PHYSICS (PHYS)

PHYS*6010 PSI Quantum Field Theory I Unspecified [0.50]
Canonical quantization of fields, perturbation theory, derivation of Feynman diagrams, applications in particle and condensed matter theory, renormalization in phi^4.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6020 PSI Statistical Physics Unspecified [0.50]
A brief review of ensembles and quantum gases, Ising model, landau theory of phase transititions, order parameters, topology, classical solutions.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6030 PSI Quantum Field Theory II Unspecified [0.50]
Feynman Path Integral, abelian and nonabelian guage theories and their quantization, spontaneous symmetry breaking, nonperturbative techniques: lattice field theory, Wilsonian renormalization.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6040 PSI Relativity Unspecified [0.50]
Special relativity, foundations of general relativity, Riemannain geometry, Einstein's equations, FRW and Schwarzschild geometries and their properties.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6050 PSI Quantum Theory Unspecified [0.50]
Schrodinger equation: free particle, harmonic oscillator, simple time-dependent problems, Heisenberg picture and connection with classical physics. Entanglement and non-locality. Pure and mixed states, quantum correlators, measurement theory and interpretation.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6060 PSI Information and Data Analysis Unspecified [0.50]
Probability, entropy, Bayesian inference and information theory. Maximum likelihood methods, common probability distributions, applications to real data including Monte Carlo methods.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6070 PSI Dynamical Systems Unspecified [0.50]
Maps, flows, stability, fixed points, attractors, chaos, bifurcations, ergodicity, approach to chaos. Hamiltonian systems, Liouville, measure, Poincare theorem, integrable systems with examples.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6080 PSI Computation Unspecified [0.50]
Common algorithms for ode and pde solving, with numerical analysis. Common tasks in linear algebra. Focus on how to write a good code, test it, and obtain a reliable result. Parallel programing.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6210 PSI Cosmology Unspecified [0.25]
FRW metic, Hubble expansion, dark energy, dark matter, CMB, Thermodynamic history of early universe. Growth of perturbations, CDM model of structure formation and comparison to observations, cosmic microwave background anisopropies, inlation and observational tests.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6220 PSI Standard Model Unspecified [0.25]
Application of Yan-Mills theory to particle physics, QCD and its tests in the perturbative regime, theory of weak interactions, precisions tests of electroweak theory, CKM matrix and flavour physics, open questions.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6230 PSI String Theory Unspecified [0.25]
Superstring spectrum in 10d Minkowski, as well as simple toroidal and orbifold compactifications. T-duality, D-branes, tree amplitudes. Construct some simple unified models of particle physics. Motivate the 10- 11-dimensional supergravities. Simple supergravity solutions and use these to explore some aspects of adS/CFT duality.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6240 PSI Mathematical Physics Topics Unspecified [0.25]
Differential forms, de Rham cohomology, differential topology and characteristic classes, monopoles and instantons, Kahler manifolds, Dirac equations, zero modes and index theorems.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6350 PSI Quantum Information Review Unspecified [0.25]
Review of selected topics in Quantum Information.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6360 PSI Gravitational Physics Review Unspecified [0.25]
Review of selected topics in Gravitational Physics.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6370 PSI Condensed Matter Theory Unspecified [0.25]
Review of selected topics in Condensed Matter Theory.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6380 PSI Quantum Gravity Unspecified [0.25]
Review of selected topics in Quantum Grativity.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6390 PSI Foundations of Quantum Theory Unspecified [0.25]
Review of selected topics in Foundations of Quantum Theory.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6410 PSI Explorations in Quantum Information Unspecified [0.25]
Review of selected topics in Quantum Information.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6420 PSI Explorations in Gravitational Physics Unspecified [0.25]
Review of selected topics in Gravitational Physics.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6430 PSI Explorations in Condensed Matter Theory Unspecified [0.25]
Review of selected topics in Condensed Matter Theory.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6440 PSI Explorations in Quantum Gravity Unspecified [0.25]
Review of selected topics in Quantum Gravity.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6450 PSI Explorations in Foundations of Quantum Theory Unspecified [0.25]
Review of selected topics in Foundations of Quantum Theory.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6460 PSI Explorations in Particle Physics Unspecified [0.25]
Review of selected topics in Particle Physics.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6470 PSI Explorations in String Theory Unspecified [0.25]
Review of selected topics in String Theory.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6480 PSI Explorations in Complex Systems Unspecified [0.25]
Review of selected topics in Complex Systems.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*6490 PSI Explorations in Cosmology Unspecified [0.25]
Review of selected topics in Cosmology.
Department(s): Department of Physics
Location(s): Waterloo Campus

PHYS*7010 Quantum Mechanics I Unspecified [0.50]
Review of formalism of nonrelativistic quantum mechanics including symmetries and invariance. Approximation methods and scattering theory. Elementary quantum theory of radiation. Introduction to one-particle relativistic wave equations.
Offering(s): Annually
Department(s): Department of Physics
Location(s): Guelph

PHYS*7020 Quantum Mechanics II Unspecified [0.50]
Concepts of relativistic quantum mechanics, elementary quantum field theory, and Feynman diagrams. Application to many-particle systems.
Prerequisite(s): PHYS*7010
Department(s): Department of Physics
Location(s): Guelph

PHYS*7030 Quantum Field Theory Unspecified [0.50]
Review of relativistic quantum mechanics and classical field theory. Quantization of free quantum fields (the particle interpretation of field quants). Canonical quantization of interacting fields (Feynman rules). Application of the formalism of interacting quantum fields to lowest-order quantum electrodynamic processes. Radiative corrections and renormalization.
Prerequisite(s): PHYS*7010
Department(s): Department of Physics
Location(s): Guelph

PHYS*7040 Statistical Physics I Unspecified [0.50]
Statistical basis of thermodynamics; microcanonical, canonical and grand canonical ensembles; quantum statistical mechanics, theory of the density matrix; fluctuations, noise, irreversible thermodynamics; transport theory; application to gases, liquids, solids.
Offering(s): Annually
Department(s): Department of Physics
Location(s): Guelph

PHYS*7050 Statistical Physics II Unspecified [0.50]
Phase transitions. Fluctuation phenomena. Kubo's theory of time correlation functions for transport and spectral properties; applications selected from a variety of topics including linearized hydrodynamics of normal and superfluids, molecular liquids, liquid crystals, surface phenomena, theory of the dielectric constant, etc.
Prerequisite(s): PHYS*7040
Department(s): Department of Physics
Location(s): Guelph

PHYS*7060 Electromagnetic Theory Unspecified [0.50]
Solutions to Maxwell's equations; radiation theory, normal modes; multipole expansion; Kirchhoff's diffraction theory; radiating point charge; optical theorem. Special relativity; transformation laws for the electromagnetic field; line broadening. Dispersion; Kramers-Kronig relations. Magnetohydrodynamics and plasmas.
Offering(s): Annually
Department(s): Department of Physics
Location(s): Guelph

PHYS*7080 Applications of Group Theory Unspecified [0.50]
Introduction to group theory; symmetry, the group concept, representation theory, character theory. Applications to molecular vibrations, the solid state, quantum mechanics and crystal field theory.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7090 Green's Function Method Unspecified [0.50]
Review of essential quantum field theory. Zero and finite temperature. Green's functions. Applications.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7100 Atomic Physics Unspecified [0.50]
Emphasis on atomic structure and spectroscopy. Review of angular momentum, rotations, Wigner-Eckart theorem, n-j symbols. Energy levels in complex atoms, Hartree-Fock theory, radiative-transitions and inner-shell processes. Further topics selected with class interest in mind, at least one of which is to be taken from current literature.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7120 Special Topics in Theoretical Physics Unspecified [0.50]
Department(s): Department of Physics
Location(s): Guelph

PHYS*7130 Molecular Physics Unspecified [0.50]
Angular momentum and the rotation of molecules; introduction to group theory with application to molecular vibrations; principles of molecular spectroscopy; spectra of isolated molecules; intermolecular interactions and their effects on molecular spectra; selected additional topics (e.g., electronic structure of molecules, experimental spectroscopic techniques, neutron scattering, correlation functions, collision induced absorption, extension of group theory to molecular crystals, normal co-ordinate analysis, etc.).
Department(s): Department of Physics
Location(s): Guelph

PHYS*7140 Nonlinear Optics Unspecified [0.50]
Classical and Quantum Mechanical descriptions of nonlinear susceptibility, nonlinear wave propogation, nonlinear effects such as Peckel's and Kerr effects, harmonic generation, phase conjugation and stimulated scattering processes.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7150 Nuclear Physics Unspecified [0.50]
Static properties of nuclei; alpha, beta, gamma decay; two-body systems; nuclear forces; nuclear reactions; single-particle models for spherical and deformed nuclei; shell, collective, interacting boson models.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7160 Special Topics in Subatomic and Nuclear Physics Unspecified [0.50]
Restriction(s): Instructor consent required.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7170 Intermediate and High Energy Physics Unspecified [0.50]
Strong, electromagnetic and weak interactions. Isospin, strangeness, conservation laws and symmetry principles. Leptons, hadrons, quarks and their classification, formation, interactions and decay.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7180 Special Topics in Subatomic and Nuclear Physics Unspecified [0.25]
Restriction(s): Instructor consent required.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7310 Solid State Physics I Unspecified [0.50]
Phonons, electron states, electron-electron interaction, electron-ion interaction, static properties of solids.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7320 Solid State Physics II Unspecified [0.50]
Transport properties; optical properties; magnetism; superconductivity; disordered systems.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7330 Special Topics in Theoretical Condensed Matter Physics Unspecified [0.50]
Department(s): Department of Physics
Location(s): Guelph

PHYS*7370 Special Topics in Surface Physics Unspecified [0.50]
Department(s): Department of Physics
Location(s): Guelph

PHYS*7380 Special Topics in Condensed Matter and Materials Physics Unspecified [0.25]
Department(s): Department of Physics
Location(s): Guelph

PHYS*7450 Special Topics in Experimental Physics Unspecified [0.50]
A modular course in which each module deals with an established technique of experimental physics. Four modules will be offered during the Winter and Spring semesters, but registration and credit will be in the spring semester. Typical topics are neutron diffraction, light scattering, acoustics, molecular beams, NMR, surface analysis, etc.
Offering(s): Annually
Department(s): Department of Physics
Location(s): Guelph

PHYS*7470 Optical Electronics Unspecified [0.50]
Optoelectronic component fabrication, light propogation in linear and nonlinear media, optical fiber properties, electro-optic and acousto-optic modulation, spontaneous and stimulated emission, semiconductor lasers and detectors, nose effects in fiber systems.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7510 Clinical Applications of Physics in Medicine Unspecified [0.50]
This course provides an overview of the application of physics to medicine. The physical concepts underlying the diagnosis and treatment of disease will be explored. Topics will include general imaging principles such as resolution, intensity, and contrast; x-ray imaging and computed tomography; radioisotopes and nuclear medicine, SPECT and PET; magnetic resonance imaging; ultrasound imaging and radiation therapy. Offered in conjunction with PHYS*4070. Extra work is required of graduate students.
Restriction(s): Credit may be obtained for only one of PHYS*4070 or PHYS*7510.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7520 Molecular Biophysics Unspecified [0.50]
Physical methods of determining macromolecular structure: energetics, intramolecular and intermolecular forces, with application to lamellar structures, information storage, DNA and RNA, recognition and rejection of foreign molecules. Offered in conjunction with PHYS*4540. Extra work is required of graduate students.
Restriction(s): Credit may be obtained for only one of PHYS*4540 or PHYS*7520
Department(s): Department of Physics
Location(s): Guelph

PHYS*7540 Special Topics in Biophysics Unspecified [0.50]
Offered on demand
Department(s): Department of Physics
Location(s): Guelph

PHYS*7570 Special Topics in Biophysics Unspecified [0.25]
Offered on demand
Department(s): Department of Physics
Location(s): Guelph

PHYS*7670 Introduction to Quantum Information Processing Fall Only [0.50]
Quantum superposition, interference, and entanglement. Postulates of Quantum Mechanics. Quantum computational complexity. Quantum Algorithms. Quantum communication and cryptography. Quantum error correction. Implementations.
Department(s): Department of Physics
Location(s): Guelph, Waterloo Campus

PHYS*7680 Special Topics in Quantum Information Processing Unspecified [0.50]
Department(s): Department of Physics
Location(s): Guelph, Waterloo Campus

PHYS*7690 Special Topics in Quantum Information Processing Unspecified [0.25]
Department(s): Department of Physics
Location(s): Guelph

PHYS*7710 Special Lecture and Reading Course Unspecified [0.50]
Department(s): Department of Physics
Location(s): Guelph

PHYS*7730 Special Topics in Physics Unspecified [0.50]
Department(s): Department of Physics
Location(s): Guelph

PHYS*7750 Interinstitution Exchange Unspecified [0.50]
At the GWPI director's discretion, a PhD or MSc student may receive credit for a term of specialized studies at another institution. Formal evaluation is required.
Restriction(s): Instructor consent required.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7760 Special Topics in Physics Unspecified [0.50]
Department(s): Department of Physics
Location(s): Guelph

PHYS*7770 Special Topics in Physics Unspecified [0.25]
Department(s): Department of Physics
Location(s): Guelph

PHYS*7810 Fundamentals of Astrophysics Unspecified [0.50]
The fundamental astronomical data: techniques to obtain it and the shortcomings present. The classification systems. Wide- and narrow-band photometric systems. The intrinsic properties of stars: colours, luminosities, masses, radii, temperatures. Variable stars. Distance indicators. Interstellar reddening. Related topics.
Department(s): Department of Physics
Location(s): Guelph, Waterloo Campus

PHYS*7840 Advanced General Relativity Winter Only [0.50]
Review of elementary general relativity. Timelike and null geodesic congruences. Hypersurfaces and junction conditions. Lagrangian and Hamiltonian formulations of general relativity. Mass and angular momentum of a gravitating body. The laws of black-hole mechanics.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7850 Quantum Field Theory for Cosmology Unspecified [0.50]
Introduction to scalar field theory and its canonical quantization in flat and curved spacetimes. The flat space effects of Casimir and Unruh. Quantum fluctuations of scalar fields and of the metric on curved space-times and application to inflationary cosmology. Hawking radiation.
Prerequisite(s): PHYS*7010
Department(s): Department of Physics
Location(s): Guelph, Waterloo Campus

PHYS*7860 General Relativity for Cosmology Unspecified [0.50]
Introduction to the differential geometry of Lorentzian manifolds. The principles of general relativity. Causal structure and cosmological singularities. Cosmological space-times with Killing vector fields. Friedmann-Lemaitre cosmologies, scalar vector and tensor perturbations in the linear and nonlinear regimes. De Sitter space-times and inflationary models.
Department(s): Department of Physics
Location(s): Guelph, Waterloo Campus

PHYS*7870 Cosmology Unspecified [0.50]
Friedmann-Robertson-Walker metric and dynamics; big bang thermodynamics; nucelosynthesis; recombination; perturbation theory and structure formation; anisotropies in the Cosmic Microwave Background; statistics of cosmological density and velocity fields; galaxy formation; inflation.
Department(s): Department of Physics
Location(s): Guelph

PHYS*7880 Special Topics in Astrophysics Unspecified [0.50]
Offered on demand
Department(s): Department of Physics
Location(s): Guelph

PHYS*7890 Special Topics in Astrophysics Unspecified [0.25]
Offered on demand
Department(s): Department of Physics
Location(s): Guelph

PHYS*7900 Special Topics in Gravitation and Cosmology Unspecified [0.50]
Department(s): Department of Physics
Location(s): Guelph

PHYS*7910 Special Topics in Gravitation and Cosmology Unspecified [0.25]
Department(s): Department of Physics
Location(s): Guelph

PHYS*7970 MSc Project Unspecified [1.00]
Study of a selected topic in physics presented in the form of a written report. For students whose MSc program consists entirely of courses.
Department(s): Department of Physics
Location(s): Guelph