PHYSICS (PHYS)

PHYS 102 | PHYSICS OF MODERN LIFE
Units: 3 Repeatability: No
Core Attributes: Quantitative reasoning comp, Science/Tech Inquiry area
Non-Core Attributes: Lab
An introduction to physics concepts and principles with tangents into related technologies and global issues. Special attention is paid to devices and networks that furnish necessities of modern life. No background in physical science is required. Lab component involves guided hands-on investigation of physics principles and related technologies.

PHYS 105 | PHYSICAL SCIENCES FOR K-8 TEACHERS
Units: 3 Repeatability: No
Core Attributes: Science/Tech Inquiry area
Non-Core Attributes: Lab
A laboratory/lecture/discussion class designed to lead students toward an understanding of selected topics in chemistry and physics. The course topics are selected to satisfy the Physical Science specifications of the Science Content Standards for California Public Schools (K-12). Enrollment is limited to liberal studies majors. Two two-hour laboratory sessions per week. This course is cross-listed with Chemistry 105. Fall semester.

PHYS 106 | EXPLORING THE NIGHT SKY
Units: 3 Repeatability: No
Core Attributes: First Yr Integration (LC Only), Quantitative reasoning comp, Science/Tech Inquiry area
Non-Core Attributes: Lab
An introduction to astronomy concepts and principles aimed at understanding the dynamics of the night sky. No background in physical science is required. Lab component involves guided hands-on investigation of astronomy principles and may include evening observing sessions.

PHYS 136 | GENERAL PHYSICS I
Units: 3 Repeatability: No
Core Attributes: Science/Tech Inquiry area
Prerequisites: MATH 115 or MATH 130 or MATH 150 or Passing the appropriate departmental placement test within the previous year or Passing the appropriate departmental placement test within the previous year
Corequisites: PHYS 136L
A study of the fundamental principles of mechanics, wave motion, sound, fluids, and heat. Physics principles will be covered using algebra and trigonometry. Three hours of lecture weekly. Concurrent enrollment in 136L required.

PHYS 136L | GENERAL PHYSICS I LAB
Units: 1 Repeatability: No
Core Attributes: Science/Tech Inquiry area
Non-Core Attributes: Lab
Prerequisites: PHYS 136 (Can be taken Concurrently)
A laboratory course introducing the concepts and techniques of experimental physics. Meets weekly.

PHYS 137 | GENERAL PHYSICS II
Units: 3 Repeatability: No
Prerequisites: PHYS 136 and PHYS 136L
Corequisites: PHYS 137L
A study of the fundamental principles of electricity and magnetism, light, and modern physics. Physics principles will be covered using algebra and trigonometry. Three hours of lecture weekly. Concurrent enrollment in 137L required.

PHYS 137L | GENERAL PHYSICS II LAB
Units: 1 Repeatability: No
Non-Core Attributes: Lab
Prerequisites: PHYS 137 (Can be taken Concurrently)
A laboratory course introducing the concepts and techniques of experimental physics. Meets weekly.

PHYS 270 | INTRODUCTION TO MECHANICS
Units: 3 Repeatability: No
Core Attributes: First Yr Integration (LC Only), Science/Tech Inquiry area
Prerequisites: MATH 150 with a minimum grade of C- or MATH 151 with a minimum grade of C-
Corequisites: PHYS 270L
A study of the fundamental principles of Newtonian mechanics, kinematics, and momentum and energy conservation laws. Harmonic oscillations and wave motion will also be discussed. Three hours of lecture weekly. Concurrent enrollment in 270L required.

PHYS 270L | MECHANICS LAB
Units: 1 Repeatability: No
Core Attributes: Science/Tech Inquiry area
Non-Core Attributes: Lab
Prerequisites: PHYS 270 (Can be taken Concurrently)
A laboratory course introducing the concepts and techniques of experimental physics. Meets weekly.

PHYS 271 | INTRODUCTION TO ELECTRICITY AND MAGNETISM
Units: 3 Repeatability: No
Core Attributes: Science/Tech Inquiry area
Prerequisites: (PHYS 270 with a minimum grade of C- and PHYS 270L with a minimum grade of C-) or (PHYS 136 with a minimum grade of C- and PHYS 136L with a minimum grade of C-) and MATH 151 and PHYS 271L (Can be taken Concurrently)
A study of the fundamental principles of classical electricity and magnetism focusing on electrostatics and magnetic force. Circuits, electromagnetism, and light are also introduced. Three hours of lecture weekly. Concurrent enrollment in 271L required.

PHYS 271L | INTRODUCTION TO ELECTRICITY AND MAGNETISM LAB
Units: 1 Repeatability: No
Core Attributes: Science/Tech Inquiry area
Prerequisites: PHYS 271 (Can be taken Concurrently)
A laboratory course that introduces the concepts and techniques of experimental physics. Meets weekly.

PHYS 272 | INTRODUCTION TO MODERN PHYSICS
Units: 3 Repeatability: No
Prerequisites: PHYS 271 with a minimum grade of C- and PHYS 271L with a minimum grade of C- and MATH 250 (Can be taken Concurrently)
An introduction to modern physics including principles and applications of quantum mechanics, atomic and nuclear physics, and special relativity. Required for all physics and biophysics majors and physics minors, and is an accepted elective for engineering students. For physics and biophysics majors concurrent enrollment in PHYS 272L and PHYS 282 is required.

PHYS 272L | INTRODUCTION TO MODERN PHYSICS LAB
Units: 1 Repeatability: No
Core Attributes: Quantitative reasoning comp
Non-Core Attributes: Lab
Prerequisites: PHYS 272 (Can be taken Concurrently)
A laboratory course where students use techniques of experimental physics to explore phenomena in modern physics.

PHYS 281 | INTRODUCTION TO OPTICS
Units: 1 Repeatability: No
Non-Core Attributes: Lab
Prerequisites: (PHYS 270 with a minimum grade of C- and PHYS 270L with a minimum grade of C-) or (PHYS 136 with a minimum grade of C- and PHYS 136L with a minimum grade of C-) and MATH 151 and PHYS 271L
This lab course provides a hands-on introduction to the fundamentals of optics. Several guided lab activities will introduce basic concepts in optics including reflection, refraction, image formation, coherence, diffraction and interference. Following these guided labs, students will have the final few weeks to work in teams on a project of their own design. Projects may extend any of the earlier lab activities or explore several other options that will be presented. But students are encouraged to pursue any feasible optics project they find exciting.

PHYS 282 | INTRODUCTION TO METHODS IN COMPUTATIONAL PHYSICS
Units: 1 Repeatability: No
Non-Core Attributes: Lab
Prerequisites: PHYS 272 (Can be taken Concurrently)
A hands-on introduction to the fundamentals of using computation in physics and biophysics. A combination of in-class guided group practice and at-home individual practice will be employed to introduce, practice and apply fundamental computational techniques including: the declaration and manipulation of variables and arrays, conditional statements, loops, as well as procedural programming through creating functions. These fundamentals will be applied to creating graphical representations and performing calculations to further elucidate topics discussed in PHYS 272. Computational techniques will be introduced to highlight the application of these fundamentals. These techniques may include: solutions to initial value problem ordinary differential equations; solving boundary value problems and the eigenvalue problem; and statistics and stochastic methods.

PHYS 294 | SPECIAL TOPICS IN PHYSICS AND BIOPHYSICS
Units: 0.5-4 Repeatability: Yes (Can be repeated for Credit)
Topics chosen by the instructor in areas that include but are not limited to: Newtonian mechanics, electricity and magnetism, waves, optics, physics and society, modern physics, astronomy, fluids, and thermodynamics. May be repeated for credit if the course material is different.

PHYS 300 | MATHEMATICAL METHODS OF THEORETICAL PHYSICS
Units: 3 Repeatability: No
Prerequisites: PHYS 271 with a minimum grade of C- and PHYS 271L with a minimum grade of C- and MATH 250 and PHYS 272 (Can be taken Concurrently)
An introduction to the methods of theoretical physics that uses physical applications to introduce mathematical techniques. This course will cover: the eigenvalue problem; Taylor expansions in one and multiple variables; solutions techniques to ordinary differential equations; Fourier analysis; separation of variables in partial differential equations; probability distribution functions and Dirac delta function. Other topics that may be discussed at the instructor's discretion include: complex variables; Green's functions and solutions to partial differential equations; vector spaces and group theory; chaos theory; special functions; Monte Carlo methods; and computational applications.

PHYS 301 | ENERGY AND THE ENVIRONMENT
Units: 3 Repeatability: No
Prerequisites: PHYS 272 with a minimum grade of C-
Energy is the lifeblood of civilization, but its use entails substantial environmental costs. This course examines the physics and technology of energy production, distribution and use, as well as its environmental and societal consequences. It is suitable for students having completed lower-division physics.

PHYS 307 | ASTROPHYSICS
Units: 3 Repeatability: No
Prerequisites: PHYS 272 with a minimum grade of C-
A study of the fundamental principles of astrophysics including topics such as stellar formation, life and death, galaxy evolution, special and general relativity, and cosmology.

PHYS 314 | ANALYTICAL MECHANICS
Units: 3 Repeatability: No
Prerequisites: PHYS 272 with a minimum grade of C-
Statics and dynamics are developed using vector analysis, the Hamiltonian and Lagrangian formulations. Orbit theory and chaos are among the special topics treated.

PHYS 319 | THERMAL AND STATISTICAL PHYSICS
Units: 3 Repeatability: No
Prerequisites: PHYS 272 with a minimum grade of C-
This course develops modern statistical mechanics and its application to thermodynamic principles and phenomena. Topics include ideal gases, phase transitions, stellar systems, chemical equilibrium, kinetic theory, paramagnetism, polymers and biophysics.

PHYS 324 | ELECTROMAGNETISM
Units: 3 Repeatability: No
Prerequisites: PHYS 272 with a minimum grade of C-
A development of Maxwell's equations using vector calculus. The electrical and magnetic properties of matter, solutions of boundary value problems, special relativity and radiation theory are also developed. Three lectures per week.

PHYS 325 | INTRODUCTION TO FLUIDS
Units: 3 Repeatability: No
Prerequisites: PHYS 272 with a minimum grade of C-
An introduction to the basic principles of fluids. This course will serve as an introduction to concepts used in physical oceanography, atmospheric science, and other disciplines in which fluids are studied or utilized. Examples of applications to a broad range of disciplines (physics, engineering, earth sciences, astrophysics, and biology) will be developed.

PHYS 330 | QUANTUM MECHANICS
Units: 3 Repeatability: No
Prerequisites: PHYS 272 with a minimum grade of C-
Introduction to the fundamental properties of nonrelativistic quantum mechanics, including the Schrödinger equation in 1-3 dimensions, the mathematical formalism (involving linear algebra and partial differential equations) of quantum theory, the solution of the hydrogen atom, and elementary perturbation and scattering theory. Entanglement, Bell's theorem, exotic states of matter, and history of physics are among the special topics discussed.

PHYS 340 | BIOLOGICAL PHYSICS
Units: 3 Repeatability: No
Prerequisites: PHYS 272 with a minimum grade of C-
Biological physics introduces the interface between the two classic sciences. Physics principles and techniques are applied to questions and problems in biology with a focus on molecular and cellular biology. Topics will be introduced systematically, building on the fundamentals of thermodynamics up to current cutting edge research topics such as protein folding, molecular machines and brain function. Specific topics may include single-molecule biophysics, optical trapping, molecular and cellular self-assembly, gene regulation, biomaterials and biomedical imaging.

PHYS 371 | COMPUTATIONAL PHYSICS
Units: 3 Repeatability: No
Prerequisites: PHYS 272 with a minimum grade of C- and PHYS 282
A hands-on introduction to the implementation of computational algorithms to solve problems in physics and biophysics and the interpretation of the results. Detailed topics covered will depend on instructor expertise. Topics may include solutions to ordinary and partial differential equations, linear algebra, fast Fourier transforms, numerical integration, differentiation and approximation, statistics and Monte Carlo methods.

PHYS 381 | EXPERIMENTAL BIOPHYSICS
Units: 4 Repeatability: No
Core Attributes: Advanced writing competency, Quantitative reasoning comp
Prerequisites: PHYS 272 and PHYS 272L
A laboratory-based course introducing biophysics majors to interdisciplinary research techniques. Instrumentation development and experimental research explore topics of fluorescence and force spectroscopy, molecular diffusion, fluctuation-dissipation theory and viscoelasticity related to molecular and cellular biophysical systems. Students are trained in wet-lab techniques and computational methods using Matlab and Fiji. This is the primary upper-division laboratory requirement for biophysics majors and fulfills the core advanced writing and quantitative reasoning requirements. Students write and edit research reports on their experimental results at a level suitable for journal publication. The writing process also includes literature search techniques and an introduction to the peer review process.

PHYS 388 | STRUCTURE OF MATTER
Units: 3 Repeatability: No
Prerequisites: PHYS 272 with a minimum grade of C-
An introduction to condensed matter physics, the study of the structure and dynamics of solids and liquids. Topics include the structure of crystals and amorphous matter, the scattering of waves to determine the arrangement and motion of atoms or particles, thermal and electrical conductivity, phase transitions, and superconductivity.

PHYS 400 | RESEARCH FORUM
Units: 1 Repeatability: Yes (Can be repeated for Credit)
Non-Core Attributes: Undergraduate Research
Prerequisites: PHYS 496 (Can be taken Concurrently)
PHYS 400 brings together all Physics and Biophysics majors involved in undergraduate research (PHYS 496) to provide a formal platform to: (1) gain skills in abstract writing and poster preparation, (2) engage in the scientific literature, (3) form a community of scholars, (4) develop a sense of ownership of their work, and (5) contextualize how their research fits into the big picture. The course meets weekly for 1 hour. Class time is primarily devoted to: learning about and practicing to write scientific abstracts and prepare posters, and having journal club style discussions on student-chosen papers. Outside of class, students are responsible for completing literature searches, reading assigned research papers, writing abstracts, preparing posters, and writing research summaries. PHYS 496 is a required concurrent prerequisite. Offered in Fall semesters.

PHYS 471 | ADVANCED COMPUTATIONAL PHYSICS LABORATORY
Units: 4 Repeatability: No
Core Attributes: Advanced writing competency
Prerequisites: PHYS 319 or PHYS 371
A writing-intensive advanced laboratory course where students learn to apply sophisticated computational tools to scientific problems. Through multi-week group projects, students will choose the overall computational approach, combine numerical and analytic work as appropriate, and evaluated the validity and applicability of results. Students will devote significant time to writing research reports in the style of peer-reviewed scientific journal articles, supported by dedicated writing instruction and intensive feedback.

PHYS 480 | EXPERIMENTAL MODERN PHYSICS
Units: 4 Repeatability: No
Core Attributes: Advanced writing competency
Prerequisites: PHYS 330
A laboratory-based course focused on the introduction to principles of research techniques with an emphasis on modern physics. Experiments illustrate physical phenomena pertaining to core areas of physics: quantum mechanics, atomic and nuclear physics, laser physics and plasma physics. Analog and digital data acquisition instrumentation, high-resolution optical and laser technology, and phase sensitive detection technology will be explored. This course is the required writing-intensive course for physics majors and fulfills the upper-division core writing requirement. Students write papers up to professional standards required of publication in physics research journals, learn to write mathematical prose, engage in the peer review process, and learn to code LaTeX.

PHYS 481W | EXPERIMENTAL BIOPHYSICS
Units: 4
Non-Core Attributes: Writing-Pre F17 CORE
Prerequisites: PHYS 272 and PHYS 272L and MATH 250
A laboratory-based course focused on the introduction to principles of biophysics research techniques. Instrumentation development and experimental research will explore topics of fluorescence and force spectroscopy, molecular diffusion, fluctuation-dissipation theory and viscoelasticity related to molecular and cellular biophysical systems. Students will also be trained in general wet-lab techniques and computational data acquisition and analysis using Labview and Matlab. This course is the primary upper division laboratory requirement for the biophysics major and fulfills the upper division core writing requirement. Students will write and edit research reports on their experimental results at a level suitable for journal publication. The writing process will also include literature search techniques and an introduction to the peer review process.

PHYS 487 | EXPERIENTIAL PHYSICS
Units: 1-3 Repeatability: Yes (Can be repeated for Credit)
Non-Core Attributes: Experiential
An independent experiential learning project focused on broad applications of physics and biophysics. Projects can include but are not limited to: teaching assistantships, internships, community outreach, communication/media, secondary school teaching, and traditional physics or biophysics research. All projects must be approved and supervised by a faculty mentor in the physics and biophysics department. A student seeking PHYS 487 credit must take initiative to meet with his/her academic advisor to identify projects that best meet his/her interests and goals. Once a student has identified a faculty mentor and project, he/she can enroll in PHYS 487 by completing the application form found on the Student Resources page of the department website. The detailed requirements for earning PHYS 487 credit can also be found on the Student Resources page.

PHYS 493 | SEMINAR I: THE CRAFT OF SCIENTIFIC PRESENTATION
Units: 1 Repeatability: No
Core Attributes: Oral communication competency
Prerequisites: PHYS 496
First semester of the physics and biophysics seminar series devoted to instruction on scientific presentations. Students give short presentations on topics of interest, and prepare a lengthy presentation on their research. Stress is laid on the preparation, execution, and critique of effective scientific presentations. One hour per week. Fall semester.

PHYS 494 | SPECIAL TOPICS IN PHYSICS AND BIOPHYSICS
Units: 0.5-4 Repeatability: Yes (Can be repeated for Credit)
Prerequisites: PHYS 271 and PHYS 271L
Topics chosen by the instructor in areas that include but are not limited to: condensed matter physics, quantum field theory, general relativity, plasma physics, electronics, soft matter physics, particle physics, neurophysics, and advanced physics and biophysics laboratories. May be repeated for credit if the course material is different.

PHYS 495 | SEMINAR II: FRONTIERS OF PHYSICS
Units: 1 Repeatability: No
Core Attributes: Advanced Integration
Prerequisites: PHYS 272
The second semester of the capstone seminar series for the Physics and Biophysics major that fulfills the Advanced Integration component of the Core curriculum. This course focuses on exposure to the breadth of current physics-related research topics, and understanding the impact and context of the research through the lens of other disciplines. Students will learn about a wide range of cutting-edge research topics such as: dark matter, global warming and alternative energy sources, biomechanics, graphene, neutrinos, etc. They will also learn about how the research fits into the "big picture" by considering ethical, political, societal, technological and/or historical issues related to the research. These goals are achieved through attending seminars, meeting with scientists, and completing routine reading and writing assignments. The course culminates with a final project in which students investigate and articulate the connection of one of the covered research topics to another discipline.

PHYS 496 | RESEARCH
Units: 1-3 Repeatability: Yes (Can be repeated for Credit)
Non-Core Attributes: Experiential
Prerequisites: PHYS 400 (Can be taken Concurrently)
An independent research project supervised by a faculty mentor in the physics and biophysics department. A student seeking PHYS 496 credit must take initiative to meet with faculty members to learn about their research interests and possible problems to research. Once a student has identified a faculty mentor and project, he/she can enroll in PHYS 496 by completing the application form found on the Student Resources page of the department website. The detailed requirements for earning PHYS 496 credit can also be found on the Student Resources page. Students completing their first unit of PHYS 496 must be concurrently enrolled in PHYS 400.

PHYS 499 | INDEPENDENT STUDY
Units: 1-3 Repeatability: Yes (Can be repeated for Credit)