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, Carr-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 tunnelling 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
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
Precludes additional credit for ELG 5103.

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
Prerequisite(s): permission of the Department.

PHYJ 5402 [0.5 credit] (PHY 5110)
Solid State Physics II
Prerequisite(s): permission of the Department.

PHYJ 5403 [0.5 credit] (PHY 5151)
Type I and II Superconductors
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
Prerequisite(s): PHY 4380 or permission of the Department.

PHYJ 5408 [0.5 credit] (PHY 5381, PHY 5781)
Semiconductor Physics II: Optical Properties
Prerequisite(s): PHY 4380 or permission of the Department.

PHYJ 5409 [0.5 credit] (PHY 5951)
Low Temperature Physics II
Prerequisite(s): PHY 4355 or permission of the Department.

PHYJ 5501 [0.5 credit]
Charged Particle Dynamics
PHYJ 5502 [0.5 credit] (PHY 5740)  
Physique 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-linéaire.  
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.  
Techniques de Monte-Carlo. Simulations thermo-  
statistiques. Percolation, fractales, et automisation  
cellulaire. Méthodes numériques stochastiques.  
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.  
Specific materials groups. Equilibrium phase diagrams and  
their relation to microstructure and kinetics. Experimental  
methods of characterization. Interactions and reactions.  
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  
Application des méthodes de la physique à l'étude des  
phénomènes biologiques. Composantes principales d'une  
cellule. Concepts physiques pertinents aux phénomènes  
cellulaires : dynamique brownienne, liquides, suspensions,  
phénomènes d'origine entropique, forces chimiques et  
Moteurs moléculaires. Impulsions nerveuses. Offert  
également, avec des exigences différentes, sous la cote  
PHY 4722.  
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 semiconducteurs. 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 semiconducteurs. 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