Physics (PHYJ) - Joint Courses

Physics - Joint (PHYJ) Courses

With the exception of PHYS 5701 (PHY 5170) and PHYS 5302 (PHY 8132), which may be offered at either Carleton or the University of Ottawa, all PHYS courses are offered only at Carleton, and all PHYJ courses are offered only at the University of Ottawa.

PHYJ 5001 [0.5 credit] (PHY 5130)
Experimental Characterization Techniques in Materials Science, Physics, Chemistry, and Mineralogy
Survey of experimental techniques used in materials science, condensed matter physics, solid state chemistry, and mineralogy to characterize materials and solid substances. Diffraction. Spectroscopy. Microscopy and imaging. Other analytic techniques.
Prerequisite(s): permission of the Department.

PHYJ 5003 [0.5 credit] (PHY 5342)
Computer Simulations in Physics
Advanced numerical methods to study large scale problems in the natural sciences; molecular dynamics, Langevin dynamics, Brownian dynamics methods. The use of different thermodynamic ensembles to compute experimentally relevant physical properties, and work with non-equilibrium situations. Methods to handle very large problems on parallel computers.
Prerequisite(s): PHY 3355 (PHY 3755), PHY 3370 (PHY 3770) and familiarity with FORTRAN, Pascal or C.

PHYJ 5004 [0.5 credit] (PHY 5340)
Computational Physics I

PHYJ 5005 [0.5 credit] (PHY 5341)
Computational Physics II

PHYJ 5006 [0.5 credit] (PHY 5362)
Computational Methods in Material Sciences
Introduction to modern computational techniques used in material science research. Classical molecular dynamics, classical and quantum Monte Carlo methods, plane-wave based electronic band structure calculations, Car-Parrinello quantum molecular dynamics. Applications to condensed matter systems: basic simulation techniques, force-field based methods, first-principles quantum mechanical methods.
Prerequisite(s): permission of the Department.

PHYJ 5102 [0.5 credit] (PHY 5361)
Nonlinear Dynamics in the Natural Sciences
Differential and difference equations, Fourier series and data analysis, stability analysis, Poincaré maps, local bifurcations, routes to chaos and statistical properties of strange attractors. Applications of these concepts to specific problems in condensed matter physics, molecular physics, fluid mechanics, dissipative structures, and evolutionary systems.
Prerequisite(s): permission of the Department.

PHYJ 5310 [0.5 credit] (PHY 5310)
Advanced Optics and Photonics
Prerequisite(s): permission of the Department.

PHYJ 5311 [0.5 credit] (PHY 5311)
Quantum Optics I
Classical and semi-classical light-matter interaction; gauges and energy conservation; two level systems in the resonant, under-resonant and over-resonant limit; time-dependent perturbation theory and Fermi's golden rule; semi-classical laser theory; Landau Zener tunneling and multi-photon transitions; tunnel ionization and multi-photon ionization.
Prerequisite(s): permission of the Department.

PHYJ 5312 [0.5 credit] (PHY 5312)
Quantum Optics II
Quantum light-matter interaction; quantization of the light field and of Schrodinger equation; number states and coherent states; photon emission and absorption; two-photon decay; photoelectric effect; Lamb shift, linewidth and renormalization; Casimir effect; multi-photon processes; density operator; quantum theory of decay; quantum laser theory.
Prerequisite(s): permission of the Department.
PHYJ 5322 [0.5 credit] (PHY 5322)
Biological Physics
Biological phenomena studied using techniques of physics. Key components of cells. Physical concepts relevant to cellular phenomena: Brownian dynamics, fluids, suspensions, entropy driven phenomena, chemical forces and self-assembly. Biological molecules. Enzymes. Molecular motors. Nerve impulses. Precludes additional credit for PHY 4322. Also offered at the undergraduate level, with different requirements, as PHYS 4322, for which additional credit is precluded.

PHYJ 5330 [0.5 credit] (PHY 5330)
Fibre Optics Communications

PHYJ 5331 [0.5 credit] (PHY 5331)
Fibre Optics Sensors

PHYJ 5332 [0.5 credit]
Nonlinear Optics
Nonlinear optical susceptibility; wave equation description of nonlinear optics processes: second harmonic generation, intensity dependent refractive index, sum- and frequency-generation, parametric amplification; quantum mechanical theory of nonlinear optics; Brillouin and Raman scattering; the electro-optic effect; nonlinear fibre optics and solitons.

PHYJ 5401 [0.5 credit] (PHY 5100)
Solid State Physics I

PHYJ 5402 [0.5 credit] (PHY 5110)
Solid State Physics II

PHYJ 5403 [0.5 credit] (PHY 5151)
Type I and II Superconductors
Flux flow and flux cutting phenomena. Clem general critical state model. Flux quantization, Abrikosov vortex model and Ginzburg-Landau theory. Superconducting tunnelling junctions (Giaevar and Josephson types). Prerequisite(s): PHY 4370 or permission of the Department.

PHYJ 5404 [0.5 credit] (PHY 6371)
Topics in Mössbauer Spectroscopy
Recoilless emission/absorption, anisotropic Debye-Waller factors, second order Doppler shifts. Mössbauer lineshape theory with static and dynamic hyperfine interactions. Distributions of static hyperfine parameters. Physics of the hyperfine parameters: origin of the hyperfine field, calculations of electric field gradients. Applications of Mössbauer spectroscopy. Prerequisite(s): permission of the Department.

PHYJ 5407 [0.5 credit] (PHY 5380)
Semiconductor Physics I
Brillouin zones and band theory. E-k diagram, effective mass tensors, etc. Electrical properties of semiconductors. Conduction, hall effect, magneto-resistance. Scattering processes. Multivalley models and non-parabolic bands. Prerequisite(s): PHY 4380 or permission of the Department.

PHYJ 5408 [0.5 credit] (PHY 5381, PHY 5781)
Semiconductor Physics II: Optical Properties
Optical constants and dispersion theory. Optical absorption, reflection and band structure. Absorption at band edge and excitons. Lattice, defect and free carrier absorption, Magneto-optics. Photo-electronic properties, luminescence, detector theory. Experimental methods. Prerequisite(s): PHY 4380 or permission of the Department.

PHYJ 5409 [0.5 credit] (PHY 5951)
Low Temperature Physics II
Helium 3 and Helium 4 cryostats. Dilution refrigerators. Theory and techniques of adiabatic demagnetization. Thermometry at low temperatures. Problems of thermal equilibrium and of thermal isolation. Properties of matter at very low temperature. Prerequisite(s): PHY 4355 or permission of the Department.

PHYJ 5501 [0.5 credit]
Charged Particle Dynamics
PHYJ 5502 [0.5 credit] (PHY 5740)  
Physics Numérique I  
Méthodes numériques déterministes en physique.  
Techniques d'interpolation. Solutions numérique des équations de Newton, de Maxwell et de Schrödinger.  
Dynamique moléculaire. Dynamique non-linaire.  
Solutions numériques des équations aux dérivées partielles en physique. Éléments finis.  
Prerequisite(s): permission of the Department.

PHYJ 5503 [0.5 credit] (PHY 5741)  
Physique Numérique II  
Interpolation, régression et modeler. Nombres aléatoires.  
Prerequisite(s): permission of the Department.

PHYJ 5504 [0.5 credit] (PHY 5387)  
Physics of Materials  
Microscopic characteristics related to the physical properties of materials. Materials families: metals and alloys, ceramics, polymers and plastics, composites, layered materials, ionic solids, molecular solids, etc.  
Prerequisite(s): PHY 4382 or equivalent. Cannot be combined with PHY 4387.

PHYJ 5505 [0.5 credit] (PHY 5355)  
Statistical Mechanics  
Ensemble theory. Interacting classical and quantum systems. Phase transitions and critical phenomena.  
Fluctuations and linear response theory. Kinetic equations.  
Prerequisite(s): PHY 4370 and PHY 3355 or permission of the Department.

PHYJ 5506 [0.5 credit] (PHY 5742)  
Simulations numériques en physique  
Un cours ayant but d'étudier des méthodes numériques avancées employées dans les problèmes à grande échelle dans les sciences naturelles. Emploi d'ensembles thermo-dynamiques différents, calculs de propriétés physiques expérimentalement pertinentes, et extension aux situations hors d'équilibre. Techniques pour ordinateurs parallèles.  
Prerequisite(s): permission of the Department.

PHYJ 5507 [0.5 credit] (PHY 5922)  
Advanced Magnetism  
Study of some experimental and theoretical aspects of magnetic phenomena found in ferro-, ferr-, antiferro-magnetic and spin glass materials. Topics of current interest in magnetism.  
Prerequisite(s): PHY 4385 and permission of the Department.

PHYJ 5508 [0.5 credit] (PHY 5320)  
Introduction to the Physics of Macromolecules  
Chemistry of macromolecules and polymers; random walks and the static properties of polymers; experimental methods; the Rouse model and single chain dynamics; polymer melts and viscoelasticity; the Flory-Huggins theory; the reptation theory; computer simulation algorithms; biopolymers and copolymers.  
Prerequisite(s): permission of the Department.

PHYJ 5509 [0.5 credit] (PHY 5347)  
Physics, Chemistry and Characterization of Mineral Systems  
The materials science of mineral systems such as the network and layered silicates. In-depth study of the relations between mineralogically relevant variables such as: atomic structure, crystal chemistry, site populations, valence state populations, crystallization conditions. Interpretation and basic understanding of characterization tools.  
Prerequisite(s): permission of the Department.

PHYJ 5603 [0.5 credit]  
Ion Collisions in Solids

PHYJ 5703 [0.5 credit] (PHY 6170)  
Advanced Quantum Mechanics II  
Systems of identical particles and many-body theory.  
Lattice and impurity scattering. Quantum processes in a magnetic field. Radiative and non-radiative transitions.  
Introduction to relativistic quantum mechanics.  
Prerequisite(s): PHY 5170 and permission of the Department.

PHYJ 5722 [0.5 credit] (PHY 5722)  
Physique Biologique  
Precludes additional credit for PHY 4722.

PHYJ 6406 [0.5 credit] (PHY 6382)  
Physics of Semiconductor Superlattices  
Fundamental physics of two-dimensional quantized semiconductor structures. Electronic and optical properties of superlattices and quantum wells. Optical and electronic applications. This course is intended for students registered for the Ph.D. in semiconductor physics research.  
Prerequisite(s): advanced undergraduate or graduate course in solid state physics and permission of the Department.
PHYJ 6407 [0.5 credit] (PHY 6782)
Physique des super-réseaux à semi-conducteurs
Physique fondamentale des structures quantiques bi-dimensionnelles à semi-conducteurs. Propriétés électroniques et optiques des super-réseaux et puits quantiques. Applications à l'électronique et à l'optique. Ce cours est destiné aux étudiants et aux étudiantes inscrits au doctorat en physique des semi-conducteurs.
Prerequisite(s): permission of the Department.

Summer session: some of the courses listed in this Calendar are offered during the summer. Hours and scheduling for summer session courses will differ significantly from those reported in the fall/winter Calendar. To determine the scheduling and hours for summer session classes, consult the class schedule at central.carleton.ca

Not all courses listed are offered in a given year. For an up-to-date statement of course offerings for the current session and to determine the term of offering, consult the class schedule at central.carleton.ca