

the taxonomies of learning, learning styles, multiple intelligence, and educational technology.

PTH749 (1)***Advanced Concepts in Women's Health Laboratory***

Advanced practice and application of clinical skills required in the physical therapy assessment and intervention of women's health. Corequisite: PTH739.

PTH750 (2)***Professional Communication & Consulting***

An introduction to the integration of the physical therapist as consultant. Discussion will include applying physical therapy consultation services to individuals, business, schools, government agencies and/or other organizations.

PTH760 (2)***Applications in Clinical Research***

Information presented on how to develop and present a publishable quality case study. It also includes the actual practice of doing an outcomes study in the clinical environment.

PTH765 (1-2)***Ethical & Legal Issues in Healthcare***

Contemporary ethical issues are explored, including the relationships among peers, superiors, subordinates, institutions, clients, and patients. Illustrations include actual cases related to Christian biblical principles.

PTH768 (1)***Professional Compendium***

Summarization of previous or added learning experiences relative to contemporary issues in physical therapy. An overview of the new graduate's role and responsibility to his/her patients and their families, employer, and community in the expanding physical therapy profession.

PTH788 (0)***Research Project Continuation***

Non-package, reduced tuition rate applies.

PTH798 (1-10)***Capstone Experience***

Serves as an essential outcome component to augment the professional development and new learning that occurs in didactic course work of the postprofessional doctoral degree and demonstrates the ability of the DPT/DScPT to make significant contributions to the profession and/or serve as a change agent in the field of physical therapy.

PTH799 (1-3)***Research Project (topic)***

Provides students with guidelines and supervision for data collection, analysis, capstone project preparation and oral presentation.

PTH880 (1)***PT Seminar***

Preparation of a personal portfolio, assessment of the clinical experiences and preparation for professional licensure.

PTH881, 882, 883, 884 (4, 4, 5, 5)***Clinical Affiliation I, II, III, IV***

Advanced full-time clinical experience (8-10 weeks each) in a variety of professional practice settings. One of the affiliations must be in outpatient orthopedics, inpatient, and a neurology setting. Thirty-six to forty hours per week. May be repeated.

PHYSICS

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Faculty

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Emeriti

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Academic Programs	Credits
BS: Physics	40
BS: Biophysics	40
Physics as a Second Major	30
Minor in Physics	20

Physics describes the world in terms of matter and energy and relates the many facets of its phenomena in terms of fundamental law. Its scope includes systems that range in size from the sub-nuclear to the entire cosmos.

A major in physics supports and enhances professional careers in engineering, the life sciences, the physical sciences, and similar areas.

A major in biophysics prepares the graduate for advanced studies in medical and bioengineering fields. Both physics programs prepare the graduate for a career in secondary teaching.

A *second major in physics* is an add-on major that complements other majors without incurring additional general education requirements. It strengthens and expands marketability and interdisciplinary opportunities.

Physics majors desiring secondary-teaching certification should also consult with the School of Education.

UNDERGRADUATE PROGRAMS

BS: Physics—40

Major Requirements: PHYS241, 242, 271, 272, 277, 377, 411, 430, 431, 477, 481, 495 plus an additional 12 credits numbered 300 and above.

Cognate Courses: MATH141, 142, 215, 240, 286; CHEM131, 132; and CPTR125 (FORTRAN or C++) or CPTR151.

Physics majors desiring secondary-teaching certification should also consult with the School of Education.

Recommended Electives: ELCT141, 142, TCED250.

BS: Biophysics—40

Offered by the biology and physics departments

BIOL165, 166, 371; 372 or BCHM421*; PHYS241, 242, 271, 272, 277, 377, 411, 416, 430 or CHEM431 and 441, PHYS431, 495

*A student may earn a minor in chemistry by selecting BCHM421 or CHEM431 and 441.

Cognate Courses: CHEM131, 132, 231, 232, 241, 242; MATH141, 142, 286.

Recommended Electives: BCHM422, 430; CHEM432,442; ELCT141, 142; MATH215, 240.

Students electing to take a BS: Biophysics should consult with the chair of the Physics Department. Biophysics majors who are interested in secondary teaching need to select electives to meet certification requirements and should consult with the School of Education early in their programs.

Senior Thesis. Physics and Biophysics majors may elect to perform original research in a topic of mutual interest with a Physics Department faculty member and present this original work in the form of a senior thesis. Students are expected to log a minimum of 180 hours, and may receive up to 3 credits in PHYS495 or HONS497. Research scholarships are available.

Physics as a Second Major—30

Major Requirements: PHYS241, 242, 271, 272, 277, 377, 411 (or ENGR285 and PHYS412), 430, 431 or ENGR435, 481, 495 plus an additional 3.5–6 credits numbered 300 and above in consultation with advisor.

Cognate Courses: MATH141, 142, 240, 286

This major is available only as a second major, to those taking a major in another field.

Minor in Physics—20

PHYS241, 242, 271, 272, 411, and electives chosen in consultation with the department chair.

PHYS110, 115, 405 are not applicable to a major or minor in Physics or a major in Biophysics.

GRADUATE PROGRAM

The Department of Physics collaborates in the MS: Mathematics and Science with the Departments of Mathematics, Biology, and Chemistry. See the program description under Mathematics and Science, p. 151.

COURSES

See inside front cover for symbol code.

PHYS110 \$ CS (4)

Astronomy

Exploring the cosmic environment—the solar system, stars and their development, star clusters, the interstellar medium, galaxies, and large-scale features of the Universe. Meets the physical science general education requirement and may substitute for Scientific Inquiry. Weekly: 3 lectures, 1 recitation, and a 2-hour lab. Prerequisite: MATH145 or 166 or MPE P3.

PHYS110 V \$ (3)

Astronomy

AU/HSI course—see content above.

PHYS115 \$ CS (4)

Concepts of Physics

A conceptual approach to physics—forces, matter, and energy with 21st century applications. Meets the physical science general education requirement and may substitute for Scientific Inquiry. Weekly: 3 lectures, 1 recitation, and a 2-hour lab. Prerequisite: MATH145 or 166 or MPE P3.

PHYS141, 142 \$ (4, 4)

General Physics

Algebra based introduction to mechanics, relativity, heat, electricity, magnetism, wave motion, physical and geometric optics, and modern physics. Weekly: 3 lectures, 1 recitation, and one 3-hour lab. Prerequisite: A minimum of MATH167 or MATH168 or MPE P4.

PHYS241, 242; PHYS241H, 242H (4, 4)

Physics for Scientists and Engineers

An introduction to mechanics, relativity, heat, electricity, magnetism, wave motion, physical and geometrical optics, and modern physics emphasizing the mathematical formulation and the physical significance of the fundamental principles. Honors credit is available as PHYS241H, 242H. Weekly: 4 lectures and 1 recitation. Prerequisite for PHYS241: MATH141. Corequisite: PHYS271. Prerequisite for PHYS242: MATH142. Corequisite: PHYS272.

PHYS271, 272; PHYS271H, 272H \$ (1, 1)

Physics for Scientists Laboratory

Weekly: one 3-hour lab. Honors credit is available as PHYS271H, 272H. Corequisites: PHYS241, 242.

PHYS277 (0.5)

Physics Colloquium

A weekly colloquium highlighting current topics and issues of interest to the physics community. Students register only in the spring semester, but attendance is required in both fall and spring semesters. A faculty mentor is assigned to each student to guide the preparation and presentation of one short talk. Grades are based on attendance and the quality of the presentation and its content. Required of all physics and biophysics majors each year, except those in which PHYS377 or PHYS477 is taken. Repeatable. *Spring*

PHYS280 (0.5–3)

Topics in _____

Introductory-level topics in astrophysics or other areas of current interest. Repeatable to 4 credits. Minimum of 4 hours work per week is required for each credit earned. Approval of the instructor is required.

PHYS295 (1–2)

Independent Study / Research

Reading and lab projects (e.g., holography and astrophotography). Repeatable to 4 credits. A minimum of 4 hours work per week is required for each credit earned. Approval of the instructor is required.

PHYS350 Alt (2.5)

Optics

Geometrical and physical optics; interference and diffraction, polarization, Fourier optics, lasers, and holography. Prerequisites: PHYS242 (recommended) or 142; MATH142.

PHYS377 \$ (1)

Advanced Physics Laboratory I

Development of advanced lab skills in the study of basic physical phenomena. Emphasis includes scientific instrumentation, lab procedure, data reduction, interpretation, and technical communication. Repeatable to 2 credits.

- PHYS400** ♦ (1–2)
Demonstrations in Physics
 Consideration of topics suitable for demonstration, a survey of the literature, prepared demonstrations, suppliers of materials and equipment. A critical evaluation of demonstrations—their design, preparation, and execution—with student participation. Prerequisite: Approval of the department.
- PHYS405** ♦ Alt \$ (3)
Acoustics of Music and Hearing
 Investigation of the properties of sound with respect to structure of musical sounds, production by musical instruments and human vocal chords, sound intensity and hearing, reverberation, and auditorium acoustics. For persons interested in a better understanding of music, speech, and hearing. Cannot be applied toward a major or minor in physics. Weekly: 2 lectures and a 2-hour lab. Prerequisite: MATH145 or 166 or MPE P3.
- PHYS411, 412** ♦ Alt-412 (2.5, 2.5)
Theoretical Mechanics
 Statics, kinematics, and dynamics of systems of particles. Application of vector calculus to mechanics; Lagrangian and Hamiltonian formulations. Prerequisite: PHYS242 (recommended) or PHYS142; MATH142.
- PHYS416** ♦ Alt (2.5)
Biophysics
 Modeling and describing physical phenomena of living systems. Topics deal with transport and diffusion across membranes and electrical processes in muscle and nerve tissue. Prerequisite: PHYS242 (recommended) or PHYS142; MATH142.
- PHYS420** (2–3)
Advanced Topics in _____
 Astrophysics, atomic physics, nuclear physics, relativity or other areas of current interest. Prerequisite: PHYS242 or 411. Repeatable to 6 credits.
- PHYS430** ♦ Alt (2.5)
Thermodynamics and Statistical Mechanics
 Systematic introduction to thermodynamics, kinetic theory, and statistical mechanics (classical and quantum). Prerequisites: PHYS242 (recommended) or PHYS142; MATH142.
- PHYS431, 432** ♦ Alt (3, 3)
Electricity and Magnetism
 A treatment of electromagnetic phenomena in terms of potentials and vector fields. PHYS431 develops Maxwell's equations with descriptions of electrostatics and magnetostatics as solutions to Laplace's and Poisson's equations. PHYS432 addresses electromagnetic radiation in media, reflection and refraction, and the fields of wave guides and antennae. Prerequisite or concurrently enrolled in PHYS411.
- PHYS445** ♦ Alt (2.5)
Particle Physics
 A study of particle properties, forces, structure, decay and reaction mechanism in the context of the Standard Model. Prerequisite: PHYS481.
- PHYS460** ♦ Alt (2.5)
Solid State Physics
 A study of crystallography, x-ray diffraction, properties of crystalline and amorphous solids, band theory of solids, and lattice dynamics. Prerequisite: PHYS411.
- PHYS475** (2.5)
Physics Review
 A review and synthesis of physics concepts and analytical and experimental techniques in preparation for entry into a graduate program. Topics include classical, statistical and quantum mechanics, waves and classical fields. Prerequisite: PHYS411.
- PHYS477** ♦ \$ (1)
Advanced Physics Laboratory II
 Important phenomena, equipment, and techniques in modern experimental physics. Repeatable to 2 credits.
- PHYS481, 482** ♦ Alt (3, 3)
Quantum Mechanics
 The mechanics of small-scale physical phenomena as developed by Heisenberg, Schroedinger, and Dirac. Treatment of square well, step, and harmonic oscillator potentials; uncertainty relations; and symmetries to include angular momenta. Prerequisite or concurrently enrolled in PHYS411.
- PHYS495** (1–3)
Independent Study/Research
 Individually directed study or research in selected fields of physics. Repeatable to 6 credits. A minimum of 4 hours work per week is required for each credit earned. A written paper required. Approval of the instructor required.
- PHYS530** (1–3)
Topics in Teaching Physics
 Discussions on 1) the principles of physics and effective approaches for teaching them, or 2) the physics lab, its purposes, administrative and safety procedures, essential equipment, seminal experiments, data analysis, lab journal, and reports. Repeatable to 9 credits.
- PHYS540** (2–3)
Topics in Physics
 Study in one of the traditional areas of graduate physics such as electromagnetic theory, analytical or quantum mechanics, solid state, atomic, nuclear or high energy physics, astrophysics, relativity, or mathematical physics. Students must complete assigned readings and problems. Satisfactory performance on a written or oral comprehensive exam required. Repeatable to 9 credits.
- PHYS648** (1–3)
Workshop
 Intensive programs for teachers wishing to qualify in physics, update their skills in the physics laboratory, or otherwise enhance their existing physics program with the latest technology.
- PHYS690** (1–3)
Independent Study/Research
 Independent problems of research in selected fields of physics. Open to qualified students who show ability and initiative. Repeatable to 6 credits. A minimum of 4 hours work per week expected for each credit earned. Prerequisite: Consent of department chair.