MASTER OF SCIENCE
PHYSICS

INTRODUCTION

The Department of Physics (College of Science) offers a Master of Science program in **Physics**. Both part-time and full-time students are admitted to this program. The program is designed to prepare individuals for a career in college or university teaching and research; a leadership role in secondary school science education; employment in technically oriented positions in government, business, or industrial laboratories, and to continue graduate education towards the Ph.D. degree. A wide range of potential areas for research are available for students to choose from. This includes: Atomic, Molecular, Solid State, Nuclear and Digital Electronics.

According to the University Council decision dated 4/2/2007, Thesis students admitted with effect from September 2007 are exempted from the comprehensive examination.

PROGRAM REQUIREMENTS

The program requirements are:

31 TOTAL COURSE CREDITS

13 COMPULSORY (credits in parenthesis)

0430-501	Classical Mechanics	(3)
0430-503	Classical Electrodynamics	(3)
0430-505	Quantum Mechanics I	(3)
0430-507	Mathematical & Computational Methods	(3)
0430-590	Seminar	(1)

9 ELECTIVES* (3 credits each)

0430-508	Special Topics I. Physics
0430-509	Special Topics II. Engineering Physics
0430-510	Atomic Spectra
0430-512	Laser Physics
0430-514	Theory of Atomic Collisions
0430-520	Molecular Spectroscopy I
0430-521	Molecular Spectroscopy II
0430-523	Photo physics
0430-525	Raman Spectroscopy
0430-530	Solid State Physics I
0430-531	Solid State Physics II
0430-533	Semiconductors
0430-535	Thermal Solar Processes
0430-540	Quantum Mechanics II
0430-542	Field Theory
0430-545	Particles and Symmetries
0430-550	Nuclear Physics I

0430-551 Nuclear Physics II
0430-560 Electronics
0430-562 Digital Design II
0430-563 Advanced Digital Signal Processing
0430-564 Quantum Computing
0430-570 Physics and Applications of GPS
0430-571 Synthetic Aperture Radar Interferometry
0430-572 Synthetic Aperture Radar Processing
0430-574 Solar Plasma and Cosmic Rays

*Students may substitute up to 6 credit hours from the upper elective Physics undergraduate courses (400 level) with the approval of the Program Committee.

9 COMPULSORY (Thesis)

0430-597 (0)
0430-598 (0)
2000-599 (9)

COURSE DESCRIPTION

0430-501: CLASSICAL MECHANICS
CR: 3

Mechanics in the Lagrangian formulation; two body central force problem; rigid body dynamics; Hamiltonian formulation; canonical transformations; covariant relativistic mechanics; small oscillations.

0430-503: CLASSICAL ELECTRODYNAMICS
CR: 3

Electrostatics; boundary value problems; multiple expansion; Maxwell's equations; electromagnetic waves; radioactive systems.

0430-505: QUANTUM MECHANICS I
CR: 3

Theory of states and operators in Hilbert space; the Schrodinger equation. Heisenberg and interaction representation; perturbation theory; approximation methods; spin and the identity of particles; scattering theory; application to actual quantum systems.

0430-507: MATHEMATICAL AND COMPUTATIONAL METHODS
CR: 3

Special functions; integral equations; integral transforms; Green's functions; computer programming techniques; programming languages; computer operating systems; computer-aided solutions of physical problems.

0430-510: ATOMIC SPECTRA
CR: 3 PR:0430-505 or equivalent

Methods of atomic structure calculations; many-electron configurations; coupling schemes in complex spectra; fine structure and multiple analysis; series perturbations and ionization limits; Zeeman and Stark effects; spectral line shape theory; plasma spectroscopy.

0430-512: LASER PHYSICS
CR: 3 PR:430-408/0430-505 or equivalent

Interaction of atomic systems with radiation field; semiclassical theory of laser; multimode operation; quantum theory of radiation and laser; coherent states; laser fluctuations, photon statistics and noise.

0430-514: THEORY OF ATOMIC COLLISIONS
CR: 3 PR:0430-505 or equivalent

Quantum statement of the problem; partial wave analysis; Ramsauer effect; variational principles for phase shift; electron hydrogen scattering problem; pauli principle and spin in collision processes; Stueckelberg theory; Coulomb scattering; excitation and ionization by electron and heavy ion impact.

0430-520: MOLECULAR SPECTROSCOPY I
CR: 3 PR: 0430-505 or equivalent
Annular momentum and symmetry in diatomic and polyatomic molecules; molecular orbital theory.

0430-521: MOLECULAR SPECTROSCOPY II
CR: 3 PR: 0430-520 or equivalent
Ligand field theory; group theory; applications.

0430-523: PHOTOPHYSICS
CR: 3 PR: 0430-520 or equivalent
Excited states of polyatomic molecules; absorption, fluorescence, and phosphorescence; excimers (liquids and crystals); molecular complexes and exciplexes; energy migration and transfer (liquids and crystals); quenching of excited states; delayed emission.

0430-525: RAMAN SPECTROSCOPY
CR: 3 PR: 0430-520 or equivalent
Introduction to the Raman effect; polarisability tensor and selection rules; symmetry effects; vibrational Raman effect; rotational and electronic Raman effect; applications.

0430-530: SOLID STATE PHYSICS I
CR: 3 PR: 0430-404 , 0430505
A review of band structure of solids, Fermi surfaces and metals; Optical processes, dielectrics and optical properties of solids, ferroelectrics; Magnetism and its applications, superconductivity.

0430-531: SOLID STATE PHYSICS II
CR: 3 PR: 0430-530, 0430-505
Interacting electron gas model of solids, Hartree-Fock Approximation, Inhomogeneous interacting electron gas, the Thomas Fermi theory leading to the density functional theory, one-electron band theory of solids, Band structure calculation methods, the tight-binding and multiple scattering approaches, Metallic magnetism-local magnetic moments, mean-eld theory of magnetic.

0430-533: SEMICONDUCTORS
CR: 3 PR: 0430-404 or equivalent
Physical principles of semiconductors and their application to various electronic and optical devices; band structure; intrinsic and extrinsic semiconductors and their statistical transport properties; optical properties; the junction diode and the transistor; tunnel diode; gunn diode; infrared detectors; solar cell; semiconductor lasers; etc.

0430-535: THERMAL SOLAR PROCESSES
CR: 3 PR: 0430-425 or equivalent
Solar insulation; absorption, transmission and reflection of radiation by surfaces; blackbody radiation and absorption; solar collectors, application of solar thermal energy to heating and cooling of buildings; solar thermal stations; advanced applications.

0430-540: QUANTUM MECHANICS II
CR: 3 PR: 0430-505 or equivalent
Theory of angular momentum, symmetry; coherence of states; the density matrix; the Dirac equation; quantization of the electromagnetic field; applications.

0430-542: FIELD THEORY
CR: 3 PR: 0430-501, 0430-503 & 0430-505 or equivalent
Klein-Gordon equation; dirac equation; second quantizaon of fields with spins 0,1/2 and 1, interaction between fields; scattering and the 5-matrix; Feynman diagrams; re normalization theory.

0430-545: PARTICLES AND SYMMETRIES
CR: 3 PR: 0430-542 or equivalent
Hadrons and leptons; conservation laws; resonance; Lie algebras; SU(2) and SU(3); Young diagrams and representations; multiples; mass formulas; cross sections; strong and weak interactions; gauge symmetries.

0430-550: NUCLEAR PHYSICS I
CR: 3 PR: 0430-402 or equivalent
Static properties of nuclei; nuclear forces; nuclear models; single particle and shell models; vibrational and collective models; liquid drop model; nuclear fission.

0430-551: NUCLEAR PHYSICS II
CR: 3 PR: 0430-550 or equivalent
Nuclear reactions; direct and compound nuclear reactions; deep inelastic collisions; alpha decay; beta decay; electromagnetic transitions.

0430-560: ELECTRONICS
CR: 3 PR: 0430-406 or equivalent

Solid state devices; integrated circuits; op.amps.; pulse amplifiers and discriminators; gater; A-D and D-A conversion circuits; scalers; memory units; system design.

0430-562: DIGITAL DESIGN II
CR: 3 PR: 0430-243, 0430-380

Theoretical and practical aspects of the modern methods of digital logic design, (VHDL VHSIC Hardware Description Language), and modern design methodologies (Design Entry, Synthesis, Implementation [place and route], and Simulation), Programmable Device Architectures, Developing structural, behavioral, and dataflow VHDL models for familiar logic and arithmetic circuits, and state machines targeting both FPGA and CPLD devices, Writing test benches for simulation. The differences between Behavioral, Functional, and Timing simulations. The difference in coding for synthesis and coding for simulation, Further development of VHDL Language skills in the context of an introduction to Computer Architecture and DSP.

0430-563: ADVANCED DIGITAL SIGNAL PROCESSING
CR: 3 PR: 0430-340, 0430-382 or 0430-482

Review of discrete transforms for LTI analysis, Digital filters, Multirate DSP, Design of Linear Filters for Prediction and Optimization, Adaptive filters, Power spectrum analysis, Wavelets, Digital speech processing, Digital image processing, Applications and examples.

0430-564: QUANTUM COMPUTING
CR: 3 PR: 0430-303, 0430-340 or 0430-482

Review of classical computing techniques, Quantum bits and quantum computations, Quantum states, Quantum algorithms, Quantum information theory' Quantum error detection and correction, Quantum hardware, Additional quantum theories, Applications and examples.

0430-570: PHYSICS AND APPLICATIONS OF GPS
CR: 3 PR: 0430-340

Precession position measurement, three dimensional transformation equations, atmospheric and relativist error sources, signal characterization and analysis, correlation studies, GAMIT software.

0430-571: SYNTHETIC APERTURE RADAR INTERFEROMETRY
CR: 3 PR: 0430-312

Concepts of interferometry, review of radar fundamentals, statistical techniques, image formation, Digital Elevation Models, GPS, land subsidence and deformation vectors.

0430-572: SYNTHETIC APERTURE RADAR INTERFEROMETRY
CR: 3 PR: 0430-312

Radar systems, SAR geometry, range compression, azimuth compression, pixel migration, focusing, band width and phase concepts.

0430-574: SOLAR PLASMA AND COSMIC RAYS
CR: 3 PR: 0430-312

Start with our nearest star and its atmosphere, solar plasma and interplanetary magnetic field, transport and acceleration of particles in space, galactic cosmic rays, solar flares and coronal mass ejections, space weather and geomantic activity, time series analysis.

0430-590: SEMINAR
CR: 1

0430-597: THESIS
CR: 0

0430-598: THESIS
CR: 0

2000-599: THESIS
CR: 9