M.S. - Physics

34-Hour Thesis/40-Hour Non Thesis Program

Two routes are available for the Master of Science in Physics. Plan 1 requires 34 semester hours of credit: 28 hours of course work plus a 6-hour thesis (PHYS 6398 and PHYS 6399). Plan 2 requires the favorable recommendation of the Physics Department Graduate Studies Committee and 40 hours of course work including the successful completion of a research problem (PHYS 6386) with a written report submitted to the department. For both plans at least a minimum GPA=3.0 must be achieved for the core courses, and a minimum GPA=3.0 must be achieved overall in the graduate program.

Thesis

A student who chooses to follow Plan 1 (thesis option) will be required to write a thesis, for which they will receive six hours of graduate credit. The student will select a thesis committee composed of a committee chairperson (normally the Thesis advisor) and two other members of the Physics and Astronomy graduate faculty, who will approve the thesis topic and assist in preparing the thesis. A written thesis prospectus must be formally approved by the thesis committee before the writing of the thesis begins. Thesis track students must pass an oral defense of the completed thesis. These students will register for PHYS 6398 and 6399 after they have completed their coursework.

Admission Requirements

Evidence of academic achievement and potential for advanced study and research is required for graduate admission. Specific criteria for Unconditional Admission for Master's degree seeking students in Physics are:

- Undergraduate GPA of 3.0
- GRE Verbal score of 650
- GRE Quantitative score of 650
- Applicants that do not meet the above criteria can be admitted conditionally by the graduate committee of the department. The graduate committee will determine a set of conditions that the student will need to satisfy by the end of the second semester in order to acquire regular standing in the program. These conditions will be determined upon careful examination of the circumstances that would justify conditional admission.

Applicants with an undergraduate GPA of at least 2.5 and/or GRE scores lower than those specified are also encouraged to apply.

Notification of decisions on graduate admission is made by the office of Graduate Studies based on the admission criteria and recommendation of the academic department. Information related to application procedures and deadlines is available through the Office of Graduate Studies.

Graduate Courses in Physics

PHYS 5421 Classical Mechanics (4)
This graduate course will introduce the student to Lagrange's equations, non-holonomic constraints, Hamilton's principle, two-body central force, rigid body dynamics, Lagrangian relativistic mechanics, Hamilton and Hamilton-Jacobi equations, and canonical transformations.

PHYS 5425 Mathematical Physics (4)
This graduate course will introduce the student to linear systems, special functions, complex variables, tensor problems in Physics, partial differential equations, boundary value problems, and special functions.

PHYS 5441 Electrodynamics (4)
This graduate course will introduce the student to boundary value problems, polarization and stress tensor, conservation laws and energy-momentum tensor, relativistic electrodynamics, covariant form of field equations, and potentials and gauge invariance.

PHYS 5461 Quantum Mechanics (4)
This graduate course will cover the Dirac formalism, wave functions in position and momentum space; quantum dynamics, time evolution and the Schrodinger equation, Heisenberg picture; simple harmonic oscillator and H-atom; angular momentum, rotations, spin 1/2 systems and finite rotations, eigenvalues and eigenstates; orbital angular momentum and addition of angular momenta.

ELECTIVES

Any of the following classes can be taken to fulfill the requirement for elective classes (six credit hours for the thesis option, eighteen credit hours for the non-thesis option).

PHYS 5194 Advanced Statistical Methods for Modern Astronomy Laboratory (1)
This graduate laboratory carries out the implementation in a Matlab environment of the data analysis topics that are being covered in the course. The laboratory has a well-designed curriculum to equip graduate students with the right skills for their subsequent research in astronomical data analysis.

PHYS 5195 Graduate Seminar (1)
This is a seminar course in which student presents research based on current literature. It may be repeated three times for credit.

PHYS 5296 Introduction to Research(2)
This is a two-credit course in which students practice elements

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of communication of research science. Prerequisite: Approval of Graduate Faculty Advisor.

PHYS 5310 Classical Mechanics I (3)
This graduate course will introduce students to Newtonian mechanics, Lagrangian and Hamiltonian dynamics, dynamics of rigid bodies, central force problem and orbital dynamics, symmetries and conservation laws, relativistic dynamics.

PHYS 5320 Electrodynamics I (3)
This graduate course will cover electrostatics and magnetostatics, boundary value problems, Maxwell's equations, plane waves, wave guides diffraction, multipole radiation.

PHYS 5330 Statistical Mechanics (3)
This graduate course will introduce students to thermodynamics, equilibrium statistical mechanics, Boltzmann equation and the collision operator, moments of the Boltzmann equations, the Navier-Stokes equations, introduction to nonequilibrium concepts, ensembles, classical and quantum gases, statistical physics of solids.

PHYS 5340 Quantum Mechanics I
This graduate course will cover linear vector spaces and linear operators, postulates, Hilbert space formulation, the Schrödinger equation and one-dimensional problems, the hydrogen atom, symmetries, rotational invariance and angular momentum, spin, system with N-degrees of freedom.

PHYS 5364 Statistical Mechanics(3)
This graduate course will introduce the student to entropy, Legendre transformations, phase transitions, critical phenomena; microcanical, canonical, and grand canonical ensembles, Ising model, random walks, quantum fluids, density matrix, transport properties, master equations, Langevin equation.

PHYS 5371 Solid State Physics (3)
This graduate course will introduce the student to electromagnetic, elastic, and particle waves in periodic lattices as applied to the electrical, magnetic, and thermal properties of solids. Prerequisite: PHYS 5361.

PHYS 6381 Introduction to Astrophysics
This graduate course will introduce students to a range of observational Astronomy: Stars, stellar evolution, neutron stars, black holes, galactic dynamics, galaxies, large-scale structure in the Universe & Cosmology. Prerequisite: PHYS 5341 and PHYS 5321.

PHYS 5392 Gravitational Wave Astronomy (3)
This course provides a basic and broad description of astrophysics related to sources of gravitational radiation, gravitational wave detectors, numerical relativity, and data analysis.

PHYS 5393 Introduction to General Relativity and Gravitation
Introduction to differential geometry. Einstein's field equations. Exact solutions. Schwarzschild and Kerr-Newman solutions. Introduction to Cosmology. Gravitational Waves.

PHYS 5394 Advanced Statistical Methods for Modern Astronomy
This course will introduce the student to: gravitational wave astronomy and the detectors, advaned statistical methods, computational methods, introduction to grid computing and the LSC grid. The course has a mandatory laboratory component which will train the students in advanced statistical data analysis and grid computing. Prerequisite: MATH 3447 Calculus III and PHYS 3490 Mathematics for scientists and engineers I, or consent of instructor.

PHYS 5391 Quantum Mechanics in Chemistry
This graduate course will introduce the student to the use of quantum mechanics in chemistry. Topics to be covered include the basic models of quantum theory, perturbation theory, ab initio and density functional methods, semi empirical methods, group theory, and computational applications. Prerequisite: PHYS 5361.

PHYS 5387 Special Topics in Physics (3)
This graduate course will introduce students to different topics. The topics will be announced. May be repeated for credit. Prerequisites: Instructor approval. Topics to be announced. May be repeated for credit. Prerequisites: Instructor approval. Examples of topics especially relevant to the Master in Physics program include numerical analysis, differential geometry, Lie groups, topology, etc.

PHYS 5475 Gravitational Wave Astronomy (4)
This is a graduate-level course which introduces the students to gravitational wave astronomy: astrophysics of gravitational wave sources, modeling of gravitational wave sources, analysis of gravitational wave data, and gravitational wave detector instrumentation.

Other courses required for the thesis option
The following courses (twelve credit hours) have to be taken in addition to the core courses listed above and the electives (six credits total) to complete the 30 credits hours required for the thesis option.

PHYS 6320 Electrodynamics II (3)
This course will introduce the student to relativistic formulation of Maxwell equations, radiation from moving charges, collisions of charged particles, radiation damping, introduction to plasmas, and magnetohydrodynamics. Prerequisite: PHYS 5320.

PHYS 6330 Quantum Mechanics II(3)
This course will introduce the student to variational and WKB methods, time-independent and time-dependent perturbation theory, scattering theory, path integration formulation, introduction to relativistic quantum mechanics and the Dirac equation. Prerequisite: PHYS 5340.

PHYS 6331 Solid State Physics (3)
This graduate course will introduce the student to Lattice vibrations and thermal properties of solids, band theory of solids, transport properties of metals and semiconductors, optical properties, magnetic properties, magnetic relaxation, superconductivity, elementary excitations, interactions phonon-

phonon, electron-electron, electron-phonon, theory of metals and semiconductors, transport theory, and optical properties. Prerequisite: PHYS 5340.

PHYS 6350 Mathematical Physics I (3)
This graduate course will include linear algebra, ordinary and partial differential equations, special functions, eigenvalue problems, complex analysis, group therapy.

PHYS 6351 Mathematical Physics II (3)
This course will introduce the student to advanced topics in mathematical physics, topology, functional analysis, differentiable manifolds, Lie groups and algebras, and cohomology theory. Prerequisite: PHYS 6350.

PHYS 6352 Computational Physics (3)
The course will cover introduction to numerical techniques for solving physics problems, theory of computation and applications to various branches oh physics, sample problems might include chaotic motion and nonlinear dynamics, particle trajectories, Monte Carlo simulations, dynamical and statistical

PHYS 6381 Introduction to Astrophysics (3)
this graduate course will introduce students to a range of basic topics in astrophysics: stars, stellar evolution, neutron stars, black holes, galactic dynamics, galaxies, large scale structure in the Universe and cosmology.

PHYS

PHYS 6396 Graduate Research in Physics (3)
This graduate course is a research in physics course in preparation for thesis work (Research I). Prerequisite: Graduate Advisor approval.

PHYS 6398 Thesis I (3)
This graduate course initiates students in their thesis work. Prerequisites: Graduate Advisor approval.

Other course required for the non-thesis option

PHYS 6386 Research Problems in Physics (3)
This graduate course is required for the 36-hour non-thesis option. To pass the course students have to present a typewritten report. May be repeated for credit; maximum credit allowed six hours. May not be counted as thesis research but may be taken one time as a preparatory investigation course prior to the beginning of thesis research. Prerequisites: Submission of the Petition of Candidacy and department approval.

Careers after completing the MS. in Physics

Students having a M.S in physics go into research, design and development in all areas of fundamental and applied physics, engineering, computing, medical physics, biophysics, astrophysics, and physics education.
Some of these students enter as research scientists, project managers, analysts, consultants, or as junior research staff in labs (e.g., technicians). Others have the capability to enter other fields such as telecommunication, medicine, marketing, patent work and production management.