS passive elements, design rules and layout, CAD tools for IC design, inverters, static logic and transmission gates, dynamic logic. PREREQ: EE 3329. D

EE 4433 Mixed Signal Design: 3 semester hours.
Analog IC design, Passive components, parasitic elements, component matching, IC layout techniques, amplifiers, current sources, comparators, op amps, noise, switched capacitor circuits. Includes lab work using design tools. PREREQ: EE 4432. D

EE 4472 Electrical Machines and Power: 3 semester hours.
Theory and application of electrical machinery and transformers. Power and energy relationships in power systems. PREREQ: EE 3340 and EE 3340L. PRE-or-COREQ: EE 4472L. F

EE 4472L Electrical Machines and Power Laboratory: 1 semester hour.
Experimental study of the fundamental physical phenomena and characteristics of transformers, induction motors, synchronous and direct current machines. PREREQ or COREQ: EE 4472. F

EE 4473 Automatic Control Systems: 3 semester hours.
Continuous-time control systems using both frequency-domain and state-space techniques. Topics include design methodology, performance specifications, analysis and design techniques. PREREQ: EE 3345 or ME 4405. S

EE 4474 Advanced Circuit Theory: 3 semester hours.
Methods of analog electrical circuit analysis and synthesis. Topics include signal flow graphs, multi-port networks, simulation techniques, and topological methods for formulation of network equations. PREREQ: EE 3340. D

EE 4475 Digital Signal Processing: 3 semester hours.
Discrete, fast Fourier and Z-transforms, correlation, convolution, finite and infinite impulse response digital filter design, spectral analysis and adaptive digital filters. Includes projects. PREREQ: EE 3345. S

EE 4476 Semiconductor Processing and Fabrication: 3 semester hours.
Silicon semiconductor processing and basic integrated circuit fabrication. Physics, chemistry and technology in basic processing steps in production of integrated circuits. PREREQ: PHYS 2212 or equivalent. D

EE 4478 Semiconductor Devices: 3 semester hours.
Operating principles of basic building blocks of modern silicon-based semiconductor devices to include p-n junctions, field effect transistors and bipolar junction transistors. PREREQ: PHYS 2212 or equivalent. D

EE 4479 Advanced Semiconductor Devices: 3 semester hours.
Review of semiconductor band theory. Opto-electronics, quantum mechanics, heterojunctions, power and microwave semiconductor devices. PREREQ: EE 4478 or equivalent. D

EE 4481 Independent Problems: 1-3 semester hours.
Students are assigned to, or request assignment to, independent problems on the basis of interest and preparation. May be repeated for a maximum of 6 credits. Equivalent to CE/ENGR 4481. PREREQ: Permission of instructor. D

EE 4482 Principles of Power Electronics: 3 semester hours.
Introduction to steady state converter modeling and analysis. Principles of converter dynamics and control including controller design. PREREQ: EE 3329. PREREQ or COREQ: EE 4473. D

EE 4491 Digital Control Systems: 3 semester hours.
Analysis and design of digital control systems, Z-transforms, transient response, stability, root locus, frequency response, design, state-space and state feedback. PREREQ: EE 4473. D

EE 4496 Project Design: 3 semester hours.
Conceptual design of multidisciplinary projects. Design, analysis, and implementation of senior projects proposed and defined in EE 4400. PREREQ: EE 4400. S

EE 4496B Project Design II: 3 semester hours.
Continuation of design sequence dealing with the design, analysis, implementation, and consequences of multi-disciplinary projects. PREREQ: EE 4496A. S

EE 4499 Experimental Course: 1-6 semester hours.
The content of this course is not described in the catalog. Title and number of credits are announced in the Class Schedule. Experimental courses may be offered no more than three times with the same title and content. May be repeated.

Health Physics Courses

HPHY 2217 RCT Internship: 3 semester hours.
Structured Internship. An optional experience taken as a class the summer prior to the start of the program. PREREQ: Acceptance into the program and permission of the program director. Su

HPHY 2218 Fundamentals of Radiation Protection Physics: 3 semester hours.
Atomic structure, nuclear structure, fission and fusion, radioactive decay, types of radiation, decay schemes, decay kinetics, interaction of radiation with matter, inverse square, attenuation, shielding, sources of radiation, reactors; accelerators, X-ray machines, units and terminology. F

HPHY 2219 RCT Internship II: 3 semester hours.
Structured Internship. A required class taken the summer between the first and second years of the program. PREREQ: Acceptance into the program and permission of the program director. Su

HPHY 2225 Radiation Protection Instrumentation: 3 semester hours.
Gas filled detectors: theory of operation, field applications, calibration and maintenance. Standard laboratory radiation detection instrumentation including solid state detectors, liquid scintillation detectors, scintillators, TLD and film dosimetry, and spectroscopy techniques. PREREQ: HPHY 2218. F
HPHY 2226 Radiation Protection I: 3 semester hours.
Principles of radiation protection; evaluating internal and external exposures and controls, survey, sampling and inspections, analytical techniques and emergency preparedness. PREREQ: HPHY 2218. S

HPHY 2227 Radiation Protection II: 3 semester hours.
Personnel dosimetry, prescribed dosimetry and radiation equipment, radiation protection dosimetry, procedures and programs (ALARA), industrial ventilation, PPE, contamination control, shielding, hazard evaluation primer on internal dosimetry and bioassay techniques. PREREQ: HPHY 2218. F

HPHY 2228 Health Physics Regulations: 3 semester hours.
Reviewing 10 CFR 19, 20, 30, 35, 835 and portions of 49 CFR dealing with shipment of Radioactive Materials and acquainting students with NCRP, NUREG, REG Guides, ICRP, etc. PREREQ: HPHY 2218. S

HPHY 3300 Medical Electronics: 2 semester hours.
A lecture-laboratory course covering circuit theory, qualitative theory of active devices and their applications to instrumentation. Laboratory work will be done with basic test instruments. Primarily for students in the allied health fields. PREREQ or COREQ: HPHY 3321. S

HPHY 3307 Radiobiology: 2 semester hours.
Survey of the effects of ionizing radiation on living matter at the sub cellular, cellular, and organismal levels. Equivalent to BIOL 3307. PREREQ: BIOL 1101 and one of the following: PHYS 1100, PHYS 1111, PHYS 2211, or HPHY 3321. S

HPHY 3321 Radiologic Physics: 2 semester hours.
Basic physics of x-ray production and the interaction of x-rays with matter. Includes topics in medical imaging. Available to juniors in Radiographic Science. PREREQ: PHYS 1100. S

HPHY 3399 Experimental Course: 1-6 semester hours.
This course is not described in the catalog. The course title and number of credits are announced in the class schedule by the scheduling department. Experimental courses may be offered no more than three times. May be repeated.

HPHY 4411 Accelerator Health Physics: 3 semester hours.
Fundamentals of particle accelerator design and operation. Examination of the potential radiation environment associated with accelerators and health and safety issues of their operation. PREREQ: Senior standing in health physics or permission of instructor. D

HPHY 4412 Environmental Health Physics: 3 semester hours.
State-of-the-art applied mathematical techniques for estimating the release, transport, and fate of contaminants in multi-media environmental pathways (air, ground water, terrestrial). Both radiological and non-radiological contaminants will be addressed, with emphasis on radiological contaminants. PREREQ: Permission of instructor. Se

HPHY 4413 Fundamentals of Industrial Hygiene: 3 semester hours.
Overview on the recognition, evaluation, and control of hazards arising from physical agents in the occupational environment. The exposure consequences associated with agents of major occupational health concerns are considered. PREREQ: Permission of instructor. Se

HPHY 4416 Introduction to Nuclear Measurements: 3 semester hours.
Lecture/laboratory course emphasizing practical measurement techniques in nuclear physics. PREREQ: CHEM 1111 and PHYS 1111 and PHYS 1113 or PHYS 2211 and PHYS 2213. S

HPHY 4416L Radiation Detection and Measurement Lab: 0 semester hours.
Laboratory course emphasizing practical measurement techniques in nuclear physics.

HPHY 4417 Industrial Ventilation and Aerosol Physics: 3 semester hours.
This course focuses on two distinct subject areas: an elaboration on the details of the ACGIH method of local exhaust-system design, and a study of applied aerosol physics based upon trajectory analysis. PREREQ: Permission of instructor. Se

HPHY 4418 Nonionizing Radiation Protection: 3 semester hours.
Occupational safety and health issues of human exposure to nonionizing radiation. Topics include health concerns and safety strategies developed for extremely low frequency, microwave, radio-frequency, ultraviolet, infrared, laser radiation, and sound-waves. PREREQ: Permission of instructor. Se

HPHY 4419 Radiological Emergency Planning: 3 semester hours.
Radiological emergency planning for facilities ranging from reactors and other major nuclear facilities to transportation accidents and smaller-scale nuclear accidents. Topics include planning, co-ordination, “exercises”, exposure pathways, modeling, measurement, control, decontamination, and recovery. PREREQ: Permission of instructor. Se

HPHY 4420 Reactor Health Physics: 3 semester hours.
Introduction to reactor physics; nuances peculiar to reactor health physics; reactor designs. Critiques of exposure pathways, accidents, decommissioning, contamination control, and emergency planning examine radiation safety approaches within the nuclear fuel cycle. PREREQ: Permission of instructor. Se

HPHY 4431 Radiation Physics I: 3 semester hours.
Atomic and nuclear structure, series and differential-equation descriptions of radioactive decay, physical theory of the interaction of radiation with matter suitable for the discipline of Health Physics. PREREQ: Permission of instructor. F

HPHY 4432 Radiation Physics II: 3 semester hours.
Continuation of HPHY 4431 considering dosimetric quantities/units, theory and technology of radiation detection and measurement, and radiobiology important to an advanced understanding of radiation protection. PREREQ: HPHY 4431 and permission of instructor. S

HPHY 4433 External Dosimetry: 3 semester hours.
Lecture course emphasizing external radiation protection including study of point kernel techniques, monte carlo modeling, and NCRP-49 methods. Also discussed are external dosimetry measurement techniques. PREREQ: HPHY 4432 or permission of instructor. F

HPHY 4434 Internal Dosimetry: 3 semester hours.
A course emphasizing internal radiation protection including studies of ICRP-2, ICRP-26&30, ICRP-60&66, and MIRD methods of internal dosimetry. PREREQ: HPHY 4433 or permission of instructor. S

HPHY 4455 Topics in Health Physics I: 2 semester hours.
A lecture/seminar course covering special topics in Health Physics such as state and federal regulations, waste disposal methodology, and emergency procedures. PREREQ: HPHY 4432 or permission of instructor. F

HPHY 4456 Topics in Health Physics II: 2 semester hours.
A continuation of HPHY 4455. A lecture/seminar course covering special topics in Health Physics such as state and federal regulations, waste disposal methodology, and emergency procedures. PREREQ: HPHY 4432 or permission of instructor. S

HPHY 4460 Special Problems in Health Physics: 1-6 semester hours.
Course covering special problems and topics in health physics. Specific, evaluated undergraduate-level activities and/or performances are identified in the course syllabus. May be repeated. May be graded S/U. PREREQ: Permission of instructor. F, S
NE 4445 Reactor Physics: 3 semester hours.
Physical principles underlying neutron interactions. Multi-region and multi-energy diffusion and transport. Beamport and filter concepts and design. PREREQ: NE 3302. PREREQ or COREQ: MATH 4421. S

NE 4446 Nuclear Fuel Cycle Systems: 3 semester hours.
Alternative fuel cycles. Analysis and design of key fuel cycle components (e.g., uranium enrichment, fuel fabrication, reactor fuel management, reprocessing, and waste management). Principles of nuclear criticality safety. Criticality and thermal analysis codes. Design principles of nuclear fuel cycle facilities and equipment. PREREQ: NE 3301 and NE 3302 or equivalent. S

NE 4447 Nuclear Systems Laboratory: 1 semester hour.
Techniques of radiation detection and measurements, flux measurements, neutron activation analysis, approach to criticality, Inhour equation, subcritical experiments. PREREQ: NE 4445 and HPHY 4416. S

NE 4450 DS Reactor Operations: 3 semester hours.
Training course; basic reactor theory and operation; regulations and qualification. PREREQ: Permission of instructor. F, S, Su

NE 4451 Nuclear Seminar: 1 semester hour.
Current topics in nuclear science and engineering. PREREQ: Senior standing or permission of instructor. Graded S/U. F, S

NE 4458 Monte Carlo Methods and Applications: 3 semester hours.
Basics of the application of stochastic methods to calculate the transport of neutrons, photons, and other sub-atomic particles. Includes introduction to the MCNP code, and sample application problems in both nuclear reactor design and in applications such as radiation beams used for cancer therapy. F

NE 4478 Reliability and Risk Assessment: 3 semester hours.
Methods of evaluating process and equipment reliability. Probabilistic methods applied to analysis and design. Setting probabilistic design objectives and calculating probabilistic performance. PREREQ: MATH 3360 and EE 4416 or permission of instructor. S

NE 4481 Independent Problems: 1-3 semester hours.
Students are assigned to, or request assignment to, independent problems on the basis of interest and preparation. May be repeated for a maximum of 6 credits. PREREQ: Permission of instructor. D

NE 4487 Medical Applications in Engineering and Physics: 3 semester hours.
Applications of engineering and physics principles, particularly nuclear science, to medicine. Covers radioisotopes, X-ray imaging, magnetic resonance and ultrasound imaging, radiation protection, codes and standards. PREREQ: MATH 3360 and PHYS 2212. S

NE 4488 Nonproliferation and Nuclear Weapons and Safeguards: 3 semester hours.
History, regulation and politics of nuclear nonproliferation; technologies and practices for safeguarding special nuclear materials; detection of nuclear proliferation and prevention of nuclear terrorism. PRE-or-COREQ: BS in Science or Engineering or permission of instructor. F

NE 4496A Project Design I: 1 semester hour.
Semester one of two semester senior design course sequence. Planning project for second semester. Special topics on professionalism, ethics, and licensing. PREREQ: Approval of application for admission to course. F

NE 4496B Project Design II: 3 semester hours.
Continuation of design sequence dealing with the design, analysis, implementation, and consequences of senior design project. PREREQ: NE 4496A. S

NE 4499 Experimental Course: 1-6 semester hours.

Physics Courses

PHYS 1100 Essentials of Physics: 4 semester hours.
A survey of basic physics principles; motion, gravitation, electricity and magnetism, light, atoms and nuclei. Includes lecture, demonstrations and elementary problem solving. COREQ: MATH 1108 or equivalent. Partially satisfies Objective 5 of the General Education Requirements. F, S

PHYS 1101 Elements of Physics: 3 semester hours.
A survey of basic physics principles; motion, gravitation, electricity and magnetism, light, atoms and nuclei. Includes lecture, demonstrations, elementary problem solving. PREREQ: Permission of the College of Technology. COREQ: MATH 1108 or equivalent; PHYS 1101L. Partially satisfies Objective 5 of the General Education Requirements. F, S

PHYS 1101L Elements of Physics Laboratory: 1 semester hour.
Laboratory-based application of PHYS 1101, to demonstrate basic physics principles; motion, gravitation, electricity and magnetism, light, atoms and nuclei. PREREQ: Permission of the College of Technology. PRE-or-COREQ: MATH 1108 or equivalent; PHYS 1101. Partially satisfies Objective 5 of the General Education Requirements. F, S
PHYS 1103 Tools for Scientists I: 1 semester hour.  
Personal computer, Internet and WWW, and HP graphics calculator applications in the sciences. Familiarizes students with the capabilities of these computing tools. Emphasizes problems frequently encountered in science and engineering courses.  

PHYS 1111 General Physics: 3 semester hours.  
Introductory physics course for students in scientific and technical fields, particularly the biological sciences; mechanics, wave motion, thermodynamics. PREREQ: MATH 1143 or MATH 1147 or equivalent. Partially satisfies Objective 5 of the General Education Requirements. F

PHYS 1112 General Physics II: 3 semester hours.  
Introduction to optics, electricity and magnetism and selected topics from atomic and nuclear physics. PREREQ: PHYS 1111 or equivalent, and MATH 1143 or MATH 1147 or equivalent. Partially satisfies Objective 5 of the General Education Requirements. S

PHYS 1113 General Physics I Laboratory: 1 semester hour.  
Demonstrating principles of physics. PRE-or-COREQ: PHYS 1111. Partially satisfies Objective 5 of the General Education Requirements. F, S

PHYS 1114 General Physics II Laboratory: 1 semester hour.  
Demonstrating principles of physics. PREREQ: PHYS 1113. PRE-or-COREQ: PHYS 1112. Partially satisfies Objective 5 of the General Education Requirements. F, S

PHYS 1152 Descriptive Astronomy: 3 semester hours.  
Survey of the historical and modern observation of the sky. Physical relationships in the solar system; planets, satellites, comets, etc., and theories of the creation of the universe and life in the universe. Partially satisfies Objective 5 of the General Education Requirements. F, S, Su

PHYS 1153 Descriptive Astronomy Laboratory: 1 semester hour.  
Use of astronomical equipment, telescopes, cameras, etc. Partially satisfies Objective 5 of the General Education Requirements. F, S, Su

PHYS 2211 Engineering Physics I: 4 semester hours.  
Mechanics of particles and rigid bodies: kinetic theory and thermodynamics; electricity and magnetism; wave motion; optics. COREQ: MATH 1175. Partially satisfies Objective 5 of the General Education Requirements. F, S

PHYS 2212 Engineering Physics II: 4 semester hours.  
Mechanics of particles and rigid bodies; kinetic theory and thermodynamics; electricity and magnetism; wave motion; optics. PREREQ: PHYS 2211. Partially satisfies Objective 5 of the General Education Requirements. F, S

PHYS 2213 Engineering Physics I Laboratory: 1 semester hour.  
Principles and methods of physical measurement. PRE-or-COREQ: PHYS 2211. Partially satisfies Objective 5 of the General Education Requirements. F, S

PHYS 2214 Engineering Physics II Laboratory: 1 semester hour.  
Principles and methods of physical measurement. PRE-or-COREQ: PHYS 2212. PREREQ: PHYS 2213. Partially satisfies Objective 5 of the General Education Requirements. F, S

PHYS 2215 Thermal Physics: 1 semester hour.  
Introduction to thermodynamics and kinetic theory. Designed for students who have taken AP Physics C in high school and have not had instruction in thermal physics normally covered in Engineering Physics I and II. COREQ: MATH 1175. D

PHYS 3301 Modern Physics: 3 semester hours.  
A one-semester course surveying 20th century physics including elements of special relativity and quantum mechanics as applied to atoms. A continuation of the Engineering Physics sequence. PREREQ: PHYS 2212. COREQ: MATH 3360. F

PHYS 3312 Introduction to Biophysics: 4 semester hours.  
Survey course designed for pre-medical, pharmacy, biology, and physical science students covering topics such as the physics of sensory systems, electromagnetic radiations, and physical measurement techniques applied to biological problems. PREREQ: CHEM 1112, CHEM 1112L, MATH 1160 or MATH 1170. D

PHYS 3313 Intermediate Laboratory I: 2 semester hours.  
Modern and historical experiments in atomic physics, nuclear physics, and optics. COREQ: PHYS 3301 and MATH 3360. F

PHYS 4400 Practicum in Physical Science: 2 semester hours.  
Emphasizes design, set-up, operation, and administration of physics teaching laboratories, demonstrations and activities. Introduces pre-designed experiments plus the design and maintenance of lab equipment. Ideal for Education majors. PREREQ: Permission of instructor. S

PHYS 4403 Advanced Modern Physics I: 3 semester hours.  
Study of the elementary principles of quantum mechanics and an introduction to atomic, solid state and nuclear physics. Quantum mechanics will be used as much as possible. PREREQ: MATH 3360 or equivalent, and PHYS 3301. S

PHYS 4404 Advanced Modern Physics II: 3 semester hours.  
Study of the elementary principles of quantum mechanics and an introduction to atomic, solid state and nuclear physics. Quantum mechanics will be used as much as possible. PREREQ: PHYS 4403. F

PHYS 4405 Advanced Physics Laboratory I: 2 semester hours.  
Experiments in radiation detection and measurement, nuclear spectroscopy including x-ray and gamma spectroscopies, neutron activation and ion beam methods. Available to Geology, Engineering, Health Physics, and Physics majors. PREREQ: Permission of the instructor. D

PHYS 4406 Advanced Physics Laboratory II: 2 semester hours.  
Senior projects providing a capstone to the physics major curriculum. Written and oral presentation of the project procedures and results are required. F, S

PHYS 4408 Error Analysis for the Physical Sciences: 3 semester hours.  
Lecture course with computation requirements. Topics include: Error propagation, Probability Distributions, Least Squares fit, multiple regression, goodness of fit, covariance and correlations. PREREQ: MATH 3360. AS

PHYS 4414 Electronic Instrumentation and Measurement: 3 semester hours.  
Lecture course with laboratory requirements. Topics include: DC and AC electrical circuits, Analog pulses, Bipolar Transistors, Field Effect Transistors, Operational amplifiers. PREREQ: PHYS 2212, PHYS 2214, and MATH 3360. AS

PHYS 4415 Statistical Physics: 3 semester hours.  
Topics covered may include kinetic theory, elementary statistical mechanics, random motion and the theory of noise. Choice of topics will depend upon the interest of the students and instructor. PREREQ: PHYS 2212 and MATH 3360. F

PHYS 4416 Radiation Detection and Measurement: 3 semester hours.  
Lecture/laboratory course emphasizing practical measurement techniques in nuclear physics. PREREQ: CHEM 1112, CHEM 1112L, and PHYS 1111 and PHYS 1113 or PHYS 2211 and PHYS 2213. S

PHYS 4416L Radiation Detection and Measurement Lab: 0 semester hours.  

PHYS 4421 Electricity and Magnetism I: 3 semester hours.  
Intermediate course in fundamental principles of electrical and magnetic theory. Free use will be made of vector analysis and differential equations. PREREQ: PHYS 2212 and MATH 3360. F

PHYS 4422 Electricity and Magnetism II: 3 semester hours.  
Intermediate course in fundamental principles of electrical and magnetic theory. Free use will be made of vector analysis and differential equations. PREREQ: PHYS 4421. S
PHYS 4425 Nuclear and Particle Physics I: 3 semester hours.
A course in Nuclear and Particle Physics with emphasis upon structural models, radioactivity, nuclear reactions, particle interactions, fission and fusion, the standard model of particle physics, symmetries and conservation laws. PREREQ: Knowledge of elementary quantum mechanics and differential equations or permission of instructor. F

PHYS 4426 Nuclear and Particle Physics II: 3 semester hours.
A course in Nuclear and Particle Physics with emphasis upon structural models, radioactivity, nuclear reactions, particle interactions, fission and fusion, the standard model of particle physics, symmetries and conservation laws. PREREQ: PHYS 4425. S

PHYS 4430 Accelerator Physics: 3 semester hours.
The physics of direct voltage accelerators, betatrons, synchrotrons, linear induction acceleration; high current accelerators; electromagnetic particle optics, free electron lasers, and synchrotron light sources. PREREQ: PHYS 4422 or permission of instructor. D

PHYS 4442 Solid State Physics: 3 semester hours.
Introduction to the field of solid state physics emphasizing the fundamental concepts. Topics usually covered are crystal structure, x-ray diffraction, crystal binding energies, free electron theory of solids, energy bands. PREREQ: PHYS 3301 and MATH 3360 or permission of instructor. AF

PHYS 4452 Intermediate Optics: 3 semester hours.
Wave theory, e/m waves, production of light, measurement of light, reflection, refraction, interference, diffraction, polarization, optical systems, matrix methods, Jones vectors, Fourier optics, propagation of e/m waves in materials, atmospheric optics. PREREQ: PHYS 2212. COREQ: MATH 3360. AS

PHYS 4453 Topics in Astrophysics: 2 semester hours.
Applications of upper division physics to astronomy or cosmology. May include lab exercises. PREREQ: Permission of instructor. AS

PHYS 4461 Introduction to Mathematical Physics I: 3 semester hours.
Introduction to the mathematics most commonly used in physics with applications to and practice in solving physical problems; includes vector analysis, ordinary and partial differential equations. PREREQ: PHYS 2212 and MATH 3360. F

PHYS 4462 Introduction to Mathematical Physics II: 3 semester hours.
Introduction to the mathematics most commonly used in physics with applications to and practice in solving physical problems; includes vector analysis, ordinary and partial differential equations. PREREQ: PHYS 4461. S

PHYS 4470 Simulations of Particle Interactions with Matter: 3 semester hours.
Lecture course with monte-carlo computation requirements. Topics include: Stopping power, interactions of electrons and photons with matter, hadronic interactions, and radiation detection devices. PREREQ: MATH 3360 and PHYS 3301. AF

PHYS 4481 Independent Problems: 1-3 semester hours.
Students are assigned to, or request assignment to, independent problems on the basis of interest. May be repeated to a maximum of 6 credits. F, S

PHYS 4483 Theoretical Mechanics: 4 semester hours.
Detailed study of the motion of particles, satellites, rigid bodies and oscillating systems. Develop and apply Lagrangian and Hamiltonian methods. PREREQ: PHYS 2212 and MATH 3360. F

PHYS 4492 Colloquium in Physics: 1 semester hour.
Faculty and student lectures in current research topics in physics. Open to upper division and graduate students in physics. May be repeated for up to 4 credits. F, S

PHYS 4499 Experimental Course: 1-6 semester hours.
This is an experimental course. The course title and number of credits are noted by course section and announced in the class schedule by the scheduling department. Experimental courses may be offered no more than three times. May be repeated.