Physics Graduate Course Descriptions

PHYS-535. METHODS OF EXPERIMENTAL PHYSICS I 3:3:0

Designed to acquaint students with the principles of basic experiments in all major branches of physics, stressing design of apparatus, procedures and analysis of projects involving mechanical, optical, electronic and thermal techniques, with microcomputers employed to collect and analyze experimental data.

Credit, three hours.

PHYS-536. METHODS OF EXPERIMENTAL PHYSICS II 3:3:0

Designed to acquaint students with the principles of basic experiments in all major branches of physics, stressing design of apparatus, procedures and analysis of projects involving mechanical, optical, electronic and thermal techniques, with microcomputers employed to collect and analyze experimental data.

Credit, three hours.

PHYS-563. MATHEMATICAL METHODS OF PHYSICS III 3:3:0

An intermediate course in applied mathematics. Topics covered include the solution of differential equations, vector

Calculus, Fourier series and Laplace transforms.

Credit, three hours.

PHYS-565. THERMAL PHYSICS 3:3:0

Statistical inference is used to deduce the fundamental principles of thermodynamics and kinetic theory. These principles are applied to ideal and real gases, solids, closed and open systems, and black body radiation.

Credit, three hours.

PHYS-567. INTERMEDIATE ELECTRICITY AND MAGNETISM I 3:3:0

A treatment of electrostatics, Dielectric Theory, magnetic phenomena, magnetic media, ac circuits and Maxwell's equations. Vector calculus is used throughout. Credit, three hours.

PHYS-568. INTERMEDIATE ELECTRICITY AND MAGNETISM II 3:3:0

A treatment of electrostatics, Dielectric Theory, magnetic phenomena, magnetic media, ac circuits and Maxwell's equations. Vector calculus is used throughout. Credit, three hours.

PHYS-574. SELECTED TOPICS FOR MIDDLE SCHOOL TEACHERS 3:3:0

A course that allows middle school teachers to pursue physics concepts as they relate to middle school science.

Credit, three hours.

PHYS-577. SELECTED TOPICS I 3:3:0

A course allowing practicing teachers to pursue independent study of a topic in physics and physical science at the graduate level.

Credit, three hours.

PHYS-578. SELECTED TOPICS II 3:3:0

A course allowing practicing teachers to pursue additional independent study of a topic in physics and physical science at the graduate level.

Credit, three hours.

PHYS-579. SELECTED TOPICS III 3:3:0

A course allowing practicing teachers to pursue additional independent study of a topic in physics and physical science at the graduate level.

Credit, three hours.

PHYS-600. MODERN OPTICS 4:4:0

Electromagnetic description of light and its interaction with matter. Topics include interference, coherence, diffraction, holography, dispersion, polarization, scattering, and confinement. Credit, four hours.

PHYS-601. NONLINEAR OPTICS 4:4:0

Principles of nonlinear interaction of light and matter based on the semi-classical approximation. Definition of nonlinear induced polarization and nonlinear susceptibility. Basic model of the coherent interaction of light with a two-level system is included. Main nonlinear optical effects are studied: harmonic generation, optical parametric amplification, saturation effects, Kerr effect, coherent effects, stimulated light scattering including stimulated Raman scattering, self-focusing and self-defocusing effects, multi-photon ionization, multi-photon ionization, and other nonlinear optical effects. The course also discusses practical applications of the nonlinear optical phenomena and related technology. Prerequisites: PHYS 600.

Credit, four hours.

PHYS-602. BIOPHOTONICS I: PRINCIPLES OF LUMINESCENCE 4:4:0

A study of the physics behind light emitting molecules and their applications in biology. Credit, four hours.

PHYS-603. BIOPHOTONICS II: INSTRUMENTATION 3:3:0

An overview of microscopes and other optical instruments used in the biomedical field. Credit, three hours.

PHYS-604. APPLIED OPTICS IN BIOMEDICINE 3:3:0

A treatment of concepts of physics and optics applied to the medical field. Topics include DNA sequencing, in situ

fluorescence, enzyme-based assays, glucose monitoring, HIV detection, and cancer diagnostics.

Credit, three hours.

PHYS-605. PRINCIPLES OF LASERS AND OPTICAL DEVICES 4:4:0

Treatment of basic principles of lasers and their applications. Topics to be covered include, fundamentals of quantum electronics, oscillator model, rate equations, stimulated transitions, population inversion, laser amplification, design of laser resonators, principles of q-switching, mode locking, injection locking and modern applications of lasers.

Credit, four hours.

PHYS-606. LABORATORY TECHNIQUES IN OPTICS AND SPECTROSCOPY 3:3:0

Modern spectroscopic methods. Human chromosomes, human leukocyte antigen (hla) haplotyping, enzyme-linked immuneassays (Elisa), diabetes testing and glucose monitoring, pregnancy testing, drug testing, HIV detection, and cancer diagnostics. Prerequisites: PHYS 602, PHYS 603.

Credit, three hours.

PHYS-607, INTRODUCTION TO LABVIEW 3:3:0

A hands-on approach to the national instruments labview programming language. Credit, three hours.

PHYS-608. SELECTED TOPICS IN OPTICS AND SPECTROSCOPY I 3:3:0

Current research topics in optics and spectroscopy. Credit, three hours.

PHYS-609. SELECTED TOPICS IN OPTICS AND SPECTROSCOPY II 3:3:0

Current research topics in optics and spectroscopy. Credit, three hours.

PHYS-633. SELECTED TOPICS IN SCIENCE EDUCATION 3:3:0

Current developments in physics education. Credit, three hours.

PHYS-652. CLASSICAL MECHANICS 3:3:0

Lagrangian formulation, the Kepler problem, Rutherford scattering, rotating coordinate systems, rigid body motion, small oscillations, stability problems, and Hamiltonian formulation. Credit, three hours.

PHYS-655. COMPUTATIONAL METHODS 3:3:0

Designed to familiarize students with the use of computers in pursuing theoretical research. Numerical analysis techniques and computational methods employed in the study of physical models will be studied.

Credit, three hours.

PHYS-661. SOLID STATE PHYSICS 3:3:0

An introductory study of the structure and physical properties of crystalline solids. Included are topics in crystal structure, lattice vibrations, thermal properties of solids, x-ray diffraction, free electron theory and energy based theory.

Credit, three hours.

PHYS-665. STATISTICAL MECHANICS 3:3:0

Laws of thermodynamics, Boltzmann and quantum statistical distributions, with applications to properties of gases, specific heats of solids, paramagnetism, black body radiation and Bose-Einstein condensation.

Credit, three hours.

PHYS-667. MATHEMATICAL METHODS OF PHYSICS IV 3:3:0

An advanced treatment of mathematical topics including operators, matrix mathematics, complex variables and eigenvalue problems.

Credit, three hours.

PHYS-671. ADVANCED ELECTROMAGNETIC THEORY I 3:3:0

Treatment of boundary value problems of electrostatics and magnetostatics, electromagnetic radiation, radiating systems, wave guides, resonating systems and multipole fields. Credit, three hours.

PHYS-672. ADVANCED ELECTROMAGNETIC THEORY II 3:3:0

Treatment of boundary value problems of electrostatics and magnetostatics, electromagnetic radiation, radiating systems, wave guides, resonating systems and multipole fields. Credit, three hours.

PHYS-675. QUANTUM MECHANICS I 3:3:0

A study of the Schroedinger wave equation, operators and matrices, perturbation theory, collision and scattering problems classification of atomic states, and introduction to field quantization.

Credit, three hours.

PHYS-676. QUANTUM MECHANICS II 3:3:0

Quantum Mechanics of molecules and solid state. Relastivistic quantum mechanics. Field quantization. Quantum theory of light. Basics of quantum electrodynamics. Credit, three hours.

PHYS-691. RESEARCH I 3:3:3

Independent student research or laboratory work in a specialized field of interest. Credit, three hours.

PHYS-692. RESEARCH II 3:3:3

Independent student research or laboratory work in a specialized field of interest. Credit, three hours.

PHYS-695. MASTER'S THESIS 6:6:6

A research problem in a selected physics topic resulting in a written thesis. Credit, one to six hours.

PHYS-800. MODERN LASER SPECTROSCOPIC METHODS 3:3:0

Basics of laser spectroscopic techniques and instrumentation. Topics include: ultra violet and visible (uv-vi) absorption spectroscopy; Fourier transform infrared spectroscopy; Raman, fluorescence, and saturation spectroscopy; polarization, correlation, and ultra-fast spectroscopy. Prerequisites: PHYS 600, PHYS 601, PHYS 605. Credit, three hours.

PHYS-801. QUANTUM THEORY OF LIGHT 3:3:0

Quantum mechanical description of light matter interaction. Presentation of basic quantum mechanics and quantum

mechanical treatment of light and atoms. Prerequisites: Consent of the Instructor. Credit, three hours.

PHYS-802. THEORY OF LIGHT SCATTERING 3:3:0

An advanced electricity and magnetism course focused on light interactions with small particles. Topics include Raleigh and Mie scattering, optical properties of nanoparticles and

surface plasmon resonance.

Credit, three hours.

PHYS-803. MODERN LASER SPECTROSCOPIC METHODS 3:3:0

The laser revolution in spectroscopy. Absorption within the Doppler line, Doppler-free broadening spectroscopy, saturation spectroscopy, multiphoton spectroscopy, laser fluorescence, laser Raman, coherent stokes and antistokes Raman spectroscopy, photon echo and coherent spectroscopy. Ultrafast spectroscopy. Modern trends in spectroscopy. Credit, three hour.

PHYS-804. PRINCIPLES OF PHOTOCHEMISTRY AND PHOTOBIOLOGY 3:3:0

Review of the main phenomena related to the interaction of light with matter that results in chemical or biological activity. The study of inorganic and organic photochemistry, environmental aspects of photochemistry, atmospheric photochemistry, photosynthesis, visual processing, bio-luminescence, interaction of light with bio-organisms, photo-medicine, and phototherapy.

Credit, three hours.

PHYS-805. PHOTOACOUSTIC AND THERMAL SPECTROSCOPY 3:3:0

Fundamentals of photo-acoustic and photo-thermal interaction of light with optical samples. Examination of basic

instrumentations and their applications for characterization of complex samples including biological samples.

Credit, three hours.

PHYS-806. MOLECULAR BIOPHYSICS 3:3:0

An overview of the physics of bio-molecular interactions. Topics will include physical models for DNA and protein systems.

Credit, three hours.

PHYS-807. OPTICAL SOLITONS 3:3:0

Basic concepts of the mathematical aspects of optical solitons. Presentation of optical waveguides, the nonlinear

Schrodinger?s equation, laws of nonlinearity, soliton perturbation, soliton-soliton interactions, Stochastic perturbation of optical solitons, optical couplers, optical switching, magneto-optic waveguides and optical bullets.

Prerequisites: PHYS 601, MTSC 853, MTSC 845.

Credit, three hours.

PHYS-808. FIBER OPTICS AND FIBER OPTICS COMMUNICATION 3:3:0

Light propagation in fiber, its dispersion and nonlinear characteristics that play an important role in light communication. Types of fiber-optic devices and their applications to communication. Wavelength division multiplexing.

Credit, three hours.

PHYS-809. PHOTONICS AND INFORMATION PROCESSING 3:3:0

Wave propagation in linear optical systems and optical information processing. Topics include: fundamentals of optical propagation, diffraction, optical imaging, Fourier transform, wave-front modulation, signal processing, and basics of optical processing devices.

Credit, three hours.

PHYS-810, CURRENT TOPICS IN OPTICS I 3:3:0

Current topics in optics and spectroscopy. Credit, three hours.

PHYS-811. CURRENT TOPICS IN OPTICS II 3:3:0

Current topics in optics and spectroscopy. Credit, three hours.

PHYS-820. DISSERTATION RESEARCH 9:9:9

The course is for Ph.D. students in the optics program working on their dissertation research project.

Credit, two to eight hours.

PHYS-890. DISSERTATION 9:9:0

Written work that describes the main research results obtained during the completion of the graduate program. The format must comply with the requirements of the College for thesis and dissertations.

Credit, three to nine hours.

PHYS-999. DOCTORAL SUSTAINING 0:0:0

Public oral defense of the thesis that includes presentation of the main research results obtained during the completion of the graduate program. It takes place after evaluation of the written dissertation by the members of the corresponding academic committee. Credit, none.

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