DEPARTMENT OF PHYSICS AND ENGINEERING

Natural Sciences, Mathematics, and Engineering (nsme) (https://catalog.csub.edu/general-information/csub-information/school-natural-sciences-mathematics-engineering/)

Department of Physics and Engineering (p. 1)

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Program Maps for Natural Sciences, Mathematics, and Engineering (https://programmap.csub.edu/academics/interest-clusters/4e942a6e-b8e4-4b60-a1ae-334235acc581/)

Courses

ENGR 1618 Introduction to Engineering I (2)
This course will provide an introduction to the practice of engineering and the various areas within the engineering disciplines. Students will be informed of engineering curricula and career opportunities within the various engineering disciplines. This course will also introduce students to important topics for academic success, both at the major level and at the university level. Each week meets for 50 minutes of lecture and 100 minutes of activity. There is a $15 course material fee.
General Education Attribute(s): First Year Seminar
Course Fee: Yes

ENGR 1628 Introduction to Engineering II (2)
This course builds on the foundational skills in engineering design and practices developed in ENGR/ECE 1618. Students will design, build, test, and present engineering projects designed to solve specified problems within given constraints. Additionally, the impact of engineering from a global, social, economic, and environmental perspective is presented through case studies. Each week meets for 50 minutes of lecture and 100 minutes of activity. There is a $15 course material fee. Prerequisite: ECE/ENGR 1618. Completion of ECE/ENGR 1618 and ECE/ENGR 1628 satisfies general education requirement First Year Seminar.
Requisite(s): Prereqs: ENGR/ECE 1618
General Education Attribute(s): First Year Seminar
Course Fee: Yes

ENGR 2070 Electric Circuits (4)
An introduction to the analysis of electrical circuits. Use of analytical techniques based on the application of circuit laws and network theorems. Analysis of DC and AC circuits containing resistors, capacitors, inductors, dependent sources and/or switches. Natural and forced responses of first and second order RLC circuits; the use of phasors; AC power calculations; power transfer; and energy concepts. 150 minutes lecture and 150 minutes laboratory. Prerequisites: PHYS 2220 with a grade of C- or better, or the equivalent, or permission of the instructor. Cross-listed as ECE 2070 or ENGR 2070 or PHYS 2070.
Requisite(s): PHYS 2220 or 222 with a C- or better
Course Fee: Yes

ENGR 2110 Analytic Mechanics, Statics (3)
Introduces students to fundamental principles of force systems acting on particles and rigid bodies in static equilibrium. Applications to structural and mechanical problems, both two-dimensional and three-dimensional. Prerequisite: PHYS 2210 and ENGR 2350 with a grade C- or better. Prerequisite or corequisite: MATH 2320 or MATH 2520.
Requisite(s): Prerequisite: PHYS 2210 or 221 and ENGR 2350 with a C- or higher. Pre-requisite or Co-requisite: MATH 2320 or 2520.

ENGR 2120 Analytical Mechanics, Dynamics (3)
Topics include vector representation of kinematics of particles; Newton's laws of motion; force-mass-acceleration, work-energy, and impulse-momentum methods; kinematics of systems of particles and rigid bodies. Prerequisites: ENGR 2110 with a grade of C- or better.
Requisite(s): Prerequisites: ENGR 2110 with C- or better.

ENGR 2130 Mechanics of Materials (3)
This course covers stress and strain and mechanical properties of materials. The axial load, torsion, bending and transverse shear; combined loadings; stress transformation; pressure vessels, deflection of beams and shafts; and buckling of columns are reviewed as well. Prerequisites: ENGR 2110 with a C- or better.
Requisite(s): Prerequisites: ENGR 2110 with C- or better.

ENGR 2140 Materials Science and Engineering (4)
Introductory course to engineering materials. The student will develop an understanding of the atomic structure of the major classes of materials. The properties (mechanical, thermal, optical, and electrical) of metals, polymers, ceramics, and electronic materials will be reviewed. The student will understand the effect of processing in the internal structures of materials. It is expected that at the end of the course the student will understand material deterioration and failure processes. Prerequisites: PHYS 2210, CHEM 1000 and CHEM 1001, all with a grade C- or better.
Requisite(s): Prerequisite: PHYS 2210 or 221, CHEM 1000 or 211, 1001 or 211L, all with a C- or better.
Course Fee: Yes

ENGR 2350 Engineering Graphics (2)
This course covers the principles of engineering drawings in visually communicating engineering designs and an introduction to computer-aided design (CAD). Topics include the development of visualization skills; orthographic projections; mechanical dimensioning and tolerancing practices. Assignments develop sketching and 2-D CAD skills. The use of CAD software is an integral part of the course.
Course Fee: Yes

ENGR 2360 Intermediate CAD in Engineering (2)
Intermediate topics in computer-aided design using CAD software. Introduction to 3-dimensional drawing and modeling with engineering applications, adding text to drawings, creating dimensions, using blocks and external references, managing content, creating a layout to plot, and plotting your drawings. Prerequisite: ENGR 2350 with a C- or better.
Requisite(s): Prerequisite: ENGR 2350 with C- or better
Course Fee: Yes

ENGR 2700 Special Topics in Engineering (1-3)
Topics and prerequisites to be announced. May be repeated for credit with different topics up to a maximum of 3 units.
Repeatable for Credit: Yes, up to 3 units

ENGR 3070 Analog Electronics (3)
Introduces basic analog circuit designs that emphasize practical applications. Includes properties of diodes and transistors; operational amplifies for use as filters, amplifiers, oscillators, and function generators. Prerequisites: PHYS 2070 or ENGR 2070 or ECE 2070 with a grade C- or better.
Requisite(s): Prerequisite: PHYS 2070 or ENGR 2070 or ECE 2070 with C- or better.
Course Fee: Yes

ENGR 3110 Thermodynamics (4)
Study of the first law of thermodynamics, properties of pure substances, entropy, the second law of thermodynamics, reversible and irreversible processes, availability (exergy), ideal vapor power cycles, ideal gas power cycles, and refrigeration and heat pump cycles. Prerequisites: PHYS 2220, and CHEM 1000 both with a C- or better.
Requisite(s): Prerequisites: PHYS 2220 and CHEM 1000 both with C- or better.
Course Fee: Yes

ENGR 3120 Fluid Mechanics (4)
Hydrostatics and fluid dynamics. Viscous flow, boundary layer concepts, lift and drag, laminar and turbulent flow, compressible flow. Experiments involving flow measurement and control, conservation equations, pressure and velocity distributions, dimension analysis, lift and drag. Prerequisites: ENGR 2120 and ENGR 3300, both with a grade C- or better, and ENGR 3110.
Requisite(s): Prerequisites: ENGR 2120 and 3300 both with a C- or better, and ENGR 3110.
Course Fee: Yes

ENGR 3300 Engineering Modeling and Analysis (3)
Formulation of mathematical models for engineering systems; applying mass, momentum, and energy balances to derive governing differential equations; solution of differential equations and eigenvalue problems typically encountered within an engineering context; fitting linear and nonlinear models to experimental data; concepts in probability and statistics. Prerequisite: PHYS 2220, MATH 2320 or MATH 2520, both with a grade of C- or better.
Requisite(s): Prerequisite: PHYS 2220, MATH 2320 or 2520, both with a grade of C- or better.
Course Fee: Yes

ENGR 3310 Numerical Methods and Applications in Engineering (3)
Formulation and solution of mathematical models for engineering systems, continuation from ENGR 3300. Numerical methods including: interpolation and polynomial approximation, numerical differentiation and integration, numerical solution of ordinary differential equations. Advanced methods in a numerical computing environment and computer-aided design. Prerequisite: ENGR 3300 with a C- or better.
Requisite(s): Prerequisite: ENGR 3300 with C- or better.

ENGR 3400 Soil and Water Resource Management (3)
Soil and water management systems and practices including hydrology, surface drainage, open channels, and erosion, subsurface drainage, impoundments and irrigation. Prerequisite: ENGR 2110 with a grade C- or better. Prerequisite or corequisite: ENGR 3300.
Requisite(s): Prerequisite: ENGR 2110 with a grade C- or better. Prerequisite or corequisite: ENGR 3300.

ENGR 3410 Agricultural Machines and Instrumentation (4)
Introduces students to application of machine systems and instrumentation to agricultural production and biological processing. Functional design and analysis of equipment. This course is designed to provide a broad foundation for understanding machine systems and instrumentation. Machine systems are an integral part of many agricultural operations from field production to post-harvest processing, storage, transportation, and bio-based processing. Prerequisites: ENGR 2110 with a grade of C- or better.
Requisite(s): Prerequisites: ENGR 2110 with C- or better.

ENGR 4110 Heat Transfer (4)
Introduces the analysis of steady and transient heat conduction, forced and natural convection, radiation heat transfer, and design of heat exchangers. Analytical and numerical methods in heat transfer and fluid mechanics. Topics include heat conduction and convection, gaseous radiation, boiling and condensation, general aspects of phase change, mass transfer principles, multimode heat transfer and the simulation of thermal fields, and the heat transfer process. Prerequisites: ENGR 3110 and ENGR 3120.
Requisite(s): Prerequisite: ENGR 3110 (310) and ENGR 3120 (320)
Course Fee: Yes

ENGR 4120 Machine Design (4)
This course is an introduction to the principles of mechanical design. Methods for determining static, fatigue, and surface failure are presented. Analysis and selection of machine components such as shafts, keys, couplings, bearings, gears, springs, power screws, and fasteners is covered. Prerequisites: ENGR 2120 and ENGR 2130, both with a grade C- or better.
Requisite(s): Prerequisites: ENGR 2120 and 2130, both with a grade C- or better.
Course Fee: Yes

ENGR 4200 Operations Research (3)
Introduction to deterministic optimization modeling and algorithms in operations research. Emphasis on formulation and solution of linear programs, network flows, and integer programs. Introduction to probabilistic models in operations research. Emphasis on Markov chains, Poisson processes, and their application to queueing systems. Prerequisites: MATH 2310 or MATH 2510 with a grade of C- or better.
Requisite(s): Prerequisites: MATH 2310 or 2510 with a grade of C- or better.

ENGR 4220 Project Management (3)
Projects are unique, strategically important, complex endeavors with definite beginning and ending dates. The course develops the skills required to manage the component processes of a project throughout its life cycle: scope, time and sequencing, cost, quality, human resources, communications, risk, procurement, and project integration management. The project life cycle encompasses development of the initiative out of strategic planning activities, articulation of project goals and objectives, planning project components and their integration, execution and control, project close out, and follow-up activities. Prerequisites: MATH 2310 or MATH 2510 with a C- or better.
Requisite(s): Prerequisites: MATH 2310 or 2510 with a grade of C- or better.

ENGR 4240 Quality Management (3)
An overview of management literature relating to quality planning, quality control, quality assurance, and quality improvement. A consideration of the core principles and methods common to most quality improvement programs and their relationship to management principles. Comparison of prevalent quality improvement programs such as ISO9004: 2008, SixSigma, and TQM and the Malcolm Baldrige Standards. Case studies. Prerequisites: MATH 2310 or MATH 2510 with a grade of C- or better.
Requisite(s): Prerequisites: MATH 2310 or 2510 with a grade of C- or better.

ENGR 4260 Economics of Engineer Design (3)
Cost measurement and control in engineering studies. Basic accounting concepts, income measurement, and valuation problems. Manufacturing cost control and standard cost systems. Capital investment, engineering alternatives, and equipment replacement studies. Prerequisites: MATH 2310 or MATH 2510 with a grade of C- or better.
Requisite(s): Prerequisites: MATH 2310 or 2510 with a grade of C- or better.

ENGR 4410 Environmental Engineering (3)
An introduction to environmental engineering, including: water usage and conservation; water chemistry including pH and alkalinity relationships, solubility and phase equilibria; air quality; solid waste disposal; fate and transport of contaminants in lakes, streams and groundwater; design and analysis of mechanical, physiochemical and biochemical water and wastewater treatment processes. Prerequisite: CHEM 1000 and CHEM 1001 (C- or higher); prerequisite or corequisite: ENGR 3300.
Requisite(s): Prerequisite: CHEM 1000 and CHEM 1001 (C- or higher); prerequisite or corequisite: ENGR 3300.

ENGR 4420 Food and Bioprocess Engineering Unit Operations (3)
Principles of the engineering design, testing and analysis of unit processing operations employed in the food and bioprocess industries, such as sterilization, pasteurization, freezing/refrigeration, drying, evaporation, and fermentation, along with physical, chemical and phase separations. Design and analysis of thermal, freezing, evaporation, dehydration; and mechanical, chemical and phase separations processes as governed by reaction kinetics and rheology of food and biological materials. Prerequisites: CHEM 1000 and CHEM 1001, both with a grade C- or better. Prerequisite or corequisite: ENGR 3110 and ENGR 3300.
Requisite(s): Prerequisites: CHEM 1000, 1001 both with a grade C- or better. Prerequisite or corequisite: ENGR 3110 and 3300.

ENGR 4520 Petroleum Production Engineering (3)
Covers topics in modern petroleum production engineering, including production technologies, production equipment, equipment design and optimization, well completion, tubing design, well performance evaluation (productivity index), inflow performance relationships (IPR), artificial lift and surface facilities. Prerequisite or corequisite: ENGR 3110. Prerequisite: GEOL 4060 with a grade C- or better.
Requisite(s): Prerequisite or corequisite: ENGR 3110. Prerequisite: GEOL 4060 with a grade C- or better.

ENGR 4530 Reservoir Engineering (4)
Fundamental equations of fluid flow through porous media, reservoir material balances, aquifer influx, well testing, and decline curve analysis. Methods for forecasting reservoir performance are covered using analytical models, enhanced oil recovery methods, numerical simulation of improved recovery processes, and reservoir aspects of horizontal wells. Prerequisites: MATH 2320 or MATH 2520, and GEOL 4060, both with a grade C- or better.
Requisite(s): Prerequisites: MATH 2320 or 2520, and GEOL 4060, both with a grade C- or better.

ENGR 4540 Drilling Engineering and Completion Technology (4)
Fundamentals of drilling equipment, engineering design calculations, wellbore diagrams, drilling fluids, cement calculations, and casing design. Additional topics such as directional drilling as well as completion technologies are covered using practical examples and field applications as applied in the oil and natural gas well drilling operations. 150 minutes lecture/discussion and 150 minutes laboratory per week. Prerequisites: ENGR 2140, and GEOL 4060, both with a grade C- or better.
Requisite(s): Prerequisites: ENGR 2140, and GEOL 4060, both with a grade C- or better.
Course Fee: Yes

ENGR 4610 Conventional Energy Production (3)
Study of combustion of fossil fuels, thermal power plant and cogeneration, gas turbine power plant and cogeneration, combined gas turbine-thermal power plant, integrated gasification combined cycle (IGCC) power plants, nuclear power plants, and environmental impacts associated with conventional energy production methods. Prerequisite: ENGR 3110.
Requisite(s): Prerequisite: ENGR 3110.

ENGR 4620 Renewable Energy Production (3)
Study of hydro energy systems, geothermal energy systems, wind energy systems, solar energy systems, fuel cells, thermoelectric power generator, biomass, carbon capturing and sequestration, energy storage, economic analysis of energy generating systems, and environmental impacts associated with renewable energy production methods. Prerequisite: ENGR 3110.
Requisite(s): Prerequisite: ENGR 3110.

ENGR 4700 Special Topics in Engineering (1-4)
This course will often be used to supplement other courses with additional work at a more advanced level. May be repeated in different topics, but only a total of up to 4 units of ENGR 4700 can be used for upper division elective credit towards major requirements. Prerequisite: Permission of instructor.
Repeatable for Credit: Yes, up to 4 units

ENGR 4800 Research Participation (1-3)
Individual study, under supervision, on a current research problem. (Experience as a research assistant does not count for credit.) May include research in the areas of curriculum and materials development. May be repeated, but only a total of up to 3 units of ENGR 4800 can be used for upper division elective credit towards major requirements. Prerequisite: Permission of instructor.
Repeatable for Credit: Yes, up to 3 units

ENGR 4900 Senior Design Project A (2)
Selection and initiation of an engineering design project under faculty supervision. Collaborative projects with local industry partners are encouraged. Projects are presented in a formal report and in a formal presentation. Prerequisite: ENGR 2140 and ENGR 2070 with C- or better; prerequisite or corequisite ENGR 4110 and ENGR 4120 and open only to Engineering Sciences majors.
Requisite(s): Prerequisite: ENGR 2140 and ENGR 2070 with C- or better and prerequisite/corequisite ENGR 4110 and 4120 and open only to Engineering Sciences majors.
Course Fee: Yes

ENGR 4910 Senior Design Project B (2)
Completion of a project under faculty supervision. This course is a continuation of ENGR 4900. Projects are presented in formal report and in formal presentations. Prerequisite: ENGR 4900. Open only to senior Engineering Sciences majors."
Requisite(s): Prerequisite: ENGR 4900 and Engineering major.
Typically Offered: Spring
Course Fee: Yes

PHYS 1010 Physics Freshman Orientation I (1)
An introduction to Physics and its subfields, and the Physics curriculum. Emphasis on study skills and problem solving. A challenge problem will be presented and a laboratory experiment will be performed. Includes seminars by guest speakers. Primarily for Physics majors, but may be taken by others interested in the sciences or Engineering. 50 minutes lecture/discussion.

PHYS 1020 Physics Freshman Orientation II (1)
Continuation of PHYS 1010. An introduction to resume writing and internships in Physics. Emphasis on mathematical tools used in Physics. A challenge problem will be presented and a laboratory experiment will be performed. Includes seminars by guest speakers. Primarily for Physics majors, but may be taken by others interested in the sciences or Engineering. 50 minutes lecture/discussion.
Typically Offered: Spring

PHYS 1609 Introduction to Astronomy (3)
Historical development of modern astronomy. Contents of the universe, the solar system, stars, and galaxies. Stellar evolution and solar processes. The planets. Modern cosmology. 100 minutes lecture and 150 minutes laboratory per week. Satisfies general education requirement Area B1.
General Education Attribute(s): GE (B1) Physical Sciences
Typically Offered: Fall, Spring

PHYS 2010 Physics Sophomore Orientation I (1)
Continuation of PHYS 1020. An introduction to professional societies in Physics and graduate study in Physics. Emphasis on statistical methods and error analysis. A challenge problem will be presented and a laboratory experiment will be performed. Includes seminars by guest speakers. Primarily for Physics majors, but may be taken by others interested in the sciences or Engineering. 50 minutes lecture/discussion.

PHYS 2020 Physics Sophomore Orientation II (1)
Continuation of PHYS 2010. An introduction to fields related to Physics and career opportunities in these fields. Emphasis on the role of simulations and models in science. A challenge problem will be presented and a laboratory experiment will be performed. Includes seminars by guest speakers. Primarily for Physics majors, but may be taken by others interested in the sciences or Engineering. 50 minutes lecture/discussion.
Typically Offered: Spring

PHYS 2070 Electric Circuits (4)
An introduction to the analysis of electrical circuits. Use of analytical techniques based on the application of circuit laws and network theorems. Analysis of DC and AC circuits containing resistors, capacitors, inductors, dependent sources and/or switches. Natural and forced responses of first and second order RLC circuits; the use of phasors; AC power calculations; power transfer; and energy concepts. 150 minutes lecture and 150 minutes laboratory. Prerequisites: PHYS 2220 with a grade of C- or better, or the equivalent, or permission of the instructor. Cross-listed as ECE 2070 or ENGR 2070 or PHYS 2070.
Requisite(s): PHYS 2220 or 222 with a C- or better
Course Fee: Yes

PHYS 2110 College Physics I (4)
This course is intended for students needing a one-year course in Physics as requirement by their major program. Offered with non-calculus based text. Newtonian mechanics with emphasis on kinematics, dynamics, work and energy, momentum, simple harmonic motion, fluids, mechanical waves and sound, thermodynamics and statistical physics. This class includes an introduction to logarithms, exponentials and trigonometry. 150 minutes of lecture and 150 minutes laboratory. Prerequisite: MATH 1040 or MATH 1050 or equivalent.
Requisite(s): MATH 1040 or 1050 or 191 or 190 or permission of the instructor.
Typically Offered: Fall, Spring
Course Fee: Yes

PHYS 2111 College Physics I Recitation (1)
Students work on questions or problems related to the PHYS 2110 coursework. Emphasis on qualitative conceptual reasoning. Students will generally work in teams of about four to discuss, analyze, understand, and solve physics problems. 50 minutes discussion. Credit/no-credit grading. Corequisite: PHYS 2110.
Requisite(s): Coreq: PHYS 2110
Typically Offered: Fall, Spring

PHYS 2120 College Physics II (4)
This course is intended for students needing a one-year course in physics as requirement by their major program. Offered with non-calculus based text. Maxwellian electromagnetics with emphasis on electrostatics, magnetism, DC circuits, optics, and modern physics. 150 minutes of lecture and 150 minutes laboratory. Prerequisite: PHYS 2110 or equivalent.
Requisite(s): Prerequisite: PHYS 2110 or 201 or permission of the instructor.
Typically Offered: Fall, Spring
Course Fee: Yes

PHYS 2121 College Physics II Recitation (1)
Students work on questions or problems related to the PHYS 2120 coursework. Emphasis on qualitative conceptual reasoning. Students will generally work in teams of about four to discuss, analyze, understand, and solve physics problems. 50 minutes discussion. Credit/no-credit grading. Corequisite: PHYS 2120.
Requisite(s): Coreq: PHYS 2120
Typically Offered: Fall, Spring

PHYS 2150 Thermodynamics (2)
Algebra-based thermodynamics for science majors. 75 minutes of lecture and 75 minutes of laboratory per week. Prerequisites: Consent of the instructor.

PHYS 2160 Electromagnetism (2)
Trigonometry-based electricity and magnetism for science majors. 75 minutes of lecture and 75 minutes of laboratory per week. Prerequisites: Consent of the instructor.

PHYS 2210 Physics for Scientists and Engineers I (4)
Intended for students majoring in the physical sciences and engineering. An introduction to kinematics, dynamics, work and energy, momentum, gravitation, simple harmonic motion, and fluids. 150 minutes lecture and 150 minutes laboratory. Prerequisites: MATH 2310 or MATH 2510 or MATH 2020.
Requisite(s): Prerequisite: MATH 2310 or 2510 or 2020.
Course Fee: Yes

PHYS 2211 Physics for Scientists and Engineers I Recitation (1)
Students work on questions or problems related to the PHYS 2210 coursework. Emphasis on qualitative conceptual reasoning. Students will generally work in teams of about four to discuss, analyze, understand, and solve physics problems. 50 minutes discussion. Credit/no-credit grading. Corequisite: PHYS 2210.
Requisite(s): Coreq: PHYS 2210
Typically Offered: Fall, Spring

PHYS 2220 Physics for Scientists and Engineers II (4)
Intended for students majoring in the physical sciences and engineering. Core topics include electrostatics, magnetism, DC and AC circuits, Maxwell's equations, thermodynamics, and statistical physics. 150 minutes lecture and 150 minutes laboratory. PHYS 2210 and MATH 2320 or MATH 2520 or MATH 2020 or permission of the instructor.
Requisite(s): PHYS 2210 and MATH 2320 or 2520 or 2020 or permission of the instructor.
Course Fee: Yes

PHYS 2221 Physics for Scientists and Engineers II Recitation (1)
Students work on questions or problems related to the PHYS 2220 coursework. Emphasis on qualitative conceptual reasoning. Students will generally work in teams of about four to discuss, analyze, understand, and solve physics problems. 50 minutes discussion. Credit/no-credit grading. Corequisite: PHYS 2220.
Requisite(s): Coreq: PHYS 2220
Typically Offered: Fall, Spring

PHYS 2230 Physics for Scientists and Engineers III (4)
Intended for students majoring in the physical sciences and engineering. Core topics include waves, geometric optics, optical instruments, wave optics, special relativity, and introduction to quantum mechanics. Additional possible topics include atomic physics, condensed matter, nuclear physics, and particle physics. 150 minutes lecture and 150 minutes laboratory. Prerequisite: PHYS 2220 with a grade of C- or better or the equivalent, or permission of the instructor.
Requisite(s): Prerequisite: PHYS 222 or 2220 with a C- or better or permission of the instructor.
Course Fee: Yes

PHYS 2231 Physics for Scientists and Engineers III Recitation (1)
Students work on questions or problems related to the PHYS 2230 coursework. Emphasis on qualitative conceptual reasoning. Students will generally work in teams of about four to discuss, analyze, understand, and solve physics problems. 50 minutes discussion. Credit/no-credit grading. Corequisite: PHYS 2230.
Requisite(s): Coreqs: PHYS 2230

PHYS 2700 Special Topics in Physics (1-3)
Topics and prerequisites to be announced. May be repeated for credit with different topics.
Repeatable for Credit: Yes, up to 3 units

PHYS 3010 Intermediate Laboratory in Modern Physics (3)
Students will perform a number of experiments chosen from Speed of Light, Photoelectric Effect, Blackbody Radiation, Millikan's Oil-Drop Experiment, Faraday Rotation, and others. Experimental equipment consists of self-contained units with detailed manuals. 50 minutes lecture/discussion and 300 minutes laboratory. Prerequisite: PHYS 2230.
Requisite(s): Prerequisite: PHYS 2230 or 223.

PHYS 3070 Analog Electronics (3)
Introduces basic analog circuit designs that emphasize practical applications. Includes properties of diodes and transistors; operational amplifies for use as filters, amplifiers, oscillators, and function generators. 100 minutes lecture/discussion and 150 minutes laboratory. Prerequisite: PHYS 2070 or ENGR 2070 or ECE 2070 with a grade C- or better.
Requisite(s): Prerequisite: PHYS 2070 or ENGR 2070 or ECE 2070 with C- or better.
Course Fee: Yes

PHYS 3110 Classical Mechanics I (2)
An intermediate level course intended for majors in the physical sciences. Newtonian and Lagrangian dynamics of particles and systems. Topics covered in PHYS 3110 and PHYS 3120 may include conservation laws, harmonic oscillators, damped and forced oscillations, nonlinear systems, gravity, central-force motion, non-inertial reference frames, coupled oscillators, waves, and special relativity. 100 minutes lecture/discussion. Prerequisites or corequisites: PHYS 2230 or PHYS 223, PHYS 3500 and MATH 2533 or MATH 204 or permission of instructor.
Requisite(s): Prerequisites or corequisites: PHYS 2230 or 223, PHYS 3500, MATH 2533 or 204, or permission of the instructor.

PHYS 3120 Classical Mechanics II (2)
Continuation of PHYS 3110. 100 minutes lecture/discussion. Prerequisite: PHYS 3110.
Requisite(s): Prerequisites: PHYS 3110 or permission of the instructor.

PHYS 3210 Electricity and Magnetism I (2)
An upper-level course intended for majors in the physical sciences. Classical theory of electric and magnetic phenomena. Topics covered in PHYS 3210 and PHYS 3220 may include: Coulomb's Law, electric fields, electric potential, electrostatics, motion of charges in static fields; conductors and dielectrics, steady currents, polarization. Magnetic fields and magnetostatics, vector potential; magnetization, magnetic materials; induction, development of Maxwell's equations, electromagnetic waves and radiation. 100 minutes lecture/discussion. Prerequisites: PHYS 2230 or PHYS 223 and PHYS 3500, or permission of the instructor.
Requisite(s): Prerequisites: PHYS 2230 or 223 and 3500 or permission of the instructor.

PHYS 3220 Electricity and Magnetism II (2)
Continuation of PHYS 3210. 100 minutes lecture/discussion. Prerequisites: PHYS 3210.
Requisite(s): Prerequisite: PHYS 3210 or 323A or permission of the instructor.
Typically Offered: Spring

PHYS 3310 Thermal Physics (3)
Elements of classical thermodynamics and statistical mechanics. Applications may include heat engines, distribution functions, magnetism, classical and quantum gases and more. 150 minutes lecture/discussion. Prerequisites: PHYS 2230 and PHYS 3500.
Requisite(s): Prerequisites: PHYS 2230 or 223 and 3500 or permission of the instructor.
Typically Offered: Spring

PHYS 3320 Statistical Mechanics (2)
Advanced topics in thermodynamics and statistical mechanics. Applications may include: non-ideal gases, phase equilibrium, ionization equilibrium, thermodynamic fluctuations, phase transitions elements and critical phenomena, and elements of the kinetic theory. 100 minutes lecture/discussion. Prerequisites: PHYS 3310.
Requisite(s): Prerequisite: PHYS 3310 or 322A or permission of the instructor.

PHYS 3500 Mathematical Methods for Physical Sciences & Engineering (2)
An upper-level course intended for majors in the Physical Sciences and Engineering to demonstrate the use of Calculus and Vector Algebra in real-world problems. Introduction of mathematical tools such as Fourier series, Dirac's delta function, the calculus of variations, complex analysis and the theory of residues. 100 minutes lecture/discussion. Prerequisite: MATH 2533 or MATH 204 or permission of the instructor and prerequisite or corequisite: PHYS 2230 or PHYS 223.
Requisite(s): Prerequisite: MATH 2533 or 204 or permission of the instructor and prerequisite or co-requisite: PHYS 2230 or 223.
Typically Offered: Spring

PHYS 3510 Modern Physics (2)
Development of quantum and relativistic physics. Quantum description of atoms, solids, and nuclei. Fundamental forces of nature, introduction to particle physics and quantum fields. 100 minutes lecture/discussion. Prerequisite: PHYS 2230.
Requisite(s): Prerequisite: PHYS 2230 or 223.

PHYS 3520 Scientific Computing (3)
Computer solutions to scientific problems. Symbolic manipulations and array processors. Mathematical operations, plotting, and symbolic and numerical techniques in calculus. Numerical methods such as histogramming, Monte Carlo methods, statistical analysis, curve fitting and numerical algorithms. Prior knowledge of computers is not required. 100 minutes lecture/discussion, 150 minutes laboratory. Prerequisite: PHYS 2230.
Requisite(s): Prerequisite: PHYS 2230 or 223.
Typically Offered: Spring

PHYS 4010 Advanced Laboratory in Modern Physics (2)
Students will perform a number of experiments chosen from Nuclear Magnetic Resonance, Lifetime of Muons in Cosmic Rays, Wave Particle Duality, and others. Continuation of PHYS 3010, but students may need to design and define the scope of the experiments. 300 minutes laboratory. Prerequisite: PHYS 3010.
Requisite(s): Prerequisite: PHYS 3010 or 324 or permission of the instructor.
Typically Offered: Spring

PHYS 4410 Quantum Mechanics I (2)
The postulates and meaning of quantum mechanics. Schroedinger's equation and its relation to one-dimensional problems; the harmonic oscillator. 100 minutes lecture/discussion. Prerequisites: PHYS 3110 or PHYS 321, MATH 2533 or MATH 204 or permission of the instructor.
Requisite(s): Prerequisites: PHYS 3110, MATH 2533 or permission of the instructor.

PHYS 4420 Quantum Mechanics II (2)
Continuation of PHYS 4410, including the hydrogen atom, angular momentum, atoms and molecules, introduction to perturbation theory. 100 minutes lecture/discussion. Prerequisite: PHYS 4410.
Requisite(s): Prerequisite: PHYS 4410 or 411A or permission of the instructor.
Typically Offered: Spring

PHYS 4510 Condensed-Matter Physics (3)
Introduction to crystal structure, direct and reciprocal lattices, x-ray diffraction analysis, thermal, electronic, magnetic and optical properties of crystalline solids. 150 minutes lecture/discussion. Prerequisite: PHYS 4410.
Requisite(s): Prerequisite: PHYS 4410 or 411A or permission of the instructor.
Typically Offered: Spring

PHYS 4520 Atomic and Molecular Physics (3)
Spectra of one- and many-electron atoms; hyperfine structure; interaction of radiation with matter; selection rules; rotational and vibrational spectra of molecules; electronic transitions in diatomic molecules; lasers. 150 minutes lecture/discussion. Prerequisite: PHYS 4410.
Requisite(s): Prerequisite: PHYS 4410 or 411A or permission of the instructor.

PHYS 4600 Teaching Physics (1-3)
Students may gain experience in teaching Physics at the High School level or at the lower division level. The determination of course credits, evaluation, and grading are the responsibility of the departmental faculty in consultation with the student's supervisor. Offered on a credit, no-credit basis only. Department will determine application of credit. Prerequisite: Major or minor in Physics or permission of the instructor. May be repeated.
Requisite(s): Prerequisite--major or minor in Physics
Repeatable for Credit: Yes, up to 4 units

PHYS 4700 Special Topics in Physics (1-3)
Topics and prerequisites to be announced. Typical courses include astrophysics, advanced electronic systems, advanced mechanics, and statistical physics. Prerequisite: Major or minor in Physics and permission of the instructor. May be repeated for credit with different topics.
Requisite(s): Prerequisite--major or minor in Physics
Repeatable for Credit: Yes, up to 20 units

PHYS 4800 Research Participation (1-3)
Individual study, under supervision, in scientific investigation. (Experience as a research assistant does not count for credit.) May include research in the areas of curriculum and materials development. Prerequisite: Consent of instructor. May be repeated for credit.
Repeatable for Credit: Yes, up to 15 units

PHYS 4900 Senior Seminar (2)
Presentation of papers and discussion by faculty and students. Topics to be chosen in consultation by faculty. Participants will be grouped by disciplinary and interdisciplinary interests. Prerequisite: Major or minor in Physics or consent of the instructor.
Requisite(s): Prerequisite--major or minor in Physics

PHYS 4910 Senior Project (2)
Design and construction of a Physics experiment/demonstration or Engineering project under faculty supervision. Students are expected to work in small groups. Projects are presented in a formal report, describing all phases of the project, including data taking and analysis, and a formal oral presentation. Prerequisite: Major or minor in Physics.
Requisite(s): Prerequisite--major or minor in Physics
Typically Offered: Spring

Faculty

Faculty: T. Acharya, L. Cabrales Arriaga, A. Dzyubenko, G. Dzyubenko, V. Gasparyan, P. Guo, S. Hong, J. Lewis, Y. Li, T. Moore, K. Prasai, K. Salehpoor, D. Saini,

Emeritus Faculty: T. Meyer (Physics and Computer Science), R. Negrini (Physics and Geology), J. Talamantes (Physics and Engineering)