PHYSICS (PHYS)

PHYS 1110. Elementary Physics Laboratory.
This course explores and illustrates some of the basic principles covered in PHYS 1310 and PHYS 1320. Corequisite: PHYS 1310 or PHYS 1320 either with a grade of "D" or better.
1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.
Grade Mode: Standard Letter
TCCN: PHYS 1105

PHYS 1115. General Physics I Laboratory.
First of two laboratory courses in General Physics for science-related majors. Course introduces students to the basics of measurement. Topics cover mechanics and heat. Corequisite: PHYS 1315 with a grade of "D" or better.
1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.
Grade Mode: Standard Letter
TCCN: PHYS 1101

PHYS 1125. General Physics II Laboratory.
Second of two laboratory courses in general Physics. Course introduces the students to experimental measurements and demonstration of principles of electricity, magnetism, optics, modern physics, electromagnetic waves.
1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.
Grade Mode: Standard Letter
TCCN: PHYS 1102

PHYS 1140. Introductory Laboratory in Astronomy.
An introduction to the constellations, the uses of telescopes, and other material relating to the study of stars and planets. This course is designed to be taken with PHYS 1340 or PHYS 1350 or those students desiring a laboratory course.
1 Credit Hour. 0 Lecture Contact Hours. 2 Lab Contact Hours.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter
TCCN: PHYS 1111

PHYS 1310. Elementary Physics.
A non-mathematical survey of mechanics, properties of matter, heat and sound. These topics are described in a conceptual way with applications relating to the world around us. The laboratory experience may be obtained in a separate one-hour credit lab (PHYS 1110). PHYS 1310 and PHYS 1320 are designed for the liberal arts student. The order in which they are taken is not important. They are not recommended for pre-engineering students or majors and minors in science. The laboratory experience is recommended with the second course.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: PHYS 1305

PHYS 1315. General Physics I.
The first course in a two semester sequence which is a survey of the basic laws and principles of physics and includes the topics of mechanics and heat. Designed for students whose program requires technical physics, but who are not pre-engineering students or majors or minors in physics. Credit for both (PHYS 1315 and PHYS 1115) and PHYS 1430 cannot be given. Prerequisite: MATH 1315 with a grade of "C" or better. Corequisite: PHYS 1115.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Co-requisite(s): PHYS 1115
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: PHYS 1301

PHYS 1320. Elementary Physics.
A non-mathematical survey of electricity, magnetism, light, relativity, and atomic and nuclear physics. These topics are described in a conceptual way with applications relating to the world around us. The laboratory experience may be obtained in a separate one-hour credit lab (PHYS 1110). PHYS 1310 and PHYS 1320 are designed for the liberal arts student. The order in which they are taken is not important. They are not recommended for pre-engineering students or majors and minors in science. The laboratory experience is recommended with the second course.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: PHYS 1307

PHYS 1325. General Physics II.
Second course in a two semester sequence which is a survey of the basic laws and principles of physics and includes the topics of waves, light, electricity and magnetism. Designed for students whose program requires technical physics, but who are not pre-engineering students or majors or minors in physics. Prerequisite: PHYS 1315 and [MATH 1315 or MATH 1317 or MATH 1319 or MATH 1329 or MATH 2321 or MATH 2417 or MATH 2471] both with grades of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Co-requisite(s): PHYS 1125
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: PHYS 1302

A study of the solar system. Topics included are a study of the sun, the planets and their satellites, the comets, and other components of the solar system. Some aspects of telescopes and ancient astronomy will be included also.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: ASTR 1304
PHYS 1350. Astronomy: Stars and Galaxies.
A study of the universe beyond the solar system. Topics included are a study of the stars and star clusters, nebulae, galaxies, and an introduction to some aspects of cosmology.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: ASTR 1303

This studio-style course introduces physics concepts through active exploration and discussion of physical phenomena. Course content includes developing concepts of electricity, magnetism, and energy, and research on physics learning. Focus is on how physics helps make sense of everyday experience. It's the first in a sequence of two courses.
3 Credit Hours. 4 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: PHYS 1305

PHYS 1370. Development of Concepts in Physics II.
This studio-style course introduces physics concepts through active exploration and discussion of physical phenomena. Course content includes concepts of force, motion, waves, light, and matter, and research on physics learning. Focus is on how physics helps make sense of everyday experience. It's the second in a sequence of two courses. Prerequisite: PHYS 1360 with a grade of "D" or better.
3 Credit Hours. 4 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030
Grade Mode: Standard Letter
TCCN: PHYS 1307

This course covers the principles of classical mechanics through problem solving and laboratory investigations. PHYS 1430, PHYS 2425, and PHYS 2435 are designed for students majoring and minorin physics and/or other disciplines within the college of science and engineering. Credit for both (PHYS 1315 and PHYS 1115) and PHYS 1430 cannot be given. Corequisite: MATH 2471 with a grade of "C" or better.
4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030,Lab Required
Grade Mode: Standard Letter
TCCN: PHYS 2425

PHYS 2230. Introduction to Computational Modeling for Physics.
This course is an introduction to computational concepts and tools that physicists use for data analysis, simulation and modeling, and visualization in research and dissemination. Python and its various libraries are emphasized. Prerequisite: PHYS 1430 with a grade of "D" or better. Corequisite: PHYS 2425 or PHYS 2435 either with a grade of "C" or better.
2 Credit Hours. 0 Lecture Contact Hours. 3 Lab Contact Hours.
Grade Mode: Standard Letter
TCCN: PHYS 2426

PHYS 2425. Electricity and Magnetism.
This course is a calculus-based introduction to electricity and magnetism. Prerequisites: PHYS 1430 and [MATH 2472 or MATH 2473] both with grades of "C" or better.
4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Life & Phys Sciences Core 030,Component Area Core 090,Life & Phys Sciences CAO 093,Lab Required
Grade Mode: Standard Letter
TCCN: PHYS 2427

PHYS 2427. Waves and Heat.
This course is a study of the fields of wave motion, sound, light, and heat at a beginning level for physics majors and minors. Prerequisites: PHYS 1430 and [MATH 2472 or MATH 2473] both with grades of "C" or better. Corequisite: MATH 2472 with a grade of "C" or better.
4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter
TCCN: PHYS 2427

PHYS 2435. Waves and Heat.
This course is a calculus-based introduction to electricity and magnetism. Prerequisites: PHYS 1430 and [MATH 2472 or MATH 2473] both with grades of "C" or better. Corequisite: MATH 2472 with a grade of "C" or better.
4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Lab Required
Grade Mode: Standard Letter
TCCN: PHYS 2427

PHYS 3210. Physics Cognition and Pedagogy.
This course is an introduction to physics-specific pedagogy and the methods and results of physics education research (PER). Students will investigate relevant literature in PER and cognitive science, engage in discussions about physics teaching and learning, and reflect on their own teaching practice in the role of Physics Learning Assistants. (WI).
2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter
TCCN: PHYS 3210

A survey of the physics of sound and acoustic measurement. Special emphasis will be placed on sound production, propagation, and perception as applied to music.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
TCCN: PHYS 3301

PHYS 3310. Mechanics I.
This course discusses the fundamentals of classical mechanics focusing on the physical description of the behavior of single and multiple particle systems. Topics included are advanced problem solving strategies for systems with position and velocity dependent forces, simple harmonic oscillators, and non-inertial reference frames. Prerequisite: PHYS 2435 with a grade of "C" or better. Corequisite: PHYS 3320 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
TCCN: PHYS 3310
PHYS 3312. Modern Physics.
This course is an introduction to the foundations of modern physics, including the following topics: relativistic mechanics, foundational experiments in the development of quantum mechanics, light and energy, wave nature of particles, and nuclear physics. Prerequisite: PHYS 2435 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 3313. Astrophysics.
This course surveys a variety of issues in astrophysics through problem solving, quantitative measurements, and theoretical reasoning. Topics include celestial mechanics, stellar dynamics and evolution, galaxy evolution, and cosmology. Corequisite: PHYS 3312 with a grade of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 3315. Thermodynamics.
This course is a fundamental study of thermodynamics and statistical mechanics. Prerequisite: MATH 3323 and [PHYS 2435 or (PHYS 1125 and PHYS 1325)] or (ENGR 2300 and PHYS 2425) all with grades of "D" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 3320. Introduction to Mathematical Physics.
This course is an introduction to the mathematical methods of theoretical physics with emphasis on development of mathematical tools used in upper division core physics courses. Students will also develop their ability to communicate mathematical ideas in the context of physics. Prerequisite: MATH 3373 and PHYS 2425 both with grades of "C" or better. Corequisite: MATH 3323 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 3311. Advanced Physics Laboratory.
This course is an introduction to experimental modern physics, with emphasis on the design and assembly of physics apparatus and the development of practical skills for controlling and automating data collection. (WI) Prerequisites: PHYS 2425 with a grade of "C" or better. Corequisites: PHYS 2435 with a grade of "C" or better.
4 Credit Hours. 2 Lecture Contact Hours. 6 Lab Contact Hours.
Course Attribute(s): Lab Required|Writing Intensive
Grade Mode: Standard Letter

PHYS 3317. Optics.
This course is a one-semester survey of geometrical and physical optics accompanied by laboratory experience. Topics covered include electromagnetic waves and their propagation, geometrical optics, polarization, interference, diffraction, Fourier optics, and holography. (WI) Prerequisites: PHYS 2425 and PHYS 2435 both with grades of "C" or better.
4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

PHYS 3417. Methods in Observational Astrophysics.
This course is an introduction to methods and instrumentation used in observational astrophysics. Topics include image processing, data acquisition and analysis, and detectors for data across the electromagnetic spectrum. Prerequisite: PHYS 2425 and PHYS 2435 both with grades "C" or better.
4 Credit Hours. 3 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

PHYS 4121. Undergraduate Research.
This course represents a student's research project in physics to be carried out under the supervision of a faculty member. The student must contact a faculty member in advance to arrange the topic and specific course objectives. This course may be repeated for credit. Prerequisite: Instructor approval.
1 Credit Hour. 0 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 4150A. Physics Cognition and Pedagogy Lab.
In this lab course, students will apply principles introduced in PHYS 3210, which include observation of student interactions, reflection on the process of learning and the use of evidence based reasoning, metacognition, and facilitation of discourse around difficult concepts. Prerequisite: PHYS 1430 with grade of "C" or better or instructor approval. Corequisite: PHYS 3210 with a grade of "D" or better.
1 Credit Hour. 0 Lecture Contact Hours. 4 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

PHYS 4150B. Computational Modeling Lab: Mechanics.
This lab provides experience in computational modeling of problems in classical mechanics. Students design and code computer programs to simulate physical dynamics and analyze data. Corequisite: PHYS 3311 with a grade of "D" or better.
1 Credit Hour. 0 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing|Topics
Grade Mode: Standard Letter

PHYS 4221. Undergraduate Research.
This course represents a student's research project in physics to be carried out under the supervision of a faculty member. The student must contact a faculty member in advance to arrange the topic and specific course objectives. This course may be repeated for credit. Prerequisite: Instructor approval.
2 Credit Hours. 0 Lecture Contact Hours. 6 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter
PHYS 4305. Statistical Physics.
Statistical physics is the study of energy flow and energy distributions within systems in equilibrium. Students will explore a range of phenomena including black-body radiation, diffusion, phase transitions, and magnetism. Emphasis will be placed on topics of entropy, probability, free energy, Boltzmann distributions, and the atomic behavior of these systems. Prerequisite: MATH 3323 and PHYS 3312 and PHYS 3320 all with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 4310. Electromagnetic Field Theory I.
An introduction to the electromagnetic field theory of classical physics for static fields. Topics included will be the electrostatic field, polarization and dielectrics, electrostatic energy, magnetic field of steady currents, magneto static energy, and magnetic properties of matter. Prerequisite: MATH 3323 and MATH 3373 and PHYS 3320 all with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

Application of physics principles to solid materials. Topics include crystal structure and the reciprocal lattice, including x-ray diffraction, crystal binding and elastic properties, lattice vibrations, energy bands, semiconductors and metals. Prerequisite: PHYS 3312 and PHYS 3320 both with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 4312. Quantum Mechanics I.
This course introduces students to quantum mechanics. Topics include mathematical foundations, fundamental postulates, time development, and one dimensional problems. Prerequisite: PHYS 3312 PHYS 3320 both with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 4315. Electromagnetic Field Theory II.
An introduction to the electromagnetic field theory of classical physics for time varying fields. Topics included will be electromagnetic induction, time varying electric and magnetic fields, Maxwell's equations, electromagnetic waves and radiation, and a brief introduction to some specialized topics. Prerequisite: PHYS 4310 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 4320. Selected Study in Physics.
Topics are chosen in theoretical and experimental areas of current interest in physics with specific topic to be discussed agreed upon prior to registration. May be repeated once with different emphasis and professor for additional credit. Prerequisite: Instructor approval.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 4321. Undergraduate Research.
A research project in physics to be carried out under the supervision of a faculty member by upper division physics majors. Student must contact a faculty member in advance to arrange topic and specific course objective. Course may be repeated only as an elective towards the BS or BA in physics. Prerequisite: Instructor approval.

3 Credit Hours. 0 Lecture Contact Hours. 9 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 4350B. Relativity.
This course includes a review of Special Relativity, an introduction to the mathematics of tensor calculus and differential geometry, and such topics from General Relativity as the Schwarzschild solution and black holes, tests of General Relativity, cosmological models, and applications of relativity in the Global Positioning System (GPS). Prerequisite: PHYS 2425 and PHYS 2435 both with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 4350D. Biophysics.
This course applies the principles of physics to the study of living organisms. An emphasis will be placed on the topics of structure, fluids, diffusion, entropy, stochastic processes, and probabilities, and on scientific modes of thinking including modeling, estimation, and data analysis. Prerequisite: PHYS 2425 and PHYS 2435 both with grades of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 4360. Physics Cognition and Pedagogy II.
This course addresses historical, philosophical, and cognitive perspectives on the learning, teaching, and discovery of physics, including results from contemporary research on learning. It is recommended for students pursuing teacher certification. Prerequisite: PHYS 3210 with a grade of "C" or better.

3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Writing Intensive
Grade Mode: Standard Letter

PHYS 5100. Professional Development.
This course covers topics related to teaching, research, and employment responsibilities. The completion of this course is required as a condition of employment for graduate assistants. This course does not earn graduate degree credit. Course is repeatable with different emphasis.

1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Graduate Assistantship|Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

PHYS 5110. Seminar in Physics.
A course designed to acquaint the graduate student with current research areas in physics. May be repeated twice for total of three semester hour's credit.

1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Grade Mode: Standard Letter
PHYS 5195. Fundamentals of Research.
This course is designed to acquaint the graduate student with materials and methods of physics research. It is open to graduate students on an individual basis by arrangement with the department of Physics. This course may be repeated with prior approval of the department.
Prerequisite: Instructor approval.
1 Credit Hour. 0 Lecture Contact Hours. 3 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 5199B. Thesis.
This course represents a student's continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding.
1 Credit Hour. 1 Lecture Contact Hour. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

PHYS 5200. Professional Development.
This course covers topics related to teaching, research, and employment rights and responsibilities. It provides a brief background on teaching and learning theories and consists of organized practice teaching. Completion is required as a condition of employment for graduate instructional and teaching assistants. This course does not earn graduate degree credit.
2 Credit Hours. 2 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Graduate Assistantship|Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

PHYS 5295. Fundamentals of Research.
This course is designed to acquaint the graduate student with materials and methods of physics research. It is open to graduate students on an individual basis by arrangement with the department of Physics. This course may be repeated with prior approval of the department.
Prerequisite: Instructor approval.
2 Credit Hours. 2 Lecture Contact Hours. 6 Lab Contact Hours.
Course Attribute(s): Graduate Assistantship|Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

PHYS 5295. Fundamentals of Research.
This course is designed to acquaint the graduate student with materials and methods of physics research. It is open to graduate students on an individual basis by arrangement with the department of Physics. This course may be repeated with prior approval of the department.
Prerequisite: Instructor approval.
2 Credit Hours. 2 Lecture Contact Hours. 6 Lab Contact Hours.
Course Attribute(s): Graduate Assistantship|Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

PHYS 5295. Fundamentals of Research.
This course is designed to acquaint the graduate student with materials and methods of physics research. It is open to graduate students on an individual basis by arrangement with the department of Physics. This course may be repeated with prior approval of the department.
Prerequisite: Instructor approval.
2 Credit Hours. 2 Lecture Contact Hours. 6 Lab Contact Hours.
Course Attribute(s): Graduate Assistantship|Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

This course discusses the fundamentals of classical mechanics focusing on the physical description of the behavior of single and multiple particle systems. This course does not earn graduate degree credit.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from Graduate GPA
Grade Mode: Leveling/Assistantships

PHYS 5302. Electricity and Magnetism.
An introduction to the electromagnetic field theory of classical physics for static fields. Topics included will be the electrostatic field, polarization and dielectrics, electrostatic energy, magnetic field of steady currents, magneto static energy, and magnetic properties of matter. This is a graduate leveling course in Electricity and Magnetism (stacked with PHYS 4310). This course does not earn graduate degree credit.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from Graduate GPA
Leveling
Grade Mode: Leveling/Assistantships

PHYS 5303. Quantum Mechanics.
This course is an introduction to quantum mechanics. Topics include mathematical foundations, fundamental postulates, time development, and one dimensional problems. This is a graduate leveling course in Quantum Mechanics (stacked with PHYS 4312). This course does not earn graduate degree credit.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from Graduate GPA
Leveling
Grade Mode: Leveling/Assistantships

PHYS 5304. Experimental Research Methods.
This is a laboratory based course introducing experimental methods used in physics research with emphasis on quantum effects through materials synthesis and characterization methods. The specific experiments are chosen by department faculty on topics of current research interests. The students are exposed to different research topics through laboratory rotations. Prerequisite: Instructor approval. Corequisite: PHYS 5314 with a grade of "C" or better.
3 Credit Hours. 1 Lecture Contact Hour. 3 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5304. Experimental Research Methods.
This is a laboratory based course introducing experimental methods used in physics research with emphasis on quantum effects through materials synthesis and characterization methods. The specific experiments are chosen by department faculty on topics of current research interests. The students are exposed to different research topics through laboratory rotations. Prerequisite: Instructor approval. Corequisite: PHYS 5314 with a grade of "C" or better.
3 Credit Hours. 1 Lecture Contact Hour. 3 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5312. Advanced Quantum Mechanics.
This course is a study of quantum mechanics including combination of two or more quantum mechanical systems, addition of angular momentum, time independent perturbation theory, and time dependent perturbation theory.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5313. Mathematical Methods of Physics.
This course is a survey of mathematical methods of physics at the graduate level focusing on complex analysis of analytic functions (Laurent expansions and evaluation of residues) and methods of solving both ordinary and partial differential equations (Frobenius’ method and Sturm-Liouville theory) with applications to mechanics and electromagnetic theory.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5314. Statistical Physics.
This course is an introduction to the laws of statistical physics and their application to realistic problems at the graduate level. The topics include a brief review of equilibrium thermodynamics, Gibbs distribution, Fermi-Dirac and Bose-Einstein statistics, derivation of Planck's Law and black-body radiation, and heat capacity of solids.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
This is an introductory course at the graduate level intended for students who have not had a previous course in Solid State Physics. Topics covered include crystal structure, the reciprocal lattice, x-ray diffraction, lattice vibrations, electronic band structure, and optical, transport and magnetic properties of metals and semiconductors including applications. Prerequisite: PHYS 5312 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5322. Semiconductor Device Microfabrication.
This course provides an in-depth overview of the physics and technology of semiconductor device micro and nano fabrication. Topics include materials used in electronic devices, thin film deposition, wet and dry etching, lithography processing, and topics relevant to semiconductor research and devices. Fabrication and characterization techniques will be covered. Corequisite: PHYS 5312 with a grade of "C" or better.
3 Credit Hours. 2 Lecture Contact Hours. 1 Lab Contact Hour.
Grade Mode: Standard Letter

PHYS 5324. Thin Film Synthesis and Characterization Laboratory.
This advanced experimental course is designed as a research group project experience with emphasis on nanoscale device fabrication. All projects are conducted in university facilities with state-of-the-art thin film growth, processing, and characterization facilities. Corequisites: PHYS 5312 and PHYS 5322 both with grades of "C" or better.
3 Credit Hours. 0 Lecture Contact Hours. 9 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5326. Electrical Characterization of Materials and Devices.
A laboratory/lecture course introducing electric characterization methods important to semiconductor materials and devices. Various measurement techniques and methods will be reviewed. Students will learn to work with industrial equipment. Prerequisite: Instructor approval.
3 Credit Hours. 0 Lecture Contact Hours. 9 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5327. Semiconductor Device Physics.
This course demonstrates how solid state physics applies to describing important examples of thin film device operation with emphasis on semiconductor devices. Additional topics may include photon and phonon effects on electronic properties, quantum phenomena, many body effects in solids, carrier transport properties, micro-electromechanical systems, and materials interface issues. Corequisite: PHYS 5314 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

Review of models of a solid and energy band theory. Additional topics may include interaction of electromagnetic waves with solids, lattice vibrations and phonons, many body effects in solids, device physics, quantum phenomena, carrier transport properties, current device configurations, and materials interface problems. Prerequisite: PHYS 5320 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

This course examines the material science of physical mechanisms governing the fundamental failure modes of materials, and particularly thin films. The application of materials physics characterization techniques for detecting the signatures of failure mechanisms will also be presented. Prerequisites: PHYS 5328 with a grade of "C" or better.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5331. Electromagnetic Field Theory.
This course is an introduction to electrodynamics at the graduate level using rigorous mathematical formulation. Topics include methods of solving problems in electrostatics and magnetostatics, boundary value problems and Green's Functions, fields in media, and Maxwell's Equations and time varying fields.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5340. Advanced Dynamics.
Classical mechanics at an advanced level. Topics covered may include special relativity in classical mechanics, Hamilton equation of motion, canonical transformations, and Hamilton-Jacobi theory.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5350A. Thin Film Photovoltaic Devices.
This course is a survey of the Physics of photovoltaic devices with emphasis on device physics including the photovoltaic effect, photon absorption, electrons and holes, generation and recombination, the pn-junction, charge separation, monocrystalline solar cells, thin film solar cells, and losses.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5350B. Relativity.
This course includes a review of Special Relativity, an introduction to the mathematics of tensor calculus and differential geometry, and such topics from General Relativity as the Schwarzschild solution and black holes, tests of General Relativity, cosmological models, and applications of relativity in the Global Positioning System (GPS).
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter

PHYS 5350C. Characterization of Materials.
This course covers skills and knowledge required for microscopy methods including optical microscopy, scanning electron microscopy, scanning tunneling electron microscopy, atomic force microscopy, and confocal microscopy. It covers x-ray and neutron diffraction techniques including structure analysis, powder and glancing angle diffraction, pole figure, texture analysis, and small angle scattering.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Standard Letter
PHYS 5350D. Cognitive Foundations of Physics Education Research.
This course is an introduction to research methods and theories in physics education research. Topics include conceptual metaphor and blending, cognitive linguistics, dual-process theory, and historical issues from the intellectual development of physics.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 5370. Problems in Advanced Physics.
Open to graduate students on an individual basis by arrangement with the Department of Physics. May be repeated with prior approval of the department. Prerequisite: Instructor approval.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 5395. Fundamentals of Research.
Course is available to graduate students only at the invitation of the department. May be repeated with prior approval of the department. Prerequisite: Instructor approval.
3 Credit Hours. 0 Lecture Contact Hours. 6 Lab Contact Hours.
Course Attribute(s): Exclude from 3-peat Processing
Grade Mode: Standard Letter

PHYS 5398. Industry Internship.
Supervised work experience in an appropriate high tech industry. Students will be required to keep a daily journal and make a final presentation (both written and oral) describing their accomplishments.
3 Credit Hours. 0 Lecture Contact Hours. 40 Lab Contact Hours.
Grade Mode: Credit/No Credit

PHYS 5399A. Thesis.
This course represents a student’s initial thesis enrollment. No thesis credit is awarded until student has completed the thesis in PHYS 5399B.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

PHYS 5399B. Thesis.
This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding. Graded on a credit (CR), progress (PR), no-credit (F) basis.
3 Credit Hours. 3 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

PHYS 5599B. Thesis.
This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding.
5 Credit Hours. 5 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit

PHYS 5999B. Thesis.
This course represents a student’s continuing thesis enrollments. The student continues to enroll in this course until the thesis is submitted for binding.
9 Credit Hours. 9 Lecture Contact Hours. 0 Lab Contact Hours.
Grade Mode: Credit/No Credit