PHYSICS (PHYSICS)

PHYSICS 5000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department. Consent of instructor required.

PHYSICS 5001 Special Topics (IND 0.0 and LEC 0.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

PHYSICS 5333 Subatomic Physics (LEC 3.0)
An introduction to elementary particles. Topics include particle properties, nuclear forces, particle interactions, the Standard Model for quarks and leptons, fundamental forces in gauge field theory models, and the role of elementary particle interactions in cosmology. Prerequisite: Physics 3311.

PHYSICS 5403 Computational Physics (LAB 1.0 and LEC 3.0)
An introduction to modern computer simulations for solving physics problems. The course will be project-oriented with examples including planetary motion, chaotic dynamics, quantum scattering, structure of atoms and clusters, molecular dynamics, and Monte-Carlo simulations. Prerequisites: Physics 2305 or Physics 2311; Math 3304; programming experience.

PHYSICS 5413 Chaos, Fractals, and Nonlinear Dynamics (LEC 3.0)
An introduction into nonlinear dynamics, deterministic chaos, and fractals. Topics covered include phase plane analysis, iterated maps, routes to chaos, Lyapunov exponents, strange attractors and pattern formation with applications to chaotic vibrations, population dynamics, chemical oscillations and lasers. Prerequisites: Math 3304; Physics 2135 or Physics 2111.

PHYSICS 5503 Fourier Optics (LEC 3.0)
Applications of Fourier analysis and linear system theory to optics. Topics include scalar diffraction theory, Fourier transforming properties of lenses, optical information processing, and imaging systems. Prerequisites: Both Elec Eng 3430 and Elec Eng 3600 or Physics 4211. (Co-listed with ELEC ENG 5210).

PHYSICS 5513 Fiber And Integrated Optics (LEC 3.0)
Introduction to optical waveguides and their applications to communication and sensing. Topics include dielectric waveguide theory, optical fiber characteristics, integrated optic circuits, coupled-mode theory, optical communication systems, and photonic sensors. Prerequisite: Elec Eng 3600 or Physics 4211. (Co-listed with Elec Eng 5220).

PHYSICS 5603 Advanced Physics Laboratory Teaching Methods (LEC 3.0)
Objectives, methods and problems related to teaching of introductory physics, with an emphasis on laboratory instruction, the development of educational laboratory experiments and techniques, student learning styles, student assessment, student work groups, computer-based data acquisition, and communication techniques. Prerequisite: Graduate standing.

PHYSICS 6000 Special Problems (IND 0.0-6.0)
Problems or readings on specific subjects or projects in the department Consent of instructor required.

PHYSICS 6001 Special Topics (LEC 0.0 and RSD 0.0)
This course is designed to give the department an opportunity to test a new course. Variable title.

PHYSICS 6002 Coop Registration (IND 0.0-1.0)
Doctoral candidates participating in a cooperative program with another UM campus must enroll for one hour of credit for their first semester in the program and zero hours of credit for successive registration periods until degree is completed. Failure to do so may invalidate candidacy. Billing is automatic as is registration upon payment.

PHYSICS 6010 Seminar (RSD 0.0-6.0)
Discussion of current topics.

PHYSICS 6040 Oral Examination (IND 0.0)
After completion of all other program requirements, oral examinations for on-campus M.S./Ph.D. students may be processed during intersession. Off-campus M.S. students must be enrolled in oral examination and must have paid an oral examination fee at the time of the defense/ comprehensive examination (oral/ written). All other students must enroll for credit commensurate with uses made of facilities and/or faculties. In no case shall this be for less than three (3) semester hours for resident students.

PHYSICS 6050 Continuous Registration (IND 1.0)
Doctoral candidates who have completed all requirements for the degree except the dissertation, and are away from the campus must continue to enroll for at least one hour of credit each registration period until the degree is completed. Failure to do so may invalidate the candidacy. Billing will be automatic as will registration upon payment.

PHYSICS 6099 Research (IND 0.0-15)
Investigations of an advanced nature leading to the preparation of a thesis or dissertation. Consent of instructor required.

PHYSICS 6101 Classical Mechanics I (LEC 3.0)
Methods of Newton, Lagrange, and Hamilton applied to the motion of particles and rigid bodies. Introduction to canonical transformations and Poisson brackets. Classical scattering and small oscillations. Prerequisites: Math 3304 and Physics 3201.

PHYSICS 6111 Electrodynamics I (LEC 3.0)
A rigorous development of the fundamentals of electromagnetic fields and waves. Electrostatics, magnetostatics, Maxwell's equations--Green's function, boundary value problems, multipoles, conservation laws. Prerequisites: Physics 4211.

PHYSICS 6201 Quantum Mechanics I (LEC 3.0)
Basic formalism applied to selected problems. Schroedinger equation and one dimensional problems, Dirac notation, matrix mechanics, harmonic oscillator, angular momentum, hydrogen atom, variational methods, introduction to spin. Prerequisite: Physics 4301 or equivalent.

PHYSICS 6211 Electrodynamics II (LEC 3.0)
A continuation of Physics 5211+D1067. Applications of time-dependent Maxwell's equations to such topics as plasmas, wave guides, cavities, radiation; fields of simple systems and multipoles. Relativity; covariant formulation of Maxwell's equations and conservation laws, fields of uniformly moving and accelerated charges. Prerequisite: Physics 5211.

PHYSICS 6301 Quantum Mechanics II (LEC 3.0)
Perturbation theory, treatment of spin, angular momentum addition, Wigner-Eckart theorem; scattering theory including partial wave analysis, born approximation, and formal scattering theory; identical particles, introduction to second quantization, and structure of complex atoms. Prerequisite: Physics 5301.

PHYSICS 6311 Statistical Mechanics (LEC 3.0)
A study of statistical ensembles; Maxwell-Boltzmann, FermiDirac and Einstein-Bose distribution laws, application to some simple physical systems. Prerequisites: Physics 4311, Physics 5301.

PHYSICS 6323 Quantum Statistical Mechanics (LEC 3.0)
Techniques for calculation of the partition function with examples drawn from interacting Fermi gas, interacting Bose gas, superconductors, and similar sources. Prerequisites: Physics 6311 and 6301.

PHYSICS 6333 Condensed Matter Physics (LEC 3.0)
A course in the physics of hard and soft matter including solids, liquids, and complex materials. Topics: atomic structure, mechanical properties, phonons, electronic structure, energy band theory, electronic correlations, transport properties, magnetism, superconductivity. Prerequisite: Physics 5301.

PHYSICS 6353 Atomic And Molecular Structure (LEC 3.0)
Applications of quantum mechanics to the structure of atoms and molecules; perturbation and variational calculations, self-consistent field, multiplets, angular momenta, Thomas-Fermi model, diatomic molecules, spectral intensities. Prerequisite: Physics 5301.

PHYSICS 6363 Atomic Collisions (LEC 3.0)
Basic quantum mechanical concepts involved in atomic scattering theory. Topics include the Born approximation elastic collisions, and inelastic collisions. Other specific topics will be chosen from the general areas of electron, ion, and atom collisions with atoms and molecules. Prerequisite: Physics 6353 or 6301.

PHYSICS 6403 Mathematical Physics I (LEC 3.0)
Vector spaces, generalized coordinate transformations, vector analysis, tensors, partial differential equations in physics and boundary value problems, orthogonal functions and solutions to ordinary differential equations, hypergeometric, confluent hypergeometric, Legendre, Laguerre, and Bessel functions, Hermite polynomials, Green's functions in one dimension. (Co-listed with Math 6802).

PHYSICS 6413 Mathematical Physics II (LEC 3.0)
Green's functions in three dimensions, integral equations, complex variable theory and contour integration, group theory with applications to quantum mechanics, solid state and molecular physics. Prerequisite: Math 6802 or Physics 6403. (Co-listed with Math 6803).