PHYSICS

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Faculty
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Emeriti
Ronald L. Johnson, *Director, Physics Enterprises*
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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: Physics program supports and enhances professional careers in all the physical sciences, engineering, and the life sciences. Its emphasis on problem-solving also provides a foundation for careers in medicine, business, law, and government.

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 CPTR125 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, 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.
**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 (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.
*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 (20)

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 (Credits)

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 measureable 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
An 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 **Alt (2.5)**
Optics
Geometrical and physical optics; interference and diffraction, polarization, Fourier optics, lasers, and holography. Prerequisites: PHYS242 (recommended) or 142; MATH192.

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. *Spring*

PHYS400 **♦ (1–2)**
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 **♦ Alt (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; MATH192. *Fall, Spring* (even years)

PHYS416 **♦ Alt (2.5)**
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 **(2–3)**
Advanced Topics in_____
Astrophysics, atomic physics, nuclear physics, relativity or other current physics area. 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: PPrerequisite: PHYS142 or 242; MATH192. *Spring* (odd years)

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 corequisite: PHYS411. *Fall* (even years), *Spring* (odd years)

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. *Spring* (even years)

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. *Fall*

PHYS477 **♦ $ (1)**
Advanced Physics Laboratory II
Important phenomena, equipment, and techniques in modern experimental physics. Repeatable to 2 credits. *Spring*

PHYS478 **♦ $ (0)**
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 **♦ 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 corequisite: PHYS411. *Fall* (odd years), *Spring* (even years)

PHYS495 **(1–3)**
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 **$ (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.

PHYS577 **$ (0, 0.5, 1)**
Physics Colloquium
Current topics and issues of interest in the physics community. Required each semester of MS: Mathematics and Science students not enrolled in MSCI575 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 **(1–3)**
Workshop
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 **(1–3)**
Independent Study/Research
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	Credits
BA: Theology	
Emphasis Areas	
Pastoral Ministry	51
Youth Ministry	51
BA: Religion	32
Emphasis Area	
Religion for Secondary Education	33–35
BA: Religion (Distance Degree)	35
AA: Personal Ministries (Distance Degree)	32
Minor in Religion	20
Minor in Biblical Languages	22
Minor in Missions	20

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 commited denominational employees in the expectation of the soon coming of Jesus Christ.

Students who are religion and theology majors must maintain a minimum overall 2.25 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.