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 in the sciences to meet certification requirements. Such persons should consult with the biophysics advisor and the School of Education early in their programs.

Minor in Physics—20
Chosen in consultation with the department including PHYS241, 242, and 271, 272.

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

Graduate Program

The Physics Department collaborates in the MS: Interdisciplinary Studies (Mathematics and Physical Sciences). See the Interdisciplinary Studies section, p. 128.

Courses

See inside front cover for symbol code.

PHYS110 Astronomy
Explodes the cosmic environment. Topics include the solar system, stars and their development star clusters, the interstellar medium, galaxies, and the large-scale features of the universe. Meets the natural science elective course requirement. Weekly: 2 lectures, 1 recitation, and a 2-hour lab. Prerequisite: MATH145 or 166 or MPE P3.

PHYS110 H Astronomy
AU/HSI course—see content above.

PHYS115 Concepts of Physics
A conceptual approach to physics for the non-science student. Explores matter, energy, motion, waves, electricity, and magnetism and quantum physics. Meets the natural science elective course requirement. Weekly: 2 lectures, 1 recitation, and a 2-hour lab. Prerequisite: MATH145 or 166 or MPE P3.

PHYS141, 142 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 MPE P5.

PHYS241, 242 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. Weekly:

**PHYS271, 272**  
$ (1, 1)  
**Physics for Scientists Laboratory**  

**PHYS280**  
(1-3)  
**Topics in________**  
Introductory-level topics in astrophysics, high-energy physics, 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 (i.e., 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)  
**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**  
$ (1)  
**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**  
$ (1)  
**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, biophysics, nuclear physics, relativity or other areas of current interest. Prerequisite: PHYS242 or 411. Repeatable to 6 credits.

**PHYS430**  
$ (2.5)  
**Thermodynamics**  
Systematic introduction to thermodynamics, kinetic theory, and statistical mechanics (classical and quantum). Prerequisites: PHYS242 (recommended) or PHYS142; MATH142.

**PHYS431, 432**  
$ (2.5)  
**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**  
$ (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**  
$ (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**  
Acquaints students with important phenomena, equipment, and technique of modern experimental physics. Repeatable to 2 credits.

**PHYS481, 482**  
$ (2.5)  
**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
Topics in Teaching Physics
Each time the course is offered, one of the following areas is discussed:
• Principles of physics and effective approaches for teaching them.
• The physics lab, its purposes, administrative and safety procedures, essential equipment, seminal experiments, data analysis, lab journal, and reports.
Repeatable to 6 credits.

PHYS540
Topics in Physics
Study of one of the traditional areas of graduate physics such as electromagnetic theory, analytical mechanics, solid state physics, astrophysics, mathematical physics, and theoretical physics.
Students must complete assigned readings and problems. Satisfactory performance on a written or oral comprehensive exam required. Repeatable to 9 credits.

PHYS648
Workshop
PHYS690
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.

RELIGION AND BIBLICAL LANGUAGES
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Ranko Stefanovic
Woodrow W. Whidden II

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Programs

BA: Theology
Choose from one of the following:

Pastoral Ministry Emphasis—68
RELB110, 115, 210, 214, 335, 406, 476; RELH316, 317;
HIST404; RELP200 (Twice), 240, 331, 332, 333, 334, 441, 442;
RELT100, 226, 250, 308, 340, 400; BIBL211, 212, 317, 321, 322, 409, 410, 427.
Competence in Greek equivalent to the level represented by BIBL212 is required.

Required Cognates (9 credits): HIST404; RELH316, 317.
Minimum grades of C- must be earned in HIST404 and in all RELB, RELH, RELP, and RELT courses to apply to major requirements.

Youth Ministry Emphasis—74
RELB110, 115, 210, 214, 335, 406, 476; RELP200 (Twice), 240, 331, 332, 333, 334, 335, 441, 442; RELT100, 226, 250, 308, 340; BIBL211, 212, 321, 322, 409, 410.
Competence in Greek equivalent to the level represented by BIBL212 is required; choose three from ANTH200, BHSC220, FMST454, 456, PSYC204, 251, 252, 319, 454, SOCI120, 345, 415, 430