Physics

PHYS 105. Foundations of Physics. 1 credit.
An introduction to the study of physics and the physics department. Presentations are given by faculty and students to acquaint the students with current research opportunities in the department and the application of physics to broad spectrum of topics.

PHYS 121. The Physical Nature of Light and Sound (3, 1). 4 credits.
A study of the physical properties of light and sound waves. Topics include production, propagation and spectral analysis of waves. Applications to be covered include musical instruments, sound reproduction, room acoustics, optical instruments (cameras, projectors, lasers), and color in art and nature. The course will include outside-of-class experiential activities. May be used for general education credit.

PHYS 140. College Physics I. 3 credits.
The first semester of a non-calculus sequence in general physics. Topics include principles of mechanics, thermal properties of matter, wave motion and sound. A working knowledge of algebra and trigonometry is required. May be used for general education credit.

PHYS 150. College Physics II. 3 credits.
The second semester of a non-calculus sequence in general physics. Topics include electric charges, circuits, magnetism, optics, atomic and nuclear physics. Prerequisite: PHYS 140 with a grade of "C-" or higher.

PHYS 140L*-150L. General Physics Laboratories. 1 credit each semester.
These laboratory courses are designed to complement and supplement the PHYS 140-150 and PHYS 240-250 lecture courses. PHYS 140L may be used for general education credit. Prerequisite or corequisite for PHYS 140L: PHYS 140 or PHYS 240. Prerequisite for PHYS 150L: PHYS 140L and either PHYS 140 or PHYS 240. Prerequisite or corequisite for PHYS 150L: PHYS 150 or PHYS 250.

PHYS 215. Energy and the Environment. 3 credits.
Energy use, sources and trends; fossil fuels, heat-work conversions, thermodynamic restrictions and electric power production; nuclear fission reactors and fusion energy; solar energy and technologies; alternative energy sources; energy storage; energy conservation; issues of waste and safety. Environmental, social and economic aspects will be discussed. Not open to ISAT majors scheduled to take ISAT 212 as part of their degree requirements. May be used for general education credit. Prerequisites: One college course in science and one in mathematics.

PHYS 240. University Physics I. 3 credits.
Kinematics, dynamics, energy and momentum conservation, oscillatory motion, fluid mechanics and waves. May be used for general education credit. Corequisite: MATH 232 or MATH 235.
PHYS 246. Data Acquisition and Analysis Techniques in Physics I. 1 credit.
This laboratory supplements PHYS 240 by establishing the experimental basis of
physics. Topics include conception, design and performance of experiments in physics
emphasizing data acquisition, analysis of experimental data, and the handling of
experimental uncertainties. Prerequisite: PHYS 240.

PHYS 247. Data Acquisition and Analysis Techniques in Physics II. 1 credit.
This laboratory completes the introductory physics lab sequence and is designed to
supplement the PHYS 240 and PHYS 250 lecture courses. Topics include conception,
design and performance of sophisticated experiments in physics, computer simulation
of physical processes, analysis of experimental data, including uncertainty estimation,
and error propagation. Prerequisites: PHYS 250 and PHYS 246.

PHYS 250. University Physics II. 3 credits.
Electric forces, fields and potentials; capacitance, dielectrics, resistance and DC
circuits; magnetic fields, induced electric fields, inductance and AC circuits; geometrical
optics, interference, diffraction and polarization. Prerequisite: PHYS 240
with a grade of "C-" or higher. Corequisite: MATH 236.

Rotational kinematics and rotational dynamics; static equilibrium and elasticity;
universal gravitation and orbital mechanics; temperature, heat, heat engines, entropy
and kinetic theory; Gauss' law, electric potential and capacitance; magnetic fields,
induced electric fields and inductance; displacement current and electromagnetic
waves; and the special theory of relativity. Prerequisite: "C" or better in PHYS 250 or
PHYS 150. Corequisites: MATH 237 and PHYS 247 or PHYS 150L.

PHYS/MATH 265. Introduction to Fluid Mechanics. 4 credits.
Introduces the student to the application of vector calculus to the description of
fluids. The Euler equation, viscosity and the Navier-Stokes equation will be covered.
Prerequisites: MATH 237 and PHYS 260.

PHYS 270. Modern Physics. 4 credits.
A course in modern physics, consisting of a discussion of the experimental basis for
and fundamental principles of quantum physics, with applications to atomic structure
and nuclear physics. Prerequisite: PHYS 260 or permission of the instructor.

PHYS 295. Laboratory Apparatus Design and Construction. 1 credit.
An introduction to the design and fabrication of laboratory apparatus using machine
tools. Prerequisites: PHYS 250 and permission of the instructor.

PHYS 297. Topics in Physics. 1-4 credits each semester.
Topics in physics at the second year level. May be repeated for credit when course
content changes. Topics selected may dictate prerequisites. Students should consult
instructor prior to enrolling for course. Prerequisite: Permission of the instructor.

PHYS 326. Biophysics. 3 credits.
Physical models are used to explain biological systems. Topics from biology include
cell division, replication, transcription, and translation of DNA, protein folding, and
molecular motors. Physics topics include entropy and free energy, diffusion, and
statistical mechanics of two state systems. Experimental tools for biophysics are also
discussed. Prerequisite: PHYS 150 or PHYS 250.

PHYS 333. Introduction to Particle Physics. 3 credits.
An introduction to current themes and ideas which confront the fundamental nature of
matter and interactions. The most widely accepted theory, the Standard Model, will be
explored. Possible extension, beyond the Standard Model physics, will be discussed. Basic properties such as charge, mass, and lepton number will be examined within these frameworks. Experiments that illuminate the basic nature of matter and ideas such as symmetry and quantum physics will be reviewed and assessed. **Prerequisite:** PHYS 270.

**PHYS/MATS 337. Solid State Physics.** 3 credits. A study of the forces between atoms, crystal structure, lattice vibrations and thermal properties of solids, free electron theory of metals, band theory of solids, semiconductors and dielectrics. **Prerequisite:** PHYS 270 or permission of the instructor.

**PHYS 338. Nuclear Physics.** 3 credits. An introduction to the study of the atomic nucleus. Topics covered include static nuclear properties and movements, the force between nucleons, the deuteron, nucleon scattering, isospin, nuclear structure, radioactivity, decay kinematics and selection rules, fission, and fusion. **Prerequisite:** PHYS 270.

**PHYS 339. Introductory Nuclear Science.** 4 credits. An introduction to nuclear science that will provide a solid foundation for experimental work in applied nuclear physics. Detection of ionizing radiation, as it applies to nuclear physics, will be additionally covered in the laboratory-component of the course. Topics include concepts of radioactive decays, radiation transport and interaction with matter, basics of radiation detection devices, dosimetry, radiation therapy, X-ray production, and fission nuclear reactors. **Prerequisite:** PHYS 270 or permission of the instructor.

**PHYS 340. Mechanics.** 3 credits. Application of fundamental laws of mechanics to particles and rigid bodies. Topics include statics, dynamics, central forces, oscillatory motion and generalized coordinates. **Prerequisites:** PHYS 260 and MATH 238.

**PHYS/MATH 341. Nonlinear Dynamics and Chaos.** 3 credits. Introductory study of nonlinear dynamics and chaos intended primarily for upper-level undergraduates in science or mathematics. Topics include stability, bifurcations, phase portraits, strange attractors, fractals and selected applications of nonlinear dynamics in pure and applied science. Computers may be utilized for simulations and graphics. **Prerequisites:** MATH 238 or (MATH 300 and MATH 336); and MATH 248.

**PHYS 342. Mechanics II.** 3 credits. A continuation of PHYS 340 including Lagrangian dynamics, rigid body motion and the theory of small oscillations. **Prerequisite:** PHYS 340.

**PHYS 344. Advanced Physics Laboratory I.** 1 credit. The first course in a three-course laboratory sequence. A set of advanced laboratory experiences in which students are introduced to experimentation in several areas of physics while gaining experience in experiment design, data analysis, formal report writing and presentations. **Prerequisite:** PHYS 247.

**PHYS 345. Advanced Physics Laboratory II.** 1 credit. This is the second course in a three-course laboratory sequence. A set of advanced laboratory experiences in which students are introduced to experimentation in several areas of physics while gaining experience in experiment design, data analysis, formal report writing and presentations. **Prerequisite:** PHYS 344.

**PHYS 346. Advanced Physics Laboratory III.** 1 credit. This is the third course in a three-course laboratory sequence. A set of advanced laboratory experiences in which students are introduced to experimentation in several
areas of physics while gaining experience in experiment design, data analysis, formal report writing and presentations. **Prerequisite:** PHYS 345.

**PHYS 350. Electricity and Magnetism.** 3 credits.
A study of the electrostatic field, the magnetic field, direct and alternating currents and electromagnetic waves. **Prerequisites:** PHYS 260 and MATH 238.

**PHYS 360. Analog Electronics (2, 4).** 4 credits.
DC and AC circuits, spectral and pulse circuit response, semiconductor physics and simple amplifier and oscillator circuits. **Prerequisite:** PHYS 250 or permission of the instructor.

**PHYS/MATH 365. Computational Fluid Mechanics.** 3 credits.
Applications of computer models to the understanding of both compressible and incompressible fluid flows. **Prerequisites:** MATH 248, either MATH 238 or MATH 336, MATH/PHYS 265, and PHYS 340.

**PHYS/MATH 366E. Computational Solid Mechanics.** 3 credits.
Development and application of mathematical models and computer simulations to investigate problems in solid mechanics, with emphasis on numerical solution of associated boundary value problems. **Prerequisites:** MATH/PHYS 266, MATH 238 and MATH 248, or permission of the instructor.

**PHYS 371. Introductory Digital Electronics (2, 4).** 2 credits.
Transistors, integrated circuits, logic families, gates, latches, decoders, multiplexers, multivibrators, counters and displays. **Prerequisite:** A grade of "C" in PHYS 150 or PHYS 250 or permission of the instructor.

**PHYS 372. Microcontrollers and Their Applications (2, 4).** 2 credits.
Microcontrollers, their instructions, architecture and applications. **Prerequisite:** PHYS 371 or permission of the instructor.

**PHYS 373. Interfacing Microcomputers (2, 4).** 2 credits.
A study of the personal computer and its input/output bus, input/output functions, commercially available devices, proto-typing circuit boards and programs for device control. **Prerequisite:** PHYS 371.

**PHYS/CHEM/MATS 375. An Introduction to Materials Science.** 3 credits.
An introduction to materials science with emphasis on general properties of materials. Topics will include crystal structure, extended and point defects and mechanical, electrical, thermal and magnetic properties of metals, ceramics, electronic materials, composites and organic materials. **Prerequisite:** CHEM 131, PHYS 150 or PHYS 250, ISAT 212 or permission of the instructor.

**PHYS 380. Thermodynamics and Statistical Mechanics.** 3 credits.
A treatment of the thermal properties of matter from both macroscopic and microscopic viewpoints. Topics include the laws of thermodynamics, heat, work, internal energy, entropy, elementary statistical concepts, ensembles, classical and quantum statistics and kinetic theory. Approximately equal attention will be given to thermodynamics and statistical mechanics. **Prerequisites:** PHYS 270.

**PHYS/MATS 381. Materials Characterization** (Lecture/Lab course). 3 credits.
A review of the common analytical techniques used in materials science related industries today, including the evaluation of electrical, optical, structural and mechanical properties. Typical techniques may include Hall Effect, scanning probe microscopy,
scanning electron microscopy, ellipsometry and x-ray diffraction. Prerequisite: PHYS/MATS 375, ISAT/MATS 431 or GEOL/MATS 395.

PHYS 386. Robots: Structure and Theory. 3 credits.
An introduction to the study of autonomous robotic platforms. Topics include robot structure, propulsion systems, robot kinematics, sensors used in robotics, and sensor integration. The course combines lectures with laboratory activities in which students will get hands-on experience in designing, building, programming, and testing autonomous robotic platforms. Prerequisite: completion of the basic preparation courses required for the robotics minor or permission of the instructor.

PHYS 390. Computer Applications in Physics. 3 credits.
Applications of automatic computation in the study of various physical systems. Problems are taken from mechanics of particles and continua, electromagnetism, optics, quantum physics, thermodynamics and transport physics. Prerequisites: MATH/CS 248, PHYS 240, PHYS 250 and six additional credit hours in major courses in physics, excluding PHYS 360, PHYS 371 and PHYS 372.

PHYS 391-392. Seminar. 1 credit per year.
Participation in the department seminar program. Prerequisites: Junior or senior standing and permission of the instructor.

PHYS 397. Topics in Physics. 1-4 credits each semester.
Topics in physics at intermediate level. May be repeated for credit when course content changes. Topics selected may dictate prerequisites. Students should consult instructor prior to enrolling for course. Prerequisite: Permission of the instructor.

PHYS/ASTR 398. Independent Study in Physics or Astronomy. 1-3 credits, repeatable to 4 credits.
An individual project related to some aspect of physics or astronomy. Must be under the guidance of a faculty adviser. A student may not earn more than a total of four credits for PHYS/ASTR 398.

PHYS 420. Modern Optics. 3 credits.
A study of the kinematic properties and physical nature of light including reflection, refraction, interference, diffraction, polarization, coherence and holography. Prerequisites: PHYS 260, PHYS 270 and MATH 237.

PHYS 446. Electricity and Magnetism II. 3 credits.
A continuation of PHYS 350. Emphasis will be placed on the solutions of Maxwell’s equations in the presence of matter, on solving boundary-value problems and on the theory of electromagnetic radiation. Prerequisite: PHYS 350.

PHYS/CHEM 455. Lasers and Their Applications to Physical Sciences (2, 3). 3 credits.
An introduction to both the theoretical and practical aspects of lasers and their applications in the physical sciences. Prerequisite: PHYS 270, CHEM 331 or permission of the instructor.

PHYS 460. Quantum Mechanics. 3 credits.
Principles and applications of quantum mechanics. Topics include wave packets and the uncertainty principle, the Schroedinger equation, one-dimensional potentials, operators and eigenvectors, three-dimensional motion and angular momentum and the hydrogen atom. Prerequisite: PHYS 340.

PHYS 491-492. Physics Assessment and Seminar. 1 credit per year.
Principal course activities are participation in the departmental assessment program and attendance at departmental seminars. Prerequisite: PHYS 392.

**PHYS 494. Internship in Physics.** 1-6 credits.
Students participate in research or applied physics outside of the university. A proposal must be approved prior to registration, and a final paper will be completed. Prerequisites: Physics major with a minimum of 12 physics credit hours and permission of the department head and the instructor.

**PHYS 497. Topics in Physics.** 1-4 credits each semester.
Topics in physics at the advanced level. May be repeated for credit when course content changes. Topics selected may determine prerequisites. Students should consult instructor prior to enrolling for course. Prerequisite: Permission of the instructor.

**PHYS/ASTR 498R. Undergraduate Research in Physics or Astronomy.** 1-4 credits, repeatable to 6 credits.
Research in a selected area of physics as arranged with a faculty research adviser. A student may not earn more than a total of six credits for PHYS/ASTR 498R. Prerequisite: Proposal for study must be approved prior to registration.

**PHYS 499. Honors.** 1-3 credits.
Participation in this course must be approved during the second semester of the junior year.