DEPARTMENT OF PHYSICS AND ENGINEERING

Mission Statement

The Physics and Engineering Department at PLNU provides strong programs of study in the fields of Physics and Engineering. Our students are well prepared for graduate studies and careers in scientific and engineering fields. We emphasize a collaborative learning environment which allows students to thrive academically, build personal confidence, and develop interpersonal skills. We provide a Christian environment for students to learn values and judgment and pursue integration of modern scientific knowledge and Christian faith.

Purposes

- To prepare students for graduate studies in physics or engineering;
- To prepare students for a career in research or teaching;
- To prepare students for employment in various fields of applied physics and engineering;
- To satisfy pre-professional requirements for students choosing to attend engineering or architectural schools.

Tradition of Excellence

The Department of Physics and Engineering offers an excellent education in a vibrant Christian setting. Caring and knowledgeable faculty engage students with one-on-one instruction and in smaller-sized classes. A number of our students gain practical work experience at Space and Naval Warfare Systems Command (SPAWAR) and engineering firms in the area. During the summer, our students participate in research on campus as well as at other undergraduate research programs around the country.

Career Opportunities

Most Physics majors continue their education in graduate school and eventually become research scientists or teachers. The Engineering Physics majors focus on either electrical or mechanical systems. Computer Science Engineering students focus on computer hardware and software. Graduates with this major have the option to attend graduate school or enter the job market in industry or government immediately after graduation. Point Loma offers both a Bachelor of Science and a Bachelor of Arts in Physics as well as a Bachelor of Science in Engineering Physics.

Faculty

Chair - Maria Zack, Ph.D.

Michelle Chen, Ph.D.
University of Pennsylvania

Anthony Cortez, Ph.D.
University of California, Riverside

Paul Schmelzenbach, Ph.D.
Oregon State University

Maria Zack, Ph.D.
University of California, San Diego

To view requirements for majors, minors, and certificates, see the Degree Program Information (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/degree-program-information/) page.

- General Engineering: Computer Science Engineering, B.S.E. (Physics and Engineering) (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/phy/general-engineering-computer-science-engineering-bse/)
- General Engineering: Electrical Engineering, B.S.E. (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/phy/general-engineering-electrical-engineering-bse/)
- General Engineering: Mechanical Engineering Physics, B.S.E. (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/phy/general-engineering-mechanical-engineering-physics-bse/)
- Physics, B.A. (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/phy/physics-ba/)
- Physics, B.A. for Associates Degree Transfer(ADT) Students (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/phy/physics-ba-adt/)
- Physics, B.S. (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/phy/physics-bs/)
- Computational Science Minor - Physics (Physics and Engineering) (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/phy/computational-science-minor-physics/)
- Physics Minor (https://pointloma-public.courseleaf.com/prior-catalogs/2022-2023/tug-catalog/colleges-schools-departments/cnss/phy/physics-minor/)

Engineering

EGR 1012 Introduction to Engineering I (1 Unit)
An introduction to engineering as a career, including problem solving, engineering disciplines, design, teamwork, and communication. Introduction to multiple tools/techniques used by engineers, including data analysis, numerical methods, error analysis, and the use of computers for solving problems in physics and engineering.
Corequisite(s): EGR 1012L and MTH 1033 (or equivalent).

EGR 1012L Introduction to Engineering I Lab (1 Unit)
Laboratory to compliment EGR 1012. Meets two hours per week.
Corequisite(s): EGR 1012

EGR 1023 Introduction to Engineering II (2 Units)
An introduction to the engineering design process building on the tools introduced in EGR 1012. In addition to designing a prototype, students learn the engineering aspects of teamwork development, ethics, professionalism, and reporting.
Prerequisite(s): EGR 1012 with a grade of C- or higher.
Corequisite(s): EGR 1023L

EGR 1023L Introduction to Engineering II Lab (1 Unit)
Laboratory to compliment EGR 1023. Meets two hours per week.
Corequisite(s): EGR 1023 with a grade of C- or higher.

EGR 1043 Introduction to Computer Programming (2 Units)
Introduces the syntax of a high level programming language with emphasis on the programming environment and the use of the constructs of the language to write simple application programs. Topics include data types, sequential, conditional, and iterative statements, one and multi-dimensional arrays, simple graphical animation, the use of objects, and I/O. Programming assignments get progressively more complex and designed to demonstrate the use of computing in a variety of disciplines including the natural sciences.
Also offered as CSC 1043.
Prerequisite(s): MTH 1013 or equivalent.
Corequisite(s): EGR 1043L

EGR 1043L Introduction to Computer Programming Lab (1 Unit)
A lab course designed for a hands-on exploration of Introductory Computer Programming. Meets two hours per week.
Also offered as CSC 1043L.
Prerequisite(s): MTH 1013 or equivalent.
Corequisite(s): EGR 1043

EGR 1054 Objects and Elementary Data Structures (3 Units)
As a continuation of EGR 1043, this course deals with more advanced computing constructs and ideas, reinforced in weekly labs. Topics include object-oriented design, inheritance, polymorphism, exception handling, and recursion, along with more intentional development and debugging strategies. Linked lists are introduced as a viable option for implementing basic ADT's. Students gain experience in the design of graphical user interfaces, event driven programming, and larger programming projects.
Also offered as CSC 1054.
Prerequisite(s): EGR 1043 with a grade of C- or higher.
Corequisite(s): EGR 1054L

EGR 1054L Objects and Elementary Data Structures Lab (1 Unit)
A lab course designed for a hands-on exploration of Objects and Elementary Data Structures. Meets two hours per week.
Also offered as CSC 1054L.
Prerequisite(s): EGR 1043 with a grade of C- or higher.
Corequisite(s): EGR 1054

EGR 2014 Engineering Mechanics: Statics (3 Units)
Statics of particles and rigid bodies as applied to engineering design. Topics include vector algebra, forces, moments and couples, conditions of equilibrium, friction, and virtual work.
Prerequisite(s): PHY 2044 with a grade of C- or higher.
Corequisite(s): EGR 2014L

EGR 2014L Engineering Mechanics: Statics Lab (1 Unit)
A lab course designed for a hands-on exploration of Engineering Mechanics. Meets two hours per week.
Prerequisite(s): PHY 2044 with a grade of C- or higher.
Corequisite(s): EGR 2014

EGR 2024 Circuit Analysis (3 Units)
Theory and analysis of electrical circuits. Topics include basic circuit elements, laws of circuit analysis, Kirchoff's laws, loop and nodal analysis, differential equations for modeling electronic circuits, AC and DC analysis, transient analysis, complex impedance and steady state analysis, Laplace Transforms, and frequency domain analysis.
Prerequisite(s): PHY 2054
Corequisite(s): EGR 2024L

EGR 2024L Circuit Analysis Lab (1 Unit)
A lab course designed for a hands-on exploration of Circuit Analysis. Meets two hours per week.
Prerequisite(s): PHY 2054 with a grade of C- or higher.
Corequisite(s): EGR 2024

EGR 3013 Nuclear Physics (2 Units)
A survey of nuclear physics including nuclear models, law of radioactive decay, radiation detection, and applications of nuclear science in engineering and medicine.
Also offered as PHY 3013.
Prerequisite(s): PHY 1054 with a grade of C- or higher or PHY 2054 with a grade of C- or higher
Corequisite(s): EGR 3013L

EGR 3013L Nuclear Physics Lab (1 Unit)
A lab course designed for a hands-on exploration of Nuclear Physics. Meets two hours per week.
Also offered as PHY 3013L.
Prerequisite(s): PHY 1054 with a grade of C- or higher or PHY 2054 with a grade of C- or higher
Corequisite(s): EGR 3013

EGR 3014 Operating Systems (4 Units)
A systems course focusing on operating systems, topics include basic operating system design, process management, device management, memory management, and file systems. Students are introduced to the basics of software evolution, reliability, concurrency, security and protection in the context of single-core, multi-core, distributed, and virtual environments. Class members gain experience using both GUI and command-line interfaces. In the course of implementing the CPU scheduling simulation, students understand the importance of thorough system testing and attention to system specs as they try to make parts of their systems work with those designed by their teammates.
Also offered as CSC 3014.
Prerequisite(s): CSC 2052 with a grade of C- or higher or CSC 2054 with a grade of C- or higher.

EGR 3023 Software Engineering (3 Units)
This course offers an in-depth treatment of the software development process. Software analysis and design study emphasizes an object-oriented approach that is introduced and contrasted with traditional design methodologies. CASE tools are used during the design process.
Also offered as CSC 3023.
Corequisite(s): CSC 2054

EGR 3034 Mechanics of Materials (3 Units)
Theory and analysis of forces, stress, and strain within engineering structural elements and members. Topics include the theory of stress and strain, elastic and plastic deformation, modes of structural failure, compression and tension, torsion, shear, shafts, beams, posts, transformations of stress and strain.
Prerequisite(s): EGR 2014 and PHY 2044 with a grade of C- or higher.
Corequisite(s): EGR 3034L

EGR 3034L Mechanics of Materials Lab (1 Unit)
A lab course designed for a hands-on exploration of Mechanics of Materials. Meets two hours per week.
Prerequisite(s): EGR 2014 and PHY 2044 with a grade of C- or higher.
Corequisite(s): EGR 3034

EGR 3043 Analytical Mechanics: Dynamics (3 Units)
Newtonian mechanics, dynamics of particles and rigid bodies, oscillatory motion, central forces, inertial tensors, Lagrangian and Hamiltonian formulations.
Also offered as PHY 3043.
Prerequisite(s): MTH 2074 with a grade of C- or higher and PHY 2054 with a grade of C- or higher.
Recommended: MTH 3033

EGR 3053 Analog Electronics (2 Units)
AC/DC circuit analysis, transients, characteristics of equivalent circuits for diodes, transistors, power supplies, transistor/operational amplifiers, and feedback applications.
Prerequisite(s): EGR 2024 with a grade of C- or higher.
Corequisite(s): EGR 3053L

EGR 3053L Analog Electronics Lab (1 Unit)
A lab course designed for a hands-on exploration of Analog Electronics. Meets two hours per week.
Prerequisite(s): EGR 2024 with a grade of C- or higher.
Corequisite(s): EGR 3053

EGR 3063 Electricity, Magnetism, and Waves I (3 Units)
Classical electromagnetism including topics in electrostatics, magnetostatics, fields in matter, electromagnetic induction, and Maxwell's equations.
Also offered as PHY 3063.
Prerequisite(s): MTH 2074 with a grade of C- or higher and PHY 2054 with a grade of C- or higher.
Recommended: MTH 3033

EGR 3073 Networking and Security (3 Units)
This course provides an introduction to modern computer network technologies. Students gain an understanding of networking fundamentals including layering and the old OSI model, protocols, standards, and network services. LANS, MANS, WANS, Internet and wireless networks are covered. The class will also cover the basics of network security. The class includes hands-on activities.
Also offered as ISS 3073.
Prerequisite(s): CSC 1054 with a grade of C- or higher or EGR 1054 with a grade of C- or higher and Junior standing.

EGR 3083 Electricity, Magnetism, and Waves II (3 Units)
Electrodynamics with an emphasis on application of Maxwell's equations particularly to electromagnetic radiation.
Also offered as PHY 3083.
Prerequisite(s): EGR 3063

EGR 3093 Digital Electronics (2 Units)
Boolean algebra, logic gates, combinational logic circuits, state minimization, flip/flops, sequential circuits, asynchronous and synchronous counters. Course emphasizes design aspects using electronic design software.
Prerequisite(s): EGR 2024 with a grade of C- or higher.
Corequisite(s): EGR 3093L

EGR 3093L Digital Electronics Lab (1 Unit)
A lab course designed for a hands-on exploration of Digital Electronics. Meets two hours per week.
Prerequisite(s): EGR 2024 with a grade of C- or higher.
Corequisite(s): EGR 3093

EGR 4003 Information and Computer Security (3 Units)
This course provides an overview of modern topics in information and computer security, including: network security, web security, compliance and operational security, threats and vulnerabilities, privacy and anonymity, application, data and host security, access control and identity management, cryptography. This class includes theoretical analysis and hands-on activities.
Also offered as ISS 4003.
Prerequisite(s): CSC 3014 or EGR 3014; EGR 3073 or ISS 3073

EGR 4013 Thermodynamics (3 Units)
Fundamental concepts of thermodynamics and statistical mechanics; applications to both classical and quantum systems.
Also offered as PHY 4013.
Prerequisite(s): PHY 2054
Recommended: MTH 3033

EGR 4042 Embedded Systems and Robotics (1 Unit)
Embedded systems are everywhere. They are in your watch, your phone, and your TV. Embedded systems are also found in cars, airplanes, and robots. They are a fundamental part of the "internet of things." In this hands-on course you will learn the basics of designing, interfacing, configuring, and programming embedded systems by working with robots.
Prerequisite(s): CSC 2054 or EGR 2024 with a grade of C- or higher.
Corequisite(s): EGR 4042L

EGR 4042L Embedded Systems and Robotics Lab (1 Unit)
A lab course designed for a hands-on exploration of Embedded Systems and Robotics. Meets two hours per week.
Prerequisite(s): CSC 2054 or EGR 2024 with a grade of C- or higher.
Corequisite(s): EGR 4042

EGR 4054 Computer Architecture and Assembly Language (4 Units)
This course covers the fundamentals of current pipelined computer designs. Experience with assembly language programming and digital logic and circuit design will be used to motivate the need for certain facets of the more general instruction set architecture. Throughout the course, performance issues, hardware constraints, and memory hierarchy will be shown to inform processor design. Additional topics include integer and floating point arithmetic, I/O and considerations surrounding multi-core architectures.
Prerequisite(s): CSC 1054 with a grade of C- or higher or EGR 1054 with a grade of C- or higher.

EGR 4063 Solid State Physics (3 Units)
An introduction to the study of solids, including crystal structure, reciprocal lattices, crystal binding, phonons, and electron band theory.
Also offered as PHY 4063.
Prerequisite(s): PHY 2054 with a grade of C- or higher.

EGR 4072 Senior Project I (2 Units)
This course provides students (teams with) the opportunity to design and build a prototype of a project of their choosing. The students will give an oral presentation of their project in a design review setting. This course will normally be completed in a student's senior year.
Prerequisite(s): Consent of instructor.

EGR 4082 Senior Project II (2 Units)
This course provides students (teams with) the opportunity to hone and finish building the project design initiated in EGR 4072. The students will prepare a scientific paper about their research/project and give an oral presentation of their findings. This course will normally be completed in a student's senior year.
Prerequisite(s): EGR 4072 or consent of instructor.

EGR 4090 Special Topics in Engineering (1-4 Units)
The topics chosen in engineering depend on regular or visiting faculty expertise as well as student demand.
May be repeated (with varied topics) up to a total of six (6) units.
Prerequisite(s): Consent of instructor.

EGR 4092 Internship in Engineering (2 Units)
A supervised experience in which the student works with industry professionals to gain experience in engineering.
May be repeated up to a total of four (4) units. Credit/No Credit.
Prerequisite(s): Student must have taken at least two upper-division engineering or physics classes and consent of instructor.

EGR 4099 Independent Studies in Engineering (1-4 Units)
Independent investigation, under the supervision of a faculty member, of a specific problem in physics or engineering.
Prerequisite(s): Consent of instructor and department chair.

EGR 4103 Electrical Signals and Systems (3 Units)
Advanced techniques for the analysis of analog electrical systems. Topics include: frequency domain analysis, Laplace transforms, Fourier series, Fourier transforms, and continuous versus discrete signal analysis. Frequency response is analyzed using transfer functions, Bode plots, and spectral plots. Digital Signal Processing (DPS) is introduced. Two lectures and one laboratory each week.
Prerequisite(s): EGR 2024 with a grade of C- or higher and MTH 3033 with a grade of C- or higher.

Physics

PHY 1034 The Physics of Sound and Music (FE) (3 Units)
An introduction to the science of sound, hearing and music. The course will focus on concepts of sound production, propagation, and perception including topics such as musical scales, instruments, and acoustics.
Pre or Corequisite(s): MTH 0099 or equivalent.
Corequisite(s): PHY 1034L

PHY 1034L The Physics of Sound and Music Lab (FE) (1 Unit)
A lab course designed for a hands-on exploration of The Physics of Sound and Music. Meets two hours per week.
Corequisite(s): PHY 1034

PHY 1044 General Physics I (FE) (3 Units)
A general introduction to physics including mechanics, thermodynamics, waves and sound. The course is taught primarily at the algebra/trigonometry level but does require limited use of calculus.
Meets the professional requirements of life and medical science majors.
Prerequisite(s): MTH 1033
Corequisite(s): PHY 1044L

PHY 1044L General Physics I Lab (FE) (1 Unit)
A lab course designed for a hands-on exploration of General Physics I. Meets two hours per week.
Prerequisite(s): MTH 1033
Corequisite(s): PHY 1044

PHY 1054 General Physics II (FE) (3 Units)
A general introduction to physics including electricity and magnetism, optics, and modern physics. The course is taught primarily at the algebra/trigonometry level but does require limited use of calculus.
Meets the professional requirements of life and medical science majors.
Prerequisite(s): PHY 1044 with a grade of C- or higher or consent of instructor.
Corequisite(s): PHY 1054L

PHY 1054L General Physics II Lab (FE) (1 Unit)
A lab course designed for a hands-on exploration of General Physics II. Meets two hours per week.
Prerequisite(s): PHY 1044 with a grade of C- or higher or consent of instructor.
Corequisite(s): PHY 1054

PHY 2044 University Physics I (FE) (3 Units)
An analytic, calculus-based study of classical physics appropriate for science and engineering majors. Includes mechanics, waves, and thermodynamics.
Corequisite(s): MTH 1044 or MTH 1064 or consent of instructor and PHY 2044L.

PHY 2044L University Physics I Lab (FE) (1 Unit)
A lab course designed for a hands-on exploration of University Physics I. Meets two hours per week.
Corequisite(s): MTH 1044 or MTH 1064 or consent of instructor and PHY 2044L.

PHY 2054 University Physics II (3 Units)
An analytic, calculus-based study of classical physics appropriate for science and engineering majors with an emphasis on electromagnetism, circuits, and optics.
Prerequisite(s): PHY 2044 with a grade of C- or higher.
Corequisite(s): MTH 1074 or consent of instructor and PHY 2054L.

PHY 2054L University Physics II Lab (1 Unit)
A lab course designed for a hands-on exploration of University Physics II. Meets two hours per week.
Prerequisite(s): PHY 2044 with a grade of C- or higher.
Corequisite(s): MTH 1074 or consent of instructor and PHY 2054.

PHY 3004 Modern Physics (3 Units)
An introduction to concepts of modern physics including relativity, quantum theory, atomic physics, and high energy physics.
Prerequisite(s): PHY 1054 with a grade of C- or higher or PHY 2054 with a grade of C- or higher.
Corequisite(s): PHY 3004L

PHY 3004L Modern Physics Lab (1 Unit)
A lab course designed for a hands-on exploration of Modern Physics. Meets two hours per week.
Prerequisite(s): PHY 1054 with a grade of C- or higher or PHY 2054 with a grade of C- or higher.
Corequisite(s): PHY 3004

PHY 3013 Nuclear Physics (2 Units)
A survey of nuclear physics including nuclear models, laws of radioactive decay, radiation detection, and applications of nuclear science in engineering and medicine.
Also offered as EGR 3013.
Prerequisite(s): PHY 1054 with a grade of C- or higher or PHY 2054 with a grade of C- or higher.
Corequisite(s): PHY 3013L

PHY 3013L Nuclear Physics Lab (1 Unit)
A lab course designed for a hands-on exploration of Nuclear Physics. Meets two hours per week.
Also offered as EGR 3013L.
Prerequisite(s): PHY 1054 with a grade of C- or higher or PHY 2054 with a grade of C- or higher.
Corequisite(s): PHY 3013

PHY 3043 Analytical Mechanics: Dynamics (3 Units)
Newtonian mechanics, dynamics of particles and rigid bodies, oscillatory motion, central forces, inertial tensors, Lagrangian and Hamiltonian formulations.
Also offered as EGR 3043.
Prerequisite(s): MTH 2074 and PHY 2054 with a grade of C- or higher.
Recommended: MTH 3033

PHY 3063 Electricity, Magnetism, and Waves I (3 Units)
Classical electromagnetism including topics in electrostatics, magnetostatics, fields in matter, electromagnetic induction, and Maxwell's equations.
Also offered as EGR 3063.
Prerequisite(s): MTH 2074 and PHY 2054 with a grade of C- or higher.
Recommended: MTH 3033

PHY 3083 Electricity, Magnetism, and Waves II (3 Units)
Electrodynamics with an emphasis on application of Maxwell's equations particularly to electromagnetic radiation.
Also offered as EGR 3083.
Prerequisite(s): EGR 3063 or PHY 3063

PHY 4013 Thermodynamics (3 Units)
Fundamental concepts of thermodynamics and statistical mechanics; applications to both classical and quantum systems.
Also offered as EGR 4013.
Prerequisite(s): PHY 2054
Corequisite(s): MTH 3033

PHY 4053 Quantum Mechanics (3 Units)
A rigorous introduction to quantum physics including Schroedinger's equation, matrix mechanics, perturbation theory, and applications in atomic and molecular physics.
Prerequisite(s): MTH 2074 with a grade of C- or higher and PHY 3004.
Recommended: MTH 3033

PHY 4063 Solid State Physics (3 Units)
An introduction to the study of solids, including crystal structure, reciprocal lattices, crystal binding, phonons, and electron band theory.
Prerequisite(s): PHY 2054 with a grade of C- or higher.

PHY 4072 Senior Project I (2 Units)
This course provides students (teams) with the opportunity to design and build a prototype of a project of their choosing. The students will give an oral presentation of their project in a design review setting. This course will normally be completed in a student's senior year.
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Prerequisite(s): PHY 4072 or consent of instructor.

PHY 4090 Special Topics in Physics (1-3 Units)
The topics in physics chosen depend on regular or visiting faculty expertise as well as student demand.
May be repeated up to a total of six (6) units as long as content is different.
Prerequisite(s): Consent of instructor.

PHY 4092 Internship in Physics (2 Units)
A supervised experience in which the student works with industry professionals to gain experience in physics or engineering.
May be repeated up to a total of four (4) units. Credit/No Credit.
Prerequisite(s): Student must have taken at least two upper-division engineering or physics classes and consent of instructor.
"C" Designation is for California Internships. "E" Designation is for Out of State Internships.

PHY 4099 Independent Studies in Physics (1-4 Units)
Independent investigation, under the supervision of a faculty member, of a specific problem in physics or engineering.
Prerequisite(s): Consent of instructor and department chair.

Physical Science

PSC 1004 The Cosmos (FE) (4 Units)
An introduction to our place in the universe emphasizing religious, cultural and historic perspectives including modern developments in physics and astronomy.
Meets a Foundational Explorations requirement; does not count toward any Chemistry or Physics majors.
Prerequisite(s): MTH 0099 or equivalent.

PSC 1014 Physical Science for Teachers (FE) (4 Units)
An introductory survey of selected principles in physics and chemistry with a discussion of related societal and environmental issues. This course focuses on topics necessary for the California multiple subject teaching credential (K-8). This class is highly interactive and will make use of many hands on activities.
Meets a Foundational Explorations requirement; does not count toward the Chemistry or Physics major.
Pre or Corequisite(s): MTH 1013 or equivalent.

PSC 1023 Earth and Space Science for Teachers (3 Units)
An introductory survey of the disciplines of geology, oceanography, meteorology, and astronomy with discussion of philosophical and societal issues. This course focuses on topics necessary for the California multiple subject teaching credential (K-8).
Prerequisite(s): PSC 1014