

Institution	Course Number & Title	Course Description	Prescribed Book	Hours Taught Per Week (10 Weeks Total), Total Hours of Work Per Week (10 Weeks Total), Credits for Whole Quarter/Semester	Grade
University of California, Santa Cruz	PHYS 5A - Introductory to Physics I	Elementary mechanics. Vectors, Newton's laws, inverse square force laws, work and energy, conservation of momentum and energy, and oscillations.	"Physics for Scientists and Engineers with Modern Physics" 6th Edition, Pearson, by Douglas C. Giancoli	3 hours, 15 hours, 5 credits	B
University of California, Santa Cruz	PHYS 5L - Introductory to Physics I Laboratory	Laboratory sequence illustrating topics covered in PHYS 5A.	"Physics 5L Laboratory Manual" - George Brown	3 hours, 3 hours, 1 credit	A-
University of California, Santa Cruz	PHYS 5B - Introductory to Physics II	Wave motion in matter, including sound waves. Geometrical optics, interference and polarization, statics and dynamics of fluids.	"Physics for Scientists and Engineers with Modern Physics" 6th Edition, Pearson, by Douglas C. Giancoli	3 hours, 15 hours, 5 credits	C+
University of California, Santa Cruz	PHYS 5M - Introductory to Physics II Laboratory	Laboratory sequence illustrating topics covered in PHYS 5B.	"Physics 5M Laboratory Manual" - George Brown	3 hours, 3 hours, 1 credit	A
University of California, Santa Cruz	PHYS 5C - Introductory to Physics III	Introduction to electricity and magnetism. Electromagnetic radiation, Maxwell's equations.	"Physics for Scientists and Engineers with Modern Physics" 6th Edition, Pearson, by Douglas C. Giancoli	3 hours, 15 hours, 5 credits	A
University of California, Santa Cruz	PHYS 5N - Introductory to Physics III Laboratory	Laboratory sequence illustrating topics covered in PHYS 5C.	"Physics 5N Laboratory Manual" - George Brown	3 hours, 3 hours, 1 credit	A
University of California, Santa Cruz	PHYS 5D - Introductory to Physics IV	Introduces temperature, heat, thermal conductivity, diffusion, ideal gases, laws of thermodynamics, heat engines, and kinetic theory. Introduces the special theory of relativity and the equivalence principle. Includes the photoelectric effect, the Compton effect, matter waves, atomic spectra, and the Bohr model.	"Physics for Scientists and Engineers with Modern Physics" 6th Edition, Pearson, by Douglas C. Giancoli	3 hours, 15 hours, 5 credits	A
University of California, Santa Cruz	MATH 19A - Calculus for Science, Engineering, and Mathematics	The limit of a function, calculating limits, continuity, tangents, velocities, and other instantaneous rates of change. Derivatives, the chain rule, implicit differentiation, higher derivatives. Exponential functions, inverse functions, and their derivatives. The mean value theorem, monotonic functions, concavity, and points of inflection. Applied maximum and minimum problems.	"Calculus, Early Transcendentals", 2nd edition, by Jon Rogawski	3 hours, 15 hours, 5 credits	C
University of California, Santa Cruz	MATH 19B - Calculus for Science, Engineering, and Mathematics	The definite integral and the fundamental theorem of calculus. Areas, volumes. Integration by parts, trigonometric substitution, and partial fractions methods. Improper integrals. Sequences, series, absolute convergence and convergence tests. Power series, Taylor and Maclaurin series.	"Calculus, Early Transcendentals", 2nd edition, by Jon Rogawski	3 hours, 15 hours, 5 credits	C
University of California, Santa Cruz	MATH 23A - Vector Calculus	Vectors in n-dimensional Euclidean space. The inner and cross products. The derivative of functions from n-dimensional to m-dimensional Euclidean space is studied as a linear transformation having matrix representation. Paths in 3-dimensions, arc length, vector differential calculus, Taylor's theorem in several variables, extrema of real-valued functions, constrained extrema and Lagrange multipliers, the implicit function theorem, some applications.	"Vector Calculus", 6th ed, by Marsden/Tromba	3 hours, 15 hours, 5 credits	C
University of California, Santa Cruz	MATH 23B - Vector Calculus	Double integral, changing the order of integration. Triple integrals, maps of the plane, change of variables theorem, improper double integrals. Path integrals, line integrals, parametrized surfaces, area of a surface, surface integrals. Green's theorem, Stokes' theorem, conservative fields, Gauss' theorem. Applications to physics and differential equations, differential forms.	"Vector Calculus", 6th ed, by Marsden/Tromba	3 hours, 15 hours, 5 credits	B+
University of California, Santa Cruz	PHYS 102 - Modern Physics	Topics in quantum physics including the Schrodinger equation; angular momentum and spin; the Pauli exclusion principle; and quantum statistics. Applications in multi-electron atoms and molecules, and in solid-state, nuclear, and particle physics.	"Modern Physics" by Randy Harris, second edition	3 hours, 15 hours, 5 credits	A-
University of California, Santa Cruz	PHYS 105 - Mechanics	Particle dynamics in one, two, and three dimensions. Conservation laws. Small oscillations, Fourier series and Fourier integral solutions. Phase diagrams and nonlinear motions, Lagrange's equations, and Hamiltonian dynamics.	"Classical Mechanics" - John R. Taylor	3 hours, 15 hours, 5 credits	B

University of California, Santa Cruz	PHYS 110A - Electricity, Magnetism, And Optics	Examines electrostatics, including the electric field, potential, solutions to Laplace's and Poisson's equations, and work and energy; electricity in matter (conductors, dielectrics); magnetostatics, including the magnetic field and vector potential, Ampere's and Faraday's laws; magnetism in matter; and Maxwell's equations.	"Introduction to Electrodynamics", Fourth Edition (Pearson Addison-Wesley, 2013) by David J. Griffiths	3 hours, 15 hours, 5 credits	A
University of California, Santa Cruz	PHYS 110B - Electricity, Magnetism, And Optics	Examines electromagnetic waves, including absorption and dispersion, reflection and transmission, and wave guides; conservation laws and gauge invariance; time-dependent vector and scalar potentials and application to radiation of charges and antennae; and electrodynamics and relativity.	"Introduction to Electrodynamics", Fourth Edition (Pearson Addison-Wesley, 2013) by David J. Griffiths	3 hours, 15 hours, 5 credits	A
University of California, Santa Cruz	PHYS 112 - Thermodynamics And Statistical Mechanics	Consequences of the first and second laws of thermodynamics, elementary statistical mechanics, thermodynamics of irreversible processes.	"An Introduction to Thermal Physics" - Daniel Schroeder	3 hours, 15 hours, 5 credits	B
University of California, Santa Cruz	PHYS 116A - Mathematical Methods In Physics	Infinite series, topics in linear algebra including vector spaces, matrices and determinants, systems of linear equations, eigenvalue problems and matrix diagonalization, tensor algebra, and ordinary differential equations.	"Mathematical Methods in the Physical Sciences", Third Edition, by Mary L. Boas	3 hours, 15 hours, 5 credits	B
University of California, Santa Cruz	PHYS 116B - Mathematical Methods In Physics	Complex functions, complex analysis, asymptotic series and expansions, special functions defined by integrals, calculus of variations, and probability, and statistics.	"Mathematical Methods in the Physical Sciences", Third Edition, by Mary L. Boas	3 hours, 15 hours, 5 credits	A-
University of California, Santa Cruz	PHYS 116C - Mathematical Methods In Physics	Fourier series and transforms, Dirac-delta function, Green's functions, series solutions of ordinary equations, Legendre polynomials, Bessel functions, sets of orthogonal functions, and partial differential equations.	"Mathematical Methods in the Physical Sciences", Third Edition, by Mary L. Boas	3 hours, 15 hours, 5 credits	A
University of California, Santa Cruz	PHYS 129 - Particle Physics And Astrophysics	The standard model of particle physics; physics beyond the standard model; neutrino physics; the early universe; dark matter and dark energy; selected topics in general relativistic cosmology and high-energy astrophysics.	"Particle Astrophysics", 2nd Edition, by D. H. Perkins	3 hours, 15 hours, 5 credits	A
University of California, Santa Cruz	PHYS 133 - Intermediate Laboratory	Demonstration of phenomena of classical and modern physics. Development of a familiarity with experimental methods.	"Physics 133 Laboratory Manual" - George Brown	3 hours, 15 hours, 5 credits	A
University of California, Santa Cruz	PHYS 135A - Astrophysics Advanced Laboratory	Introduction to techniques of modern observational astrophysics at optical and radio wavelengths through hands-on experiments.	"An Introduction to Observational Astrophysics" - Mark Gallaway	3 hours, 9 hours, 3 credits	A
University of California, Santa Cruz	PHYS 135B - Astrophysics Advanced Laboratory	Introduction to techniques of modern observational astrophysics at optical and radio wavelengths through hands-on experiments.	"An Introduction to Observational Astrophysics" - Mark Gallaway	3 hours, 6 hours, 2 credit	B+
University of California, Santa Cruz	PHYS 139A - Quantum Mechanics I	Basic principles and mathematical techniques of nonrelativistic quantum mechanics: Schrodinger equation and Dirac notation; one-dimensional systems, including the free particle and harmonic oscillator; three-dimensional problems with spherical symmetry; angular momentum; hydrogen atom; spin; identical particles and degenerate gases.	"Introduction to Quantum Mechanics" - David J. Griffiths	3 hours, 15 hours, 5 credits	A
University of California, Santa Cruz	PHYS 195A - Senior Thesis I	Independent research for seniors conducted under the supervision of a faculty mentor. Students develop a written research proposal, thesis outline, and introductory material.	None	3 hours, 15 hours, 5 credits	A
University of California, Santa Cruz	PHYS 195B - Senior Thesis II	Independent research for seniors conducted under the supervision of a faculty mentor. Students prepare an oral presentation of their results, and they submit a written senior thesis on their research topic.	None	3 hours, 15 hours, 5 credits	A
University of California, Santa Cruz	ASTR 112 - Physics of Stars	The leading observational facts about stars as interpreted by current theories of stellar structure and evolution. Spectroscopy, abundances of the elements, nucleosynthesis, stellar atmospheres, stellar populations. Final stages of evolution, including white dwarfs, neutron stars, supernovae.	"An Introduction to Modern Stellar Astrophysics" by Dale Ostlie and Bradley Carroll	3 hours, 15 hours, 5 credits	A
University of California, Santa Cruz	ASTR 113 - Introduction to Cosmology	Physical examination of our evolving universe: the Big Bang model; simple aspects of general relativity; particle physics in the early universe; production of various background radiations; production of elements; tests of geometry of the universe; dark energy and dark matter; and formation and evolution of galaxies and large-scale structure.	"Introduction to Modern Cosmology - Andrew Liddle	3 hours, 15 hours, 5 credits	A-

University of California, Santa Cruz	ASTR 119 - Introduction to Scientific Computing	Introduction to solving scientific problems using computers. A series of simple problems from Earth sciences, physics, and astronomy are solved using a user-friendly scientific programming language (Python/SciPy).I	"Programming for Computations - Python: A Gentle Introduction to Numerical Simulations with Python", 1st Edition, by Svein Linge and Hans Langtangen	3 hours, 15 hours, 5 credits	A
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