PHYSICS (PHYS)

PHYS 490 Physics Teaching (1-2 semester hours)
Guided teaching of introductory physics. Permission of instructor required. May be repeated for credit.

PHYS 498 Special Studies (1-4 semester hours)

PHYS 499 Independent Studies (0-4 semester hours)

PHYS 1000 Thinking in Science (3 semester hours)
Enhancement of scientific reasoning. Topics include: identify and control of variables, deductive and inductive reasoning, proportional reasoning, analysis of scientific data, and problem solving.

PHYS 1100 Introduction to Mechanics (4 semester hours)
Vectors, Newton's laws of motion, work and energy, impulse and momentum, rotation, angular momentum, static equilibrium, harmonic motion. May include a brief introduction to quantum mechanics. Laboratory experiments pertaining to mechanics. Measurement, estimation, and uncertainty. Projectile motion, Newton's laws, friction, torque. Prerequisites: MATH 131 or concurrent enrollment.

PHYS 1200 Computational Lab (2 semester hours)
Introduction to computation and measurement software commonly used in physics and engineering, such as MATLAB, Mathematica, Maple, Python, and LabVIEW. Basic computational techniques in physics: root-finding, numerical integration, curve fitting, numerical solutions to differential equations, the Fourier transform. Introduction to controlling experimental equipment and collecting data with computers. Prerequisites: PHYS 1100 or concurrent enrollment, and MATH 131 or concurrent enrollment. Physics and Applied Physics majors only.

PHYS 1600 Waves, Optics, and Thermodynamics (4 semester hours)
An introduction to mechanical waves, optics, and thermodynamics with an emphasis on applications to the modern world. Topics include: the wave equation, superposition, standing waves, ray-tracing, reflection, refraction, thin lenses, polarization, interference, diffraction, thin films, wave-particle duality of light, laws of thermodynamics, kinetic theory of gases Physics and Applied Physics majors only.

PHYS 1998 Special Studies (1-4 semester hours)

PHYS 1999 Independent Studies (1-4 semester hours)

PHYS 2100 Introduction to Electricity and Magnetism (4 semester hours)
Electrostatics. Current, resistance, and D.C. circuits. Magnetism. Induced electromotive force. Electric and magnetic properties of matter. Maxwell's equations. Laboratory experiments pertaining to electricity and magnetism. Coulomb's Law, static electricity, electric field plotting, circuits, charge/mass ratio for electron. Prerequisites: PHYS 1100; MATH 132 or concurrent enrollment.

PHYS 2200 Intermediate Mechanics (4 semester hours)
Newtonian mechanics. General motion of a particle in three dimensions. Oscillations. Non-inertial coordinate systems. Central forces. Systems of particles. Motion of rigid bodies in two and three dimensions. Introduction to Lagrangian and Hamiltonian dynamics. Numerical techniques for solving mechanics problems. Prerequisites: PHYS 1100; MATH 246 or concurrent enrollment.

PHYS 2500 General Physics I (4 semester hours)
Vectors. Kinematics. Newton's laws of motion, energy, momentum, rotational motion, and harmonic motion. Fluid mechanics. Heat and thermodynamics. Laboratory experiments pertaining to mechanics, thermodynamics, and fluid mechanics. Lecture, 3 hours; Laboratory, 2 hours. Prerequisite: MATH 112 or MATH 122 or MATH 131 or concurrent enrollment. NOTE: THE PHYS 2500-2550 series is suitable for biology and chemistry majors and others desiring a college-level experience in physics. This series is not acceptable for credit in the physics or engineering programs.

PHYS 2550 General Physics II (4 semester hours)
Electrostatics. Magnetism. Current, D.C. circuits. Electromagnetic waves. Geometrical and wave optics. Relativity. Nuclear physics. Laboratory experiments pertaining to electricity, magnetism, and optics. Prerequisite: PHYS 2500.

PHYS 2600 Foundations of Modern Physics (4 semester hours)
An introduction to special relativity (SR) and quantum mechanics (QM). Selected topics include (SR) frames of reference, Minkowski diagrams and space time structure, causality, Lorentz transformations, four-vectors and Lorentz invariants, relativistic conservation laws. (QM) failures of classical theory, wave- PHYS - 14 particle duality, models of the hydrogen atom, emission spectra, the Heisenberg uncertainty principle, wave functions and probability, the Schrodinger equation. Prerequisites: PHYS 2100 or PHYS 2550; MATH 246 or concurrent enrollment. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics.

PHYS 2710 Astronomy (3 semester hours)
Understanding the universe. Topics include: history of astronomy, solar system, stars, galaxies, evolution of the universe. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics.

PHYS 2780 Great Ideas in Physics (3 semester hours)
Principles of physics with an emphasis on conceptual understanding. Physics as a human activity. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics, Flag: Quantitative Literacy.

PHYS 2998 Special Studies (1-4 semester hours)

PHYS 2999 Independent Studies (1-4 semester hours)

PHYS 3100 Electrodynamics (4 semester hours)
Electric and magnetic fields, Dielectric materials, Poisson's equation, Boundary value problems, Field energy, Vector potential, Faraday's law, Maxwell's equations. Prerequisites: PHYS 2100, MATH 356 or concurrent enrollment.

PHYS 3200 Quantum Mechanics (4 semester hours)
Schrodinger equation in various one-and three-dimensional systems, Dirac notation and Hilbert space; position and momentum representations; uncertainty relations, quantum harmonic oscillator, angular momentum and spin, perturbation theory. Prerequisites: PHYS 2600, MATH 246 or concurrent enrollment.

PHYS 3300 Thermodynamics and Statistical Mechanics (4 semester hours)
Classical thermodynamics, applications to simple systems. Kinetic theory and the approach to equilibrium. Statistical interpretation of entropy, the Laws of Thermodynamics. Classical statistical mechanics. Quantum statistics. Systems of interacting particles. Prerequisite: PHYS 2600, MATH 246.

PHYS 3400 Advanced Laboratory (4 semester hours)
Experiments in modern physics and optics. Emphasis is placed on instrumentation, data acquisition, programming applications, theoretical interpretations, statistical analysis, and communication of results through written and oral reports. Prerequisites: PHYS 2600, MATH 246. University Core Fulfilled: Engaged Learning Flag.

PHYS 3740 Weapons of Mass Destruction (3 semester hours)
Scientific principles underlying nuclear weaponry, including basic atomic theory, fission, and fusion; quantifying effect of nuclear explosions; exploring the history, development, and use of nuclear weapons, including potential nuclear terrorism scenarios; social, political, and ethical ramifications of the nuclear arms race and the Cold War. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher. University Core fulfilled: Integrations: Interdisciplinary Connections, Flag: Quantitative Literacy.

PHYS 3800 Junior Project (1 semester hour)
Students develop and propose a research project; students must complete a written proposal, literature search, and oral presentation. Junior or Senior PHYS and APHY majors only.

PHYS 3998 Special Studies (1-4 semester hours)

PHYS 3999 Independent Studies (1-3 semester hours)

PHYS 4100 Space Physics (4 semester hours)
An introduction to solar-terrestrial physics. Topics include the physics of space plasmas and single fluid magnetohydrodynamics, solar physics, solar winds, collisionless shocks, ionospheres, aurorae, space weather and geomagnetic storms, pulsations and magnetohydrodynamic waves, and planetary magnetospheres. Emphasis on the impacts of space weather on society. Data analysis techniques used in space physics research. Research project on current space physics topics. Prerequisites: MATH 234 and PHYS 2600.

PHYS 4150 Condensed Matter Physics (4 semester hours)
An introduction to the physics of matter and the relationships between fundamental atomic interactions and observable macroscopic properties (structure, dynamics and phases) that arise from atoms' collective behavior. Topics include: crystal structure, mechanical and thermal properties, free electron Fermi gas, energy band structure, semiconductors and their applications, superconductors, magnetic properties, phase transitions, soft matter systems (such as liquids, polymers, granular materials, liquid crystals). Prerequisite: PHYS 3200, PHYS 3300.

PHYS 4200 Astrophysics (4 semester hours)
Orbital mechanics, Earth-Moon system, solar system, electromagnetic radiation and matter, astronomical detection of light, stellar properties, nuclear fusion, Milky Way Galaxy, cosmology. Prerequisites: PHYS 2100 and PHYS 2600.

PHYS 4250 Modern Optics (4 semester hours)
Application of Maxwell's equations to electromagnetic waves in free space and in matter. Applied geometrical optics, Fourier analysis, polarization, interference and diffraction, coherence theory, lasers, holography, topics in modern optics such as nonlinear optics and quantum optics. Prerequisite: PHYS 3100.

PHYS 4300 Biophysics (4 semester hours)
Application of physical laws to biological structure and function at the molecular and macroscopic levels: protein dynamics, diffusion, membranes, biomechanics, circulatory system, hearing and vision, radiation. Prerequisite: PHYS 3300.

PHYS 4350 Elementary Particle Physics (4 semester hours)
Symmetries and conservation laws. Feynman diagrams and rules. Quantum electrodynamics. The parton model. Quantum chromodynamics. Weak interactions and electroweak unification. Gauge theories and the Standard Model. Particle physics beyond the Standard Model. Approaches to quantum gravity and their implications. Prerequisite: PHYS 3200.

PHYS 4400 Introduction to Relativity and Cosmology (4 semester hours)
Review of Special Relativity. Differential geometry, tensor analysis and curvature. The Equivalence Principle and Einstein's field equations. The Schwarzschild solution and Black Holes. Gravitational waves. Kruskal-Szekeres coordinates and Penrose Diagrams. The standard model of Cosmology and Friedmann-Robertson-Walker metrics. The Friedmann equation and the cosmological constant. Inflation, Dark Matter, Dark Energy, and other problems of current cosmology. Black hole thermodynamics. Alternative theories of gravity and their implications for astrophysics, cosmology, and quantum gravity. Prerequisite: PHYS 2600, MATH 246.

PHYS 4800 Capstone Experience (2 semester hours)
Preparation for life after graduation, including graduate school, work in industry, and teaching. Colloquia, journal reading, and seminars on topics in contemporary physics, scientific/proposal writing, and presentation skills. Prerequisite: PHYS 3800 Enrollment is limited to Physics/Applied Physics seniors only.

PHYS 4810 Senior Thesis (1 semester hour)
Independent research with a faculty member in his/her area of expertise; students must complete a written thesis and oral presentation. Prerequisite: PHYS 4800 Enrollment is limited to Physics/Applied Physics seniors only.

PHYS 4900 Physics Teaching (1-2 semester hours)
Guided teaching of introductory physics. May be repeated for credit. Requires consent of instructor. Engaged Learning Flag.

PHYS 4993 Physics/Applied Physics Internship (1-3 semester hours)
Research/development work conducted in a local government or industrial laboratory. The project may be theoretical or experimental and is jointly supervised by on-site staff and LMU faculty.

PHYS 4998 Special Studies (1-4 semester hours)

PHYS 4999 Independent Studies (0-4 semester hours)