PHYSICS

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Stephen C. Thorman

Emeriti
Ronald L. Johnson, Director, Physics Enterprises
Robert E. Kingman
S. Clark Rowland

Academic Programs Credits
BS: Physics 40
BS: Biophysics 40
BS: Physics Education 30
Major in Physics Studies 30
Minor in Physics 20

Mission
Advance the appreciation, understanding and application of physics in the context of personal integrity and service, scientific rigor, and Seventh-day Adventist faith.

Strategies
A. Create an environment of scholarly inquiry, learning, and creativity
B. Develop technical, analytical, and critical thinking skills
C. Provide opportunities for intellectual independence, collaboration, and outreach
D. Promote personal wholeness, integrity, balance, and spiritual well-being

Student and Faculty Goals
1. Understand physics ideas, principles and interpretation, supporting and participating in research and education
2. Measure, analyze and model physical phenomena, lending insight to other disciplines and professions
3. Communicate scholarship in written and oral form, networking with scholarly, faith, and civic communities
4. Connect scientific and religious world views, serving the Seventh-day Adventist Church and society

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

The BS: Biophysics program prepares the graduate for direct entry into the workforce or advanced studies in medical and bioengineering fields as well as biophysics.

The BS: Physics Education program prepares the graduate for a career in secondary teaching.

The Major in Physics Studies is an add-on degree program that complements any baccalaureate degree without incurring additional general education requirements. It strengthens and expands marketability and interdisciplinary opportunities.

A Minor in Physics complements any baccalaureate degree. It is the minimum requirement for secondary teaching certification in physics. All physics majors and minors desiring certification should consult with the School of Education throughout their program.

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
*PHYS277 is required every semester. MATH389 may substitute for PHYS277.
Cognate Courses: MATH191 or 195, 192, 215, 240, 286; CHEM131, 132; and CPTR25 or 151 or PHYS235.
Secondary-teaching Certification: Physics majors desiring secondary-teaching certification should also consult with the School of Education. Program is certified by the State of Michigan.
Recommended Electives: ELCT141, 142, TCED250

BS: Biophysics (40)
Offered by the biology and physics departments
BIOL165, 166, 371; 372 or BCHM421*; PHYS241, 262, 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.
**PHYS277 is required every semester. MATH389 may substitute for PHYS277.
Cognate Courses: CHEM131, 132, 231, 232, 241, 242; MATH191 or 195, 192, 286
Recommended Electives: BCHM422, 430; CHEM432, 442; ELCT141, 142; MATH215, 240

Senior Thesis. All Physics and Biophysics majors do some original research in collaboration with an established physicist on-campus or at another university, industrial or national laboratory. If students enroll for 3 credits of PHYS495 or HONS497, they may prepare a Senior Thesis. Undergraduate Research Scholarships are available through the Office of Research & Creative Scholarship when students collaborate with Andrews Physics faculty.

BS: Physics Education (30)
Major Requirements: PHYS241, 242, 271, 272, 277,* 377, 411, 430, 431, 481, 495 plus an additional 6 credits numbered 300 and above in consultation with advisor.
*PHYS277 is required every semester. MATH389 may substitute for PHYS277.
**Cognate Courses:** MATH191 or 195, 192, 240, 286; CHEM131
This major is available only to those who are obtaining secondary teacher certification. Pending approval for certification by the state of Michigan.

**Major in Physics Studies**

**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.
*PHYS277 is required every semester. MATH389 may substitute for PHYS277.

**Cognate Courses:** MATH191 or 195, 192, 240, 286
This major is available only as a second major. It is designed to complement engineering, computer science, chemistry and mathematics degrees, but may be added to a major in any field.

**Minor in Physics**

**Minor Requirements:** PHYS241, 242, 271, 272, 277, 411, and electives chosen in consultation with the department chair.
*PHYS277 is required every semester. MATH389 may substitute for PHYS277.

**Secondary-teaching Certification:** Students in a teacher certification program are required to take PHYS430. Program is certified by the State of Michigan.

**Graduate Program**

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

**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 General Education Physical Science requirement. Does not apply to a major or minor. Weekly: 3 lectures, 1 recitation, and a 2-hour lab. Prerequisite: MPE P2 or MATH145 or 166 or STAT285. *Fall, Spring*

**PHYS110 V $ (3)**

*Astronomy*
AU/GU course—see content above.

**PHYS115 $ CS (4)**

*Mythbusting*
Examining what is commonly believed about the physical world and how to realign it with measurable reality. A conceptual and relevant understanding of physics—forces, matter and energy with 21st century applications. Meets the General Education Physical Science requirement. Does not apply to a major or minor. Weekly: 3 lectures, 1 recitation and a 2-hour lab. Prerequisite: MPE P2 or any GE-level math course.

**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: MPE P4 or MATH167 or 168. PHYS142 must be preceded by PHYS141.

**PHYS225 $ CS (4)**

*Sound and Waves*
The production, transmission, synthesis, and perception of sound as understood through the physical principles, properties, and nature of waves. Includes a survey of applications—music, speech, locomotion, and imaging—and comparisons with light and other kinds of waves. Meets the General Education Physical Science requirement. Does not apply to a major or minor. Weekly: 3 lectures and a 2-hour lab. Prerequisite: MPE P2 or MATH145 or 166 or STAT285.

**PHYS235 $ (2–3)**

*MATLAB*
An introduction to MATLAB programming with a focus on its application to physics problems. The capabilities of MATLAB are explored in the areas of graphing, data analysis, numerical methods, Fourier analysis, and signal processing. Weekly: 1 lecture/lab 4 hours.

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

*Physics for Scientists and Engineers*
Algebra based introduction to mechanics, relativity, heat, electricity, magnetism, wave motion, physical and geometric optics, and modern physics emphasizing the mathematical formulation and the physical significance of fundamental principles. Honors credit is available as PHYS241H, 242H. Weekly: 4 lectures and 1 recitation. Prerequisite for PHYS241 or 241H: MATH191 or 195. Corequisite for PHYS241 or 241H: PHYS271 or 271H. Prerequisites for PHYS242 or 242H: MATH192 and PHYS241 or 241H. Corequisite for PHYS242 or 242H: PHYS272 or 272H.

**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 or PHYS241H, 242H.

**PHYS277 $ (0)**

*Physics Colloquium*
Current topics and issues of interest to the physics community. Required each semester of all students with a physics major or minor. Weekly: 1 lecture or activity. Repeatable. Interchangeable with MATH389.

**PHYS280 $ (0.5–3)**

*Topics in________*
Introductory-level topics in astrophysics, other current physics area or associated scientific programming. Repeatable to 4 credits. Minimum of 4 hours per week is required for each credit earned. Prerequisite: Approval of the instructor.

**PHYS295 $ (1–2)**

*Independent Study/Research*
Individually directed reading and lab projects (e.g., holography and astrophotography). A minimum of 4 hours per week is required for each credit earned. Repeatable to 4 credits. Prerequisite: Approval of the instructor.
PHYS350 Optics
Geometrical and physical optics; interference and diffraction, polarization, Fourier optics, lasers, and holography. Prerequisite: PHYS242 (recommended) or 142; MATH192.

PHYS377 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. Spring

PHYS400 Demonstrations in Physics
Identifying topics suitable for demonstration, surveying the literature, preparing demonstrations, finding suppliers of materials and equipment. A critical evaluation of demonstrations—their design, preparation, and execution—with student participation. Prerequisite: Approval of the department chair.

PHYS411, 412 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; MATH192. Fall, Spring (even years)

PHYS416 Biophysics
Modeling and describing physical phenomena of living systems, including transport and diffusion across membranes and electrical processes in muscle and nerve tissue. Prerequisite: PHYS142 or 242; MATH192. Spring (odd years)

PHYS420 Advanced Topics in________
Astrophysics, atomic physics, nuclear physics, relativity or other current physics area. Prerequisite: PHYS242 or 411. Repeatable to 6 credits.

PHYS430 Thermodynamics and Statistical Mechanics
Systematic introduction to thermodynamics, kinetic theory, and statistical mechanics (classical and quantum). Prerequisites: PHYS142 or 242; MATH192. Spring (odd years)

PHYS431, 432 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 corequisite: PHYS411. Full (even years), Spring (odd years)

PHYS455 Particle Physics
A study of particle properties, forces, structure, decay and reaction mechanism in the context of the Standard Model. Prerequisite: PHYS481. Spring (even years)

PHYS460 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 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. Fall

PHYS477 Advanced Physics Laboratory II
Important phenomena, equipment, and techniques in modern experimental physics. Repeatable to 2 credits. Spring

PHYS478 Study Tour:
Travel to destinations relevant to individual programs of study. Classes will be selected from department(s) offerings. Fee may be required.

PHYS481, 482 Quantum Mechanics
The mechanics of small-scale physical phenomena as developed by Heisenberg, Schrodinger, and Dirac. Treatment of square well, step, and harmonic oscillator potentials; uncertainty relations; and symmetries to include angular momenta. Prerequisite or corequisite: PHYS411. Fall (odd years), Spring (even years)

PHYS495 Independent Study/Research
Individually directed study, problem-solving, or research in selected fields of physics. A minimum of 4 hours work per week is required for each credit earned and a written paper is required. Repeatable to 6 credits. Prerequisite: Approval of the instructor.

PHYS530 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 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.

PHYS577 Physics Colloquium
Current topics and issues of interest in the physics community. Required each semester of MS: Mathematics and Science students not enrolled in MSC1575 and whose program includes physics as one of their two areas. For non-zero credit options, includes specialized study and the preparation and delivery of a public
presentation. Weekly: 1 lecture or activity. Half credit possible. Repeatable to maximum of 1 credit.

PHYS648 Workshop (1–3)
An intensive program for middle school and secondary teachers and teachers-in-training who seek certification or endorsement in physics and who wish to update and expand their skills in the physics laboratory.

PHYS690 Independent Study/Research (1–3)
Individually directed study, problem-solving, or research in selected fields of physics. Open to qualified students who show ability and initiative. A minimum of 4 hours work per week expected for each credit earned. Repeatable to 6 credits. Prerequisite: Consent of department chair.

RELIGION & BIBLICAL LANGUAGES
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Academic Programs

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<td>Emphasis Areas</td>
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<td>Pastoral Ministry</td>
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<td>BA: Religion (Distance Degree)</td>
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<td>AA: Personal Ministries (Distance Degree)</td>
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<td>Minor in Biblical Languages</td>
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<td>Minor in Missions</td>
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Mission
The Department of Religion & Biblical Languages seeks to engage majors and general education students through a biblically grounded, theologically astute and relevant process of spiritual formation; equipping and inspiring them to passionately serve the Seventh-day Adventist Church and the wider world beyond as dedicated laypersons and committed denominational employees in the expectation of the soon coming of Jesus Christ.

Students who are religion and theology majors must maintain a minimum overall GPA (2.5 for BA: Religion for Secondary Education). They must be in good and regular standing in terms of student life citizenship. As future ministers of the church, they are expected to live in harmony with Seventh-day Adventist beliefs and practices. Failure in any of these areas may lead to a student being placed on probation or being dismissed from the program. Academic requirements and other program standards are stated in detail in the departmental handbook.

Programs
A minimum grade of “C-” must be earned for all major classes and cognates.