

PHYSICS

PHY 5905 Individual Work 1-4 Credits, Max 12 Credits

Grading Scheme: Letter Grade

Assigned reading and problems program, special topics, or development of special experimental or theoretical problems. Work selected according to student's needs and interests.

Prerequisite: consent of instructor.

PHY 6246 Classical Mechanics 3 Credits

Grading Scheme: Letter Grade

Review of Lagrangian formulation and special relativity. Hamiltonian mechanics, canonical transforms and Hamilton-Jacobi theories, action angle variables, rigid rotators, normal modes, mechanics of continuous media. Fluid mechanics.

PHY 6346 Electromagnetic Theory I 3 Credits

Grading Scheme: Letter Grade

Electrostatics, special function expansions, magnetostatics, linear media, time dependent Maxwell theory, wave propagation and dispersion, diffraction, scattering, radiation, relativistic covariance, applications.

PHY 6347 Electromagnetic Theory II 3 Credits

Grading Scheme: Letter Grade

Continuation of PHY 6346.

Prerequisite: PHY 6346.

PHY 6536 Statistical Mechanics I 3 Credits

Grading Scheme: Letter Grade

Equilibrium ensembles for classical and quantum systems, fluctuations, applications to normal fluids, phase transitions and critical phenomena, plasmas.

Prerequisite: PHY 6645 and PHY 6246.

PHY 6555C Cryogenics 4 Credits

Grading Scheme: Letter Grade

Production and use of cryogenic fluids; temperature measurement and control; use of cryogenics in science and industry, superconducting magnet and power generator, and electronics. Hands-on experience.

Prerequisite: PHY 3101 and consent of instructor.

PHY 6645 Quantum Mechanics I 3 Credits

Grading Scheme: Letter Grade

Hilbert space, Heisenberg and Schrodinger dynamics, invariance properties and symmetry operations, spin, perturbation, and variational methods.

Prerequisite: MAP 5304, PHY 4605.

PHY 6646 Quantum Mechanics II 3 Credits

Grading Scheme: Letter Grade

Time dependent perturbation theory, scattering theory, identical particles and second quantization, Dirac equation.

Prerequisite: PHY 6645.

PHY 6648 Quantum Field Theory I 3 Credits

Grading Scheme: Letter Grade

The Poincare group; the Dirac equation; quantization of free fields; the scattering matrix; applications.

Prerequisite: PHY 6646.

PHY 6905 Individual Work 1-4 Credits, Max 12 Credits

Grading Scheme: Letter Grade

Treatment of an experimental or theoretical problem or topic assigned on the basis of student's needs and interests.

PHY 6910 Supervised Research 1-5 Credits, Max 5 Credits

Grading Scheme: S/U

Supervised Research

PHY 6920 Departmental Colloquium 1 Credit, Max 14 Credits

Grading Scheme: S/U

Summary presentation of contemporary topics by visiting and local researchers.

PHY 6932 Seminar in Molecular and Computational Physics 1 Credit, Max 10 Credits

Grading Scheme: S/U

Invited speakers on topics of current interest in computation and theory in dynamics, and molecular and solid state physics.

Prerequisite: senior or graduate standing.

PHY 6943 Internship in College Teaching 2-4 Credits

Grading Scheme: Letter Grade

Required for Master of Science in Teaching students, but available for students needing additional practice and direction in college-level teaching.

Prerequisite: graduate standing.

PHY 6971 Research for Master's Thesis 1-15 Credits

Grading Scheme: S/U

Research for Master's Thesis

PHY 7097 Advanced Topics in Theoretical Physics 3 Credits, Max 10 Credits

Grading Scheme: Letter Grade

Special studies in mathematical methods and applications of current interest at the forefront of one or more specialties in theoretical physics.

PHY 7669 Quantum Field Theory II 3 Credits

Grading Scheme: Letter Grade

Path integral quantization; perturbation theory; renormalization; quantization of gauge fields; applications.

Prerequisite: PHY 6648.

PHY 7979 Advanced Research 1-12 Credits

Grading Scheme: S/U

Research for doctoral students before admission to candidacy. Designed for students with a master's degree in the field of study or for students who have been accepted for a doctoral program. Not appropriate for students who have been admitted to candidacy.

PHY 7980 Research for Doctoral Dissertation 1-15 Credits

Grading Scheme: S/U

Research for Doctoral Dissertation

PHZ 5155C Physical Modeling and Simulation 3 Credits

Grading Scheme: Letter Grade

Principles and applications of physical modeling and computer simulation. Fundamental interactions among particles such as atoms, molecules, condensed matter, and planets. Introduction to variety of simulation techniques in modern research.

PHZ 5354 Introduction to Particle Physics 3 Credits

Grading Scheme: Letter Grade

Descriptive survey of particle and nuclear phenomena and states: conserved quantities and quantum numbers, invariance principles.

Prerequisite: consent of instructor.

PHZ 6355 Elementary Particle Physics I 3 Credits**Grading Scheme:** Letter Grade

Dirac and Klein-Gordon equations, Feynman diagrams, scattering amplitudes; the standard model of weak, electromagnetic, and strong interactions; phenomenology of high energy physics.

Prerequisite: PHY 6646.**PHZ 6358 Standard Model of Elementary Particles I 3 Credits****Grading Scheme:** Letter Grade

Nonabelian gauge theory, Glashow-Weinberg-Salam model of electromagnetic and weak interactions. Spontaneous symmetry breaking and Higgs mechanism, theory of weak processes focusing on quantum corrections and their physical consequences.

PHZ 6391 Seminar in Astrophysics 1 Credit, Max 12 Credits**Grading Scheme:** S/U

Seminar in Astrophysics

PHZ 6392 Seminar in Particle Physics 1 Credit, Max 12 Credits**Grading Scheme:** S/U

Seminar in Particle Physics

PHZ 6426 Solid State I 3 Credits**Grading Scheme:** Letter Grade

Quantum theory of crystalline solids: Bloch theorem, electronic structure, thermodynamic and transport properties of metals, lattice dynamics, electronic interactions in solids, semiconductors and insulators.

Prerequisite: PHY 6536.**PHZ 6493 Seminar in Condensed Matter Physics 1 Credit, Max 12 Credits****Grading Scheme:** S/U

Seminar in Condensed Matter Physics

PHZ 6607 Special and General Relativity 3 Credits**Grading Scheme:** Letter Grade

Special relativity, tensor analysis, covariant electromagnetism and hydrodynamics; general relativity, Riemannian geometry, gravity as curvature, exact solutions; relativistic astrophysics, cosmology.

Prerequisite: PHY 6246.**PHZ 7357 Elementary Particle Physics II 3 Credits****Grading Scheme:** Letter Grade

Continuation of PHZ 6355. Extensions of the standard model. Calculations of QCD corrections.

Prerequisite: PHZ 6355.**PHZ 7359 Standard Model of Elementary Particles II 3 Credits****Grading Scheme:** Letter Grade

Strong interactions, perturbation study of quantum chromodynamics (QCD) of quarks and gluons. Chiral description of long-range QCD, supersymmetric extensions of standard model, grand unification

Prerequisite: PHZ 6358.**PHZ 7427 Solid State II 3 Credits****Grading Scheme:** Letter Grade

Physics of collective phenomena in condensed matter systems: electron-electron and electron-phonon interactions, magnetism, superconductivity, and quantum transport.

Prerequisite: PHZ 6426.**PHZ 7428 Modern Condensed Matter Physics 3 Credits****Grading Scheme:** Letter Grade

Green's functions and many-body perturbation theory, with applications to topics in modern condensed matter physics. Superconductors, quantum magnetism, quantum transport, quantum hall effect. Other modern techniques and numerical methods.

Prerequisite: PHZ 6426.**PHZ 7429 Phases of Condensed Matter 3 Credits****Grading Scheme:** Letter Grade

Focus on structural properties, transitions and properties of topological defects in crystalline solids, liquid crystals, incommensurate crystals, quasicrystals, magnetically ordered systems, and random fractals.

Prerequisite: PHZ 6426 or consent of instructor.**PHZ 7608 Special and General Relativity II 3 Credits****Grading Scheme:** Letter Grade

Relativistic stars, black holes, gravitational radiation; advanced topics in general relativity and cosmology.

Prerequisite: PHZ 6607.