

Physics and Engineering

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The purpose of the physics and engineering department is to provide an educational experience within a Christian context that equips students with the ability to obtain knowledge and understanding about the physical world for use in research, graduate studies and careers and to positively impact society. The physics and engineering department offers instruction in physics, engineering, astronomy, and physical science. Space physics, experimental condensed matter physics, theoretical high-energy physics, acoustics, advanced engineering instrumentation, power electronics and microelectronics provide the major research interests in the department.

Departmental majors include: physics, physics/systems, engineering physics, environmental engineering, physics science education, physical science education/physics concentration and physics/mathematics education.

Physics (BA)

The bachelor of arts degree with a major in physics requires two years of one foreign language and 76-82 hours in the major.

Major Requirements

| | | |
|---------|---|--|
| PHY 211 | 4 | University Physics I |
| PHY 212 | 5 | University Physics II |
| PHY 311 | 4 | Modern Physics |
| PHY 321 | 3 | Electricity and Magnetism |
| PHY 322 | 3 | Waves and Physical Optics |
| PHY 330 | 2 | Advanced Lab |
| PHY 341 | 3 | Math Methods in Physics and Engineering |
| PHY 342 | 3 | Analytical Mechanics |
| PHY 350 | 4 | Thermodynamics and Statistical Mechanics |
| PHY 412 | 3 | Quantum Mechanics |
| PHY 493 | 3 | Physics Senior Capstone |

Electives

Select 10 hours of physics and engineering elective courses from:

| | | |
|---------|-----|---|
| ENP 252 | 4 | Principles of Engineering |
| ENP 301 | 3 | Statics and Dynamics |
| ENP 321 | 2 | Applied Electromagnetics |
| ENP 331 | 4 | Introduction to Electronics |
| ENP 332 | 4 | Control Systems |
| ENP 341 | 4 | Microcomputer Interfacing |
| ENP 351 | 3 | Thermodynamics |
| ENP 352 | 3 | Materials Science and Solid State Physics |
| ENP 355 | 3 | Fluid Mechanics and Water Flow |
| ENP 370 | 1-4 | Selected Topics |
| ENP 431 | 4 | Advanced Electronics and Microcircuits |
| PHY 201 | 4 | Introductory Astronomy |
| PHY 313 | 2 | Nuclear Radiation Experimental Methods |
| PHY 370 | 1-4 | Selected Topics |
| PHY 413 | 2 | Quantum Mechanics II |
| PHY 441 | 3 | Advanced Mathematical Methods in Physics |
| PHY 450 | 1-4 | Directed Research |

Additional Major Requirements

| | | |
|----------|---|--|
| *ENP 104 | 2 | Introduction to Engineering and Software Tools |
| *ENP 105 | 1 | Introduction to Engineering Ethics |
| COS 120 | 4 | Introduction to Computer Science I |
| MAT 230 | 4 | Calculus II |
| MAT 240 | 4 | Calculus III |
| MAT 251 | 4 | Differential Equations |

Select one course from the following:

| | | |
|----------|---|---|
| NAS 480 | 1 | Natural Science Seminar |
| IAS 231H | 2 | Issues in Science and Religion (Honors) |

Select one of the following chemistry course combinations:

| | | |
|---------|---|----------------------|
| CHE 201 | 4 | General Chemistry I |
| CHE 202 | 4 | General Chemistry II |

or

| | | |
|---------|---|----------------------|
| CHE 211 | 4 | College Chemistry I |
| CHE 212 | 4 | College Chemistry II |

Select one option from the following:

| | | |
|----------|---|--|
| MAT 151 | 4 | Calculus I |
| †MAT 145 | 3 | Introduction to Functions and Calculus |
| and | | |
| †MAT 146 | 3 | Functions and Calculus |

†MAT 145 & 146 count as one option.

*ENP 104 and 105 will substitute for the general education COS 104 requirement; alternatively, COS 104 may be taken.

Additional courses in computer science, systems, engineering, and mathematics are strongly recommended.

Physics (BS)

The bachelor of science degree with a major in physics requires 89-97 hours in the major.

Major Requirements

| | | |
|---------|---|--|
| ENP 370 | 1 | Preparation for the Physics GRE |
| PHY 211 | 4 | University Physics I |
| PHY 212 | 5 | University Physics II |
| PHY 311 | 4 | Modern Physics |
| PHY 321 | 3 | Electricity and Magnetism |
| PHY 322 | 3 | Waves and Physical Optics |
| PHY 330 | 2 | Advanced Lab |
| PHY 341 | 3 | Math Methods in Physics and Engineering |
| PHY 342 | 3 | Analytical Mechanics |
| PHY 350 | 4 | Thermodynamics and Statistical Mechanics |
| PHY 412 | 3 | Quantum Mechanics |
| PHY 413 | 2 | Quantum Mechanics II |
| PHY 441 | 3 | Advanced Mathematical Methods in Physics |
| PHY 493 | 3 | Physics Senior Capstone |

Select one course from the following:

| | | |
|---------|-----|-------------------|
| PHY 393 | 2 | Practicum |
| PHY 450 | 2-4 | Directed Research |

Technical Electives

Select at least 11 additional hours from the following:

| | | |
|--------------|------|---|
| CHE 431 | 3 | Physical Chemistry I |
| CHE 431L | 1-2 | Physical Chemistry I Lab |
| CHE 432 | 3 | Physical Chemistry II |
| CHE 432L | 1-2 | Physical Chemistry II Lab |
| *ENP 200-499 | 1-11 | Engineering Physics Electives |
| MAT 310 | 3 | Mathematical Modeling with Numerical Analysis |
| MAT 352 | 4 | Mathematical Statistics |
| MAT 382 | 3 | Advanced Statistical Methods |
| PHY 201 | 4 | Introductory Astronomy |
| *PHY 300-499 | 1-11 | Physics Electives |

*ENP 200-, 300-, 400-level & PHY 300- and 400-level courses not already used in major may be taken to meet the additional 11 hour requirement.

Physics requirements continued on next page

Physics requirements continued from previous page

Additional Major Requirements

| | | |
|----------|---|--|
| *ENP 104 | 2 | Introduction to Engineering and Software Tools |
| *ENP 105 | 1 | Introduction to Engineering Ethics |
| COS 120 | 4 | Introduction to Computer Science I |
| MAT 230 | 4 | Calculus II |
| MAT 240 | 4 | Calculus III |
| MAT 245 | 4 | Linear Algebra |
| MAT 251 | 4 | Differential Equations |

Select one course from the following:

| | | |
|----------|---|---|
| NAS 480 | 1 | Natural Science Seminar |
| IAS 231H | 2 | Issues in Science and Religion (Honors) |

Select one of the following chemistry course combinations:

| | | |
|---------|---|----------------------|
| CHE 201 | 4 | General Chemistry I |
| CHE 202 | 4 | General Chemistry II |
| or | | |
| CHE 211 | 4 | College Chemistry I |
| CHE 212 | 4 | College Chemistry II |

Select one option from the following:

| | | |
|----------|---|--|
| MAT 151 | 4 | Calculus I |
| †MAT 145 | 3 | Introduction to Functions and Calculus |
| and | | |
| †MAT 146 | 3 | Functions and Calculus |

†MAT 145 & 146 count as one option.

*ENP 104 and 105 will substitute for the general education COS 104 requirement; alternatively, COS 104 may be taken.

Physics/Systems (BS)

This integrated major provides a strong background in physics, systems, management, mathematics and problem solving. The bachelor of science degree with a major in physics/systems requires 57-62 hours in the major and curriculum requirements in systems analysis. All systems curriculum courses must be completed with a grade of C- or better.

Major Requirements

| | | |
|---------|---|---|
| PHY 211 | 4 | University Physics I |
| PHY 212 | 5 | University Physics II |
| PHY 311 | 4 | Modern Physics |
| PHY 321 | 3 | Electricity and Magnetism |
| PHY 330 | 2 | Advanced Lab |
| PHY 341 | 3 | Math Methods in Physics and Engineering |
| PHY 342 | 3 | Analytical Mechanics |
| PHY 393 | 3 | Practicum |
| PHY 412 | 3 | Quantum Mechanics |
| PHY 493 | 3 | Physics Senior Capstone |
| ENP 332 | 4 | Control Systems |

Select one course from the following:

| | | |
|----------|---|--|
| †ENP 351 | 3 | Thermodynamics |
| †PHY 350 | 4 | Thermodynamics and Statistical Mechanics |

Additional Major Requirements

| | | |
|----------|---|--|
| *ENP 104 | 2 | Introduction to Engineering and Software Tools |
| *ENP 105 | 1 | Introduction to Engineering Ethics |
| MAT 251 | 4 | Differential Equations |

Select one course from the following:

| | | |
|----------|---|---|
| NAS 480 | 1 | Natural Science Seminar |
| IAS 231H | 2 | Issues in Science and Religion (Honors) |

Select one of the following chemistry course combinations:

| | | |
|---------|---|----------------------|
| CHE 201 | 4 | General Chemistry I |
| CHE 202 | 4 | General Chemistry II |
| or | | |
| CHE 211 | 4 | College Chemistry I |
| CHE 212 | 4 | College Chemistry II |

*ENP 104 and 105 will substitute for the general education COS 104 requirement; alternatively, COS 104 may be taken.

Electives

Select four additional hours of electives from:

| | | |
|----------|-----|---|
| ENP 252 | 4 | Principles of Engineering |
| ENP 301 | 3 | Statics and Dynamics |
| ENP 321 | 2 | Applied Electromagnetics |
| ENP 331 | 4 | Introduction to Electronics |
| ENP 341 | 4 | Microcomputer Interfacing |
| †ENP 351 | 3 | Thermodynamics |
| ENP 352 | 3 | Materials Science and Solid State Physics |
| ENP 355 | 3 | Fluid Mechanics and Water Flow |
| ENP 370 | 1-4 | Selected Topics |
| ENP 431 | 4 | Advanced Electronics and Microcircuits |
| PHY 201 | 4 | Introductory Astronomy |
| PHY 313 | 2 | Nuclear Radiation Experimental Methods |
| PHY 322 | 3 | Waves and Physical Optics |
| †PHY 350 | 4 | Thermodynamics and Statistical Mechanics |
| PHY 370 | 1-4 | Selected Topics |
| PHY 413 | 2 | Quantum Mechanics II |
| PHY 441 | 3 | Advanced Mathematical Methods in Physics |

†Courses in both areas may count only once.

Systems Requirements

| | | |
|---------|---|------------------------------------|
| COS 120 | 4 | Introduction to Computer Science I |
| IAS 330 | 3 | Human Relations in Organizations |
| MAT 151 | 4 | Calculus I |
| MAT 230 | 4 | Calculus II |
| MAT 240 | 4 | Calculus III |
| MAT 382 | 3 | Advanced Statistical Methods |
| SYS 101 | 3 | Introduction to Systems |
| SYS 390 | 3 | Information Systems Analysis |
| SYS 392 | 1 | Systems Seminar |
| PHY 393 | 3 | Practicum |

Select one course from the following:

| | | |
|---------|---|-------------------------------------|
| COS 121 | 4 | Introduction to Computer Science II |
| COS 240 | 3 | Business Application Programming |

Select one course from the following:

| | | |
|---------|---|-------------------------|
| MAT 210 | 4 | Introductory Statistics |
| MAT 352 | 4 | Mathematical Statistics |

Select one course from the following:

| | | |
|---------|---|-------------------------|
| SYS 401 | 4 | Operations Research |
| SYS 402 | 4 | Modeling and Simulation |

Physics Minor

A minor in physics consists of 20 hours.

Minor Requirements

| | | |
|---------|---|-----------------------|
| PHY 211 | 4 | University Physics I |
| PHY 212 | 5 | University Physics II |

Electives

Select at least 11 elective hours of upper-division (300- or 400-level) physics and engineering courses. ENP 252 may also meet elective hours.

Engineering Physics (BS)

The bachelor of science degree with a major in engineering physics requires the completion of 104-108 hours and is a general engineering degree which prepares students for industry practice or graduate study in a variety of engineering disciplines. This program is accredited by the Engineering Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012; telephone (410) 347-7700.

Program Objectives:

1. Develop Christian leaders who serve God and humanity through active service to their family, church, job, and global community.
2. Develop competent engineers who use their broad knowledge of engineering, science, and mathematics to work in industry or complete advanced degrees.
3. Develop engineers who apply their ability to acquire new knowledge and skills, and who are imbued with the required knowledge, attitude, and experience to continuously strengthen their capabilities.
4. Develop engineers who utilize their project experience to efficiently and satisfactorily solve engineering problems using good problem management and design abilities.
5. Develop engineers who have a strong work ethic, collaborate effectively, demonstrate effective communication skills, and act in an ethically responsible manner.
6. Develop engineers who have an attitude and practice of innovation by effectively developing new solutions with an open mind to creative problem resolution.

Science and Math Requirements

| | | |
|---------|---|---|
| MAT 151 | 4 | Calculus I |
| MAT 230 | 4 | Calculus II |
| MAT 240 | 4 | Calculus III |
| MAT 251 | 4 | Differential Equations |
| PHY 211 | 4 | University Physics I |
| PHY 212 | 5 | University Physics II |
| PHY 311 | 4 | Modern Physics |
| PHY 321 | 3 | Electricity and Magnetism |
| PHY 341 | 3 | Math Methods in Physics and Engineering |

Select one course from the following:

| | | |
|---------|---|---------------------|
| CHE 201 | 4 | General Chemistry I |
| CHE 211 | 4 | College Chemistry I |

Select one course from the following:

| | | |
|----------|---|--|
| NAS 480 | 1 | Natural Science Seminar |
| IAS 231H | 2 | Issues in Science and Religion (<i>Honors</i>) |

Engineering Requirements

| | | |
|---------|---|--|
| ENP 104 | 2 | Introduction to Engineering & Software Tools |
| ENP 105 | 1 | Introduction to Engineering Ethics |
| COS 120 | 4 | Introduction to Computer Science I |
| ENP 252 | 4 | Principles of Engineering |
| ENP 301 | 3 | Statics and Dynamics |
| ENP 331 | 4 | Introduction to Electronics |
| ENP 332 | 4 | Control Systems |
| ENP 351 | 3 | Thermodynamics |
| ENP 352 | 3 | Materials Science and Solid State Physics |
| ENP 392 | 2 | Junior Engineering Project |
| ENP 393 | 2 | Practicum |
| ENP 491 | 1 | Review of the Fundamentals of Engineering |
| ENP 492 | 2 | Engineering Senior Capstone I |
| ENP 493 | 3 | Engineering Senior Capstone II |
| ENP 494 | 1 | Engineering Senior Capstone III |

Other Requirements

| | | |
|---------|---|----------------------------------|
| ECO 201 | 4 | Principles of Microeconomics |
| IAS 330 | 3 | Human Relations in Organizations |

Tier A Electives

(Tier A must total at least 15 hours.)

| | | |
|---------|-----|--|
| ENP 302 | 3 | Strength of Materials and Machine Design |
| ENP 321 | 2 | Applied Electromagnetics |
| ENP 333 | 3 | Introduction to Solid State Devices |
| ENP 341 | 4 | Microcomputer Interfacing |
| ENP 345 | 3 | Fundamentals of Space Systems |
| ENP 355 | 3 | Fluid Mechanics and Water Flow |
| ENP 357 | 3 | Heat Transfer |
| ENP 394 | 2-4 | Advanced Engineering Project |
| ENP 431 | 4 | Advanced Electronics and Microcircuits |
| ENx xxx | 4 | Earth Science Elective |
| COS 121 | 4 | Introduction to Computer Science II |
| COS 230 | 2 | Missions Technology |
| COS 331 | 3 | Data Communication |
| PHY 313 | 2 | Nuclear Radiation Experimental Methods |
| SYS 390 | 3 | Information Systems Analysis |
| SYS 403 | 3 | Operations Management |

Tier B Electives

(Tier A plus B must total at least 18 hours.)

| | | |
|---------|---|--|
| PHY 322 | 3 | Waves and Physical Optics |
| PHY 342 | 3 | Analytical Mechanics |
| PHY 412 | 3 | Quantum Mechanics |
| PHY 441 | 3 | Advanced Mathematical Methods in Physics |
| ENT 422 | 3 | New Venture Planning |
| MAT 245 | 4 | Linear Algebra |
| MAT 352 | 4 | Mathematical Statistics |

Environmental Engineering (BS)

The bachelor of science degree with a major in environmental engineering requires 93-98 hours and provides a strong background in engineering and environmental science for students who plan to enter environment-related jobs or to attend graduate school.

Physics Requirements

| | | |
|---------|---|--|
| ENP 104 | 2 | Introduction to Engineering & Software Tools |
| ENP 105 | 1 | Introduction to Engineering Ethics |
| ENP 252 | 4 | Principles of Engineering |
| ENP 351 | 3 | Thermodynamics |
| ENP 352 | 3 | Materials Science and Solid State Physics |
| ENP 355 | 3 | Fluid Mechanics and Water Flow |
| PHY 211 | 4 | University Physics I |
| PHY 212 | 5 | University Physics II |
| PHY 313 | 2 | Nuclear Radiation Experimental Methods |
| PHY 330 | 2 | Advanced Lab |
| ENP 331 | 4 | Introduction to Electronics |
| PHY 493 | 3 | Physics Senior Capstone |

Select one of the following chemistry course combinations:

| | | |
|---------|---|----------------------|
| CHE 201 | 4 | General Chemistry I |
| CHE 202 | 4 | General Chemistry II |
| or | | |
| CHE 211 | 4 | College Chemistry I |
| CHE 212 | 4 | College Chemistry II |

Select at least three hours of electives from:

| | | |
|---------|---|--|
| CHE 311 | 4 | Organic Chemistry I |
| COS 120 | 4 | Introduction to Computer Science I |
| ENP 321 | 2 | Applied Electromagnetics |
| ENP 332 | 4 | Control Systems |
| ENP 341 | 4 | Microcomputer Interfacing |
| ENP 431 | 4 | Advanced Electronics and Microcircuits |
| PHY 311 | 4 | Modern Physics |
| PHY 321 | 3 | Electricity and Magnetism |
| PHY 341 | 3 | Math Methods in Physics and Engineering |
| PHY 350 | 4 | Thermodynamics and Statistical Mechanics |
| PHY 441 | 3 | Advanced Mathematical Methods in Physics |

Environmental Science Requirements

| | | |
|----------|---|---------------------------------------|
| CHE 320 | 3 | Environmental Chemistry |
| CHE 320L | 1 | Environmental Chemistry Lab |
| ENS 231 | 4 | Introduction to Environmental Science |
| ENS 241 | 4 | Physical Geology |
| ENS 355 | 4 | Geospatial Analysis |
| ENS 402 | 4 | Environmental Law and Policy |

Select four hours of electives from:

| | | |
|---------|---|--|
| ENS 341 | 4 | Earth Materials |
| ENS 361 | 4 | Geomorphology |
| ENS 362 | 4 | Hydrogeology |
| ENS 363 | 4 | Applied Geology and Environmental Planning |

Select one course from the following:

| | | |
|---------|---|-----------|
| ENS 393 | 2 | Practicum |
| PHY 393 | 2 | Practicum |
| ENP 393 | 2 | Practicum |

Students double majoring in engineering physics and environmental engineering do not have to complete two practicum courses.

Mathematics Requirements

| | | |
|---------|---|-------------------------|
| MAT 230 | 4 | Calculus II |
| MAT 240 | 4 | Calculus III |
| MAT 251 | 4 | Differential Equations |
| MAT 352 | 4 | Mathematical Statistics |

Select one option from the following:

| | | |
|----------|---|--|
| MAT 151 | 4 | Calculus I |
| †MAT 145 | 3 | Introduction to Functions and Calculus |
| and | | |
| †MAT 146 | 3 | Functions and Calculus |

†MAT 145 & 146 count as one option.

Physics Science Education (BS)

The bachelor of science degree with a major in physics requires 89-91 hours of professional education courses and major courses. *Secondary Education majors must complete specific general education requirements as outlined by the Education Department.*

Professional Education

| | | |
|---------|----|---|
| EDU 150 | 3 | Education in America |
| EDU 210 | 3 | Writing for Teachers |
| EDU 260 | 3 | Educational Psychology |
| EDU 310 | 2 | Discipline and Classroom Management |
| EDU 309 | 1 | Teaching in Secondary, Junior High/Middle Schools— Special Methods |
| EDU 415 | 1 | Student Teaching Seminar |
| EDU 431 | 15 | Supervised Internship in Secondary Schools |
| NAS 309 | 2 | Science Education Methods |
| SED 320 | 3 | Exceptional Children |

Major Requirements

| | | |
|----------|---|--|
| COS 120 | 4 | Introduction to Computer Science I |
| ENP 331 | 4 | Introduction to Electronics |
| IAS 231H | 2 | Issues in Science and Religion (<i>Honors</i>) |

Select one course from the following:

| | | |
|---------|---|---------------------|
| CHE 201 | 4 | General Chemistry I |
| CHE 211 | 4 | College Chemistry I |

Additional Major Requirements

| | | |
|---------|---|-------------------------|
| MAT 230 | 4 | Calculus II |
| MAT 240 | 4 | Calculus III |
| PHY 211 | 4 | University Physics I |
| PHY 212 | 5 | University Physics II |
| PHY 311 | 4 | Modern Physics |
| PHY 330 | 2 | Advanced Lab |
| PHY 493 | 3 | Physics Senior Capstone |

Select one option from the following:

| | | |
|----------|---|--|
| MAT 151 | 4 | Calculus I |
| †MAT 145 | 3 | Introduction to Functions and Calculus |
| and | | |
| †MAT 146 | 3 | Functions and Calculus |

†MAT 145 & 146 count as one option.

Electives

Select 12 hours of electives from the following:

| | | |
|----------------------------|---|---------------------------|
| ENP 252 | 4 | Principles of Engineering |
| ENP 300-/400-level courses | | |
| PHY 300-/400-level courses | | |

Physical Science Education/Physics Concentration (BS)

The bachelor of science degree with a major in physical science and an emphasis in physics requires 75-80 hours of professional education courses, a physical science core and physics/ mathematics courses. *Secondary Education majors must complete specific general education requirements as outlined by the Education Department.*

Professional Education

| | | |
|----------|----|---|
| EDU 150 | 3 | Education in America |
| EDU 210 | 3 | Writing for Teachers |
| EDU 260 | 3 | Educational Psychology |
| EDU 309 | 1 | Teaching in Secondary, Junior High/Middle Schools— Special Methods |
| EDU 310 | 2 | Discipline and Classroom Management |
| *EDU 332 | 3 | The Junior High/Middle School |
| EDU 415 | 1 | Student Teaching Seminar |
| EDU 431 | 15 | Supervised Internship in Secondary Schools |
| NAS 309 | 2 | Science Education Methods |
| SED 320 | 3 | Exceptional Children |

*EDU 332 is required only for those seeking licensure in junior high/middle school.

Physics Concentration

| | | |
|----------|---|--|
| IAS 231H | 1 | Issues in Science and Religion (<i>Honors</i>) |
| MAT 240 | 4 | Calculus III |
| PHY 311 | 4 | Modern Physics |
| ENP 331 | 4 | Introduction to Electronics |

Physical Science Core

| | | |
|---------|---|-----------------------|
| CHE 211 | 4 | College Chemistry I |
| CHE 212 | 4 | College Chemistry II |
| MAT 230 | 4 | Calculus II |
| PHY 211 | 4 | University Physics I |
| PHY 212 | 5 | University Physics II |

Select one option from the following:

| | | |
|----------|---|---|
| MAT 151 | 4 | Calculus I |
| iMAT 145 | 3 | Introduction to Functions and Calculus and |
| iMAT 146 | 3 | Functions and Calculus |

iMAT 145 & 146 count as one option.

Electives

Select four hours of electives from the following:

| | | |
|----------------------------|---|---------------------------|
| ENP 252 | 4 | Principles of Engineering |
| ENP 300-/400-level courses | | |
| PHY 300-/400-level courses | | |

Physics/Mathematics Education (BS)

The bachelor of science degree with a major in physics/mathematics education requires 91-99 hours of professional education courses, physics and mathematics courses. *Secondary Education majors must complete specific general education requirements as outlined by the Education Department.*

Professional Education

| | | |
|----------|----|---|
| EDU 150 | 3 | Education in America |
| EDU 210 | 3 | Writing for Teachers |
| EDU 260 | 3 | Educational Psychology |
| EDU 309 | 1 | Teaching in Secondary, Junior High/Middle Schools— Special Methods |
| EDU 310 | 2 | Discipline and Classroom Management |
| *EDU 332 | 3 | The Junior High/Middle School |
| EDU 415 | 1 | Student Teaching Seminar |
| EDU 431 | 15 | Supervised Internship in Secondary Schools |
| SED 320 | 3 | Exceptional Children |

Select one course from the following:

| | | |
|----------|---|-------------------------------|
| N7AS 309 | 2 | Science Education Methods |
| MAT 309 | 2 | Mathematics Education Methods |

*EDU 332 is required only for those seeking licensure in junior high/middle school.

Physics Core

| | | |
|----------|---|--|
| COS 120 | 4 | Introduction to Computer Science I |
| IAS 231H | 2 | Issues in Science and Religion (<i>Honors</i>) |
| PHY 211 | 4 | University Physics I |
| PHY 212 | 5 | University Physics II |
| PHY 311 | 4 | Modern Physics |
| ENP 331 | 4 | Introduction to Electronics |

Select one course from the following:

| | | |
|---------|---|-----------------------------|
| PHY 493 | 3 | Physics Senior Capstone |
| MAT 493 | 3 | Mathematics Senior Capstone |

Mathematics Core

| | | |
|----------|---|--|
| MAT 230 | 4 | Calculus II |
| MAT 240 | 4 | Calculus III |
| MAT 245 | 4 | Linear Algebra |
| MAT 251 | 4 | Differential Equations |
| *MAT 280 | 3 | Mathematics in the Junior High/Middle School |
| MAT 312 | 4 | College Geometry |
| MAT 352 | 4 | Mathematical Statistics |

Select one option from the following:

| | | |
|----------|---|---|
| MAT 151 | 4 | Calculus I |
| iMAT 145 | 3 | Introduction to Functions and Calculus and |
| iMAT 146 | 3 | Functions and Calculus |

iMAT 145 & 146 count as one option.

*MAT 280 is required only for those seeking licensure in junior high/middle school.

Electives

Select four hours of electives from the following:

| | | |
|----------------------------|---|---------------------------|
| ENP 252 | 4 | Principles of Engineering |
| ENP 300-/400-level courses | | |
| PHY 300-/400-level courses | | |

Computer Engineering

Computer engineering is an interdisciplinary major offered jointly by the physics and engineering & computer science and engineering departments. See computer science and engineering department (pages 165-174) for program details.

Physics Courses

PHY 120 4 hours

Experiences in Physical Science

Intended for non-science majors. Selected topics from physical science are studied to afford insight into man's current understanding of natural phenomena, the models used to represent nature, and methods used in the quest to fathom the physical universe. Three hours of lecture and two hours of lab each week. *Meets general education physical science requirement. Offered intermittently.*

PHY 170 1-4 hours

Selected Topics

A course offered on a subject of interest but not listed as a regular course offering. *May count toward the departmental major and general education requirements.*

PHY 201 3-4 hours

Introductory Astronomy

A descriptive course about the solar system, stars and stellar evolution, and galaxies and the universe. Recent findings of space exploration and radio astronomy are included. Telescopes are provided for viewing sessions. Two or three hours of lecture and two hours of lab. *Physics or Engineering Physics majors wishing to take PHY 201 for elective credit must take the "majors-only" lab section that is offered periodically. Students interested in this option should consult with the department chair to determine availability of this special lab section. Students taking PHY 201 for elective credit should also check to ensure that they maintain the required minimum number of upper-division credit hours. Meets general education earth science requirement. Offered January interterm for three credit hours and fall semesters for four credit hours.*

PHY 203 4 hours

General Physics I

A study of mechanics, thermodynamics, waves and sound, electricity, magnetism, and optics. Assumes mathematics at the algebra-trigonometry level. For majors that do not require a calculus-based treatment of physics. *Meets general education physical science requirement. Three hours of lecture and two hours of lab. Offered annually.*

PHY 204 4 hours

General Physics II

See PHY 203.

PHY 211 4 hours

University Physics I

A calculus-based study of mechanics, waves and sound, electricity and magnetism, optics, fluids, and the structure of matter. *Meets general education physical science requirement. Three hours of lecture and two hours of lab. Corequisite: MAT 146 or 151. Offered annually.*

PHY 212 5 hours

University Physics II

Four hours of lecture and two hours of lab. See PHY 211. *Prerequisite: PHY 211.*

PHY 270 1-4 hours

Selected Topics

A course offered on a subject of interest but not listed as a regular course offering. *May count toward the departmental major and general education requirements.*

PHY 311 4 hours

Modern Physics

An introduction to modern physics, including special relativity, quantum effects of radiation and particles, atomic structure, and elementary particles. Three hours of lecture and two hours of lab per week. *Prerequisites: PHY 211, 212. Offered fall semester.*

PHY 313 2 hours

Nuclear Radiation Experimental Methods

A study of nuclear radiation and detection and experimental methods of measuring nuclear radiation. One hour of lecture and two hours of lab per week. *Prerequisites: PHY 211, 212. Offered spring semester of odd years.*

PHY 321 3 hours

Electricity and Magnetism

The vector field approach to electromagnetic theory. Includes electrostatics, magnetostatics, induction, dielectric and magnetic materials, and Maxwell's equations. *Co-requisites: MAT 251 and PHY 341. Prerequisites: PHY 211, 212. Offered fall semester of odd years.*

PHY 322 3 hours

Waves and Physical Optics

Applications of Maxwell's equations, including electromagnetic waves, wave guides, diffraction, and Fourier optics. *Prerequisites: PHY 211, 212, and 321. Offered spring semester of even years.*

PHY 330 1-2 hours

Advanced Lab

Students complete an open-ended project, laboratory experiment or research project. The individual project depends on student and faculty interests. Specific learning outcomes vary depending on faculty, student and project selected. *Prerequisites: ENP 252 or 301 or PHY 311 and junior classification. Offered as needed for physics and engineering physics majors.*

PHY 341 3 hours

Math Methods in Physics and Engineering

An application of analytical and computational methods to various mathematical topics, including linear algebra, matrices, eigenequations, vector field theory, partial differential equations, Fourier series and transforms, orthogonal functions, and complex analysis. Use of a computer application such as MATLAB is required. *Prerequisite: PHY 212. Corequisite: MAT 251. Offered spring semesters.*

PHY 342 3 hours

Analytical Mechanics

A formal treatment of mechanics covering harmonic motion, the translation and rotation of rigid bodies, noninertial reference frames, and gravitation. The course concludes with the Hamiltonian and Lagrangian formulations of mechanics. *Prerequisites: PHY 211, 212, 341. Offered spring semester of even years.*

PHY 350 4 hours

Thermodynamics and Statistical Mechanics

Develops thermal physics and statistical mechanics, with application to solid state physics. In the thermal physics portion of the course, the three laws of thermodynamics are developed and applied to problems. In the statistical mechanics portion, the development of the partition function is accomplished through the microcanonical formalism. The partition function is then applied to various problems, such as: Bose-Einstein and Fermi-Dirac statistics, Bose-Einstein condensation, blackbody radiation, and the behavior of electrons and phonons in solid materials. *Prerequisite: PHY 341. Offered fall of even years.*

PHY 360 1-4 hours

Independent Study

An individualized, directed study involving a specified topic.

PHY 370 1-4 hours

Selected Topics

Current topics include: Astrophysics, Space Science, and Preparation for the Physics GRE.

PHY 393 1-4 hours

Practicum

Supervised learning involving a first-hand field experience or a project. Generally, one hour of credit is awarded for a minimum of 40 hours of practicum experience. *Offered primarily during summer.*

PHY 412 3 hours

Quantum Mechanics

A quantum mechanical treatment of the free particle, harmonic oscillator and hydrogen atom. Includes creation and annihilation operators and an introduction to angular momentum. *Prerequisites: PHY 211, 212, 311 and 341. Offered spring semester of odd years.*

PHY 413 2 hours
Quantum Mechanics II
An in-depth treatment of several advanced topics in quantum mechanics. Topics covered include spin, angular momentum, three-dimensional problems, matrix mechanics, the density matrix, and perturbation theory. *Prerequisite: PHY 412. Offered fall semester of odd years.*

PHY 441 3 hours
Advanced Mathematical Methods in Physics
Application of analytical and computational methods to various advanced mathematical topics in physics, such as: group theory, complex analysis, partial differential equations, Green's functions, the Gamma function, Bessel functions, Legendre functions, and Fourier analysis. *Prerequisite: PHY 341. Offered fall of even years.*

PHY 450 1-4 hours
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.

PHY 480 1-4 hours
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

PHY 490 1-2 hours
Honors
Individualized study or research of an advanced topic within a student's major. Open to students with at least a 3.00 GPA in the major field.

PHY 493 3 hours
Physics Senior Capstone
A capstone course in which each senior's technical, analytical, and laboratory skills, along with coursework knowledge, are applied to an intensive physics or engineering project. Three weeks are devoted to the completion of the project, and the remainder of the term is spent off-campus, strengthening interpersonal relationships, integrating faith and learning, and examining topics critical to post-baccalaureate life. *Prerequisite: Senior status.*

Engineering Physics Courses

ENP 104 2 hours
Introduction to Engineering and Software Tools
This course introduces the students to the engineering discipline, providing a hands-on over-view of the tools they will acquire and use over the course of their major. These tools include process and methodology tools, analytical tools, software tools, and hardware tools. A goal of the course is to provide the students with a frame-work for their engineering studies along with a practical 'hands-on' example of what engineering might "look like." This framework should help the student better understand the role, need, and benefit of each successive course in their major. A group hardware project will be carried out as part of the course, helping to engage the students' learning and interest, and re-enforcing the concepts taught in class. *Offered January term every year.*

ENP 105 1 hour
Introduction to Engineering Ethics
Course introduces students to the ethical requirements of the engineering profession and the ethical issues associated with living in a technological intense digital society. Through the course, students should: appreciate the ethical use of computers and dangers of computer misuses, have knowledge of professional codes of ethics, be aware of the impact of technology on society, have an appreciation for the needs of society and how engineering can meet those needs, begin developing an understanding of how their Christian faith integrates with their engineering practice

ENP 170 1-4 hours
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering. *May count toward the departmental major and general education requirements.*

ENP 252 4 hours
Principles of Engineering
This course introduces students to the engineering profession and prepares students for summer internships and upper-division course work and design projects. Topics include: design methodology, parametric 3D modeling, oral and written communication and engineering ethics. The course also introduces Statics, Materials, Thermodynamics, Fluid Statics, Heat Transfer and Finite Element Methods. This course includes a semester-long design project that integrates design methodology, CAD, communication and expertise in various engineering disciplines. *Prerequisites: ENP 104, MAT 230 and PHY 211 or permission of instructor. Offered spring semester.*

ENP 270 1-4 hours
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering. *May count toward the departmental major and general education requirements.*

ENP 301 3 hours
Statics and Dynamics
This course is a one-semester introduction to the statics and dynamics of particles and rigid bodies. Topics include: forces, moments, equilibrium, structures in equilibrium, energy, momentum, kinematics and dynamics in planar and 3D problems. Course makes applications to engineering and uses software tools for engineering mechanics. *Prerequisite: ENP 252. Offered fall semester of even years.*

ENP 302 3 hours
Strength of Materials and Machine Design
Course investigates the fundamentals of strength of materials and machine design. The strength of materials section covers stress – strain relationships, axial loading, torsion, beam loading and linear buckling. The machine design portion applies the fundamental knowledge of statics, dynamics and strength of materials to mechanical components and integration of components into systems. *Prerequisite: ENP 301.*

ENP 321 2 hours
Applied Electromagnetics
The course considers the application and technology of electromagnetic field theory to computing and communications systems. Topics may include wave propagation, transmission lines, fiber optics, high frequency communication networks, antennas, and satellite communications. *Prerequisites: ENP 252, MAT 251, and ENP 331. Offered fall semester of even years.*

ENP 341 4 hours
Microcomputer Interfacing
Course develops the student's ability to design, build and test embedded systems. Hardware architecture and software programming of microcontrollers and other embedded system devices are studied. Operation and use of LCDs, AtoD and DtoA converters, keypads and other interface devices are investigated. Serial communication through I2C, OneWire, USB and RS232 are used. In addition, networking and RF techniques and protocols are studied. *Prerequisite: ENP 331 or permission of instructor. Offered spring semester of odd years.*

ENP 331 4 hours
Introduction to Electronics
Introductory concepts and experiments designed to acquaint students with the operation and application of modern electronic devices and components. Experiments dealing with elementary concepts of electricity, electrical measurements, diodes, transistors, integrated circuits, and a variety of solid state devices, as well as digital electronics, are provided. Three hours of lecture and one three-hour lab each week. *Prerequisites: PHY 211, 212. Offered fall semester.*

ENP 332 4 hours
Control Systems
Linear and nonlinear systems with analytical methods, modeling, forcing functions, response analysis, feedback, stability, control systems, mechanical and fluid systems, electrical systems, three phase circuits and machines, transmission lines, and communications. MATLAB and Interactive Physics software tools are used. *Prerequisites:* ENP 252, MAT 251, or permission of instructor. Offered fall semester of even years.

ENP 333 3 hours
Introduction to Solid State Devices
The course emphasizes the physical foundations underlying properties and operation of modern electronic and photonic devices. The content includes: crystalline structures and quantum mechanics, energy bands in semiconductor (in comparison with metals and insulators), electrons and holes in semiconductors, doping (p and n type), state occupation statistics, transport properties of electrons and holes, p-n junctions, bipolar transistors, MOSFETs and JFETs. In addition, metal devices (e.g. quantum interferometers) and optical devices (dielectrics and waveguides, and photonic crystals) will also be discussed. *Prerequisite:* ENP 331.

ENP 345 3 hours
Fundamentals of Space Systems
Course is an introduction to space systems, the atmosphere, and astronomy. Course includes study and lab experiments coupled to the atmospheric and space environments, atmospheric and space sensors, orbits, nanosatellites, remote sensing, and penetrating nuclear radiation. *Prerequisites:* PHY 212.

ENP 351 3 hours
Thermodynamics
Course develops engineering thermodynamics including use of the first and second law, phase diagrams, properties, heat transfer, second law consequences, power and refrigeration cycles as well as other selected topics. *Prerequisites:* MAT 251, PHY 212, ENP 252. Offered fall semester of odd years.

ENP 352 3 hours
Materials Science and Solid State Physics
The structure, processing, and properties of engineering materials are studied, with an emphasis on metallic systems. This includes: crystal structure, defects, diffusion, phase transformations, deformation mechanisms, strength, and fracture toughness. Also covered are material selection, linear elastic fracture mechanics, and dislocation theory. Course contains a significant research component. *Prerequisite:* ENP 252. Offered spring semester of even years.

ENP 355 3 hours
Fluid Mechanics and Water Flow
An introduction to the basic properties of fluids in motion. Topics include: Differential fluid equations, streamlines, continuity, energy and linear angular momentum, incompressible viscous flow, potential flow, Navier-Stokes equations, open channel flow, pipe flow, laminar and turbulent boundary layers. *Prerequisite:* ENP 252. *Corequisite:* MAT 251. Offered fall semester of odd years.

ENP 357 3 hours
Heat Transfer
Course investigates the fundamentals of heat transfer and applies those fundamentals to engineering applications. Topics covered include modeling of conduction, convection, radiation and mixed mode heat transfer problems. Course covers both steady state and transient response and make applications to satellite thermal control and cooling of electrical devices. *Prerequisite:* ENP 252

ENP 360 1-4 hours
Independent Study
An individualized, directed study involving a specified topic.

ENP 370 1-4 hours
Selected Topics
A course offered on a subject of interest but not listed as a regular course offering. May count toward the departmental major and general education requirements.

ENP 392 2-4 hours
Junior Engineering Project
In the context of completing an engineering project, students learn and practice: elements of the design process, the ability to be innovative and think creatively, the ability to acquire new knowledge and skills, the ability to solve engineering problems, the application of analytical or software tools to engineering problems, and the ability to communicate effectively. *Prerequisite:* ENP 252.

ENP 393 1-4 hours
Practicum
Engineering Practicum is a supervised work experience which integrates significant activities in an industrial setting with principles and skills learned through the educational program. Practicum must involve a significant engineering work experience, and preference is given to an experience away from the Taylor campus. Practicum may be completed between either the sophomore and junior years or between the junior and senior years. Offered primarily during summer. *Prerequisite:* ENP 252.

ENP 394 2-4 hours
Advanced Engineering Project
Students complete an open-ended project, laboratory experiment or research project. The individual project depends on student and faculty interest. Many projects are externally funded. Specific learning outcomes vary depending on faculty, student, and project selected. *Prerequisite:* ENP 252.

ENP 431 4 hours
Advanced Electronics and Microcircuits
Theoretical analog and digital VLSI microcircuit design principles are studied. Implementation and advanced design of digital programmable logic arrays and layout of analog microchips is performed in the lab portion of this course. Electronics topics also include Karnaugh maps and minimization, sequential logic and state machines, device modeling with computer-aided design, controllers, computer hardware, architecture, memories, and interrupt systems. *Prerequisites:* ENP 252, ENP 331. Offered spring semester of even years.

ENP 450 1-4 hours
Directed Research
Investigative learning involving closely directed research and the use of such facilities as the library or laboratory.

ENP 480 1-4 hours
Seminar
A limited-enrollment course designed especially for upper-class majors with emphasis on directed readings and discussion.

ENP 490 1-2 hours
Honors
Individualized study or research of an advanced topic within a student's major. Open to students with at least a 3.00 GPA in the major field.

ENP 491 1 hour
Review of the Fundamentals of Engineering
Course reviews the fundamentals of engineering and prepares students to enter the engineering profession. Depending on students incoming ability, the course will review subjects from chemistry, computers, dynamics, electric circuits, engineering economics, ethics, fluid mechanics, materials science, mathematics, mechanics of materials, statics and thermodynamics. *Prerequisite:* Senior status. Offered fall of every year.

ENP 492 2 hours
Engineering Senior Capstone I
Course is the first of a three-course culminating experience which prepares students for engineering practice through a major design experience based on the knowledge and skills acquired in earlier course work and incorporating engineering standards and realistic constraints that include most of the following considerations: economic, environmental, sustainability, manufacturability, ethical, health and safety, social and political. *Prerequisites:* Senior status. Offered fall semester.

