Physics (M.S.)

About The Program:

The objective of the M.S. degree program in Physics is to provide advanced training in Physics sufficiently broad to permit the graduate to pursue a range of technical careers. Students choose to pursue the Coursework Track or Thesis Track to complete the M.S. degree.

Career Options: The program is dedicated to producing well-trained scientists prepared for careers as high school science teachers, technical writers, or members of a technical support staff.

Prerequisites for Admission: Applicants should have successfully completed coursework typically required for a bachelor's degree in Physics, and a baccalaureate degree in Physics is typically required. A certified transcript is required from each institution previously attended by the applicant.

Non-Matriculated Student Policy: Non-matriculated students are restricted to taking the following courses:

- Analytical Mechanics I
- Electromagnetic Theory
- Mathematical Physics I

Requirements of Programs:

- **Total Credit Hours**: 30
- **Culminating Events**:

  Comprehensive Examination:

  The M.S. comprehensive examination is required for students in the Coursework Track, but not for students in the Thesis Track. The exam, which tests the student's mastery of undergraduate and beginning graduate physics, consists of a three-part written exam and an oral exam. General subject areas covered by the examination include classical electromagnetic theory, classical mechanics, mathematical physics, modern physics, quantum mechanics, statistical mechanics, and thermodynamics.

  M.S. students in the Coursework Track are required to take the comprehensive examination in the summer at the end of their first year of full-time graduate study. They are tested on the subject matter in six core courses: PHYS 5101, PHYS 5301, PHYS 5501, PHYS 5701, PHYS 5702, and PHYS 8102. In the event of failure, the exam may be retaken once. If the student fails a second time, s/he is dropped from the graduate program.

  Thesis:

  A master's thesis is required for students in the Thesis Track, but not for students in the Coursework Track. The thesis is based on the student's research and approved in accordance with the policies of the Department of Physics and the Graduate School.

Core Courses

Analytical Mechanics I – Variational principles, Lagrange's and Hamilton's equations; canonical transformations; small oscillations; dynamics of particles, rigid bodies, strings and membranes; hydrodynamics; chaos in deterministic systems.

Electromagnetic Theory – Boundary value problems of the electrostatic and magnetostatic fields; Maxwell's equations; plane waves at boundaries in dielectric and conducting media; potentials in the Lorentz gauge; Green's functions for wave and Helmholtz equations; multipole radiation; material dispersion; diffraction.

Electromagnetic Theory – Maxwell stress tensor; relativistic dynamics; Lagrangian formulation of electrodynamics; Noether's theorem; laser resonant cavities and optics of Gaussian beams; Eikonal and geometrical optics limit; synchrotron radiation.

Mathematical Physics I – Tensor analysis; group theory; complex variable theory; partial differential equations; Sturm-Liouville systems; integral transforms; integral equations and Green's function methods.

Mathematical Physics II – Preliminaries; numerical applicability, survey of algorithms, computer modeling, programming considerations; basic numerical methods; numerical linear algebra; numerical solution to ordinary and partial differential equations; molecular dynamics; Monte Carlo simulations; nonlinear methods.

Quantum Mechanics I – Fundamental principles of quantum mechanics; relation to classical mechanics; Schroedinger and operator formulations; path integrals; Aharonov-Bohm effect; examples of exact solutions; central forces and angular momentum; scattering theory; Bell's theorem.

Quantum Mechanics II – Matrix mechanics; theory of electron spin; Hilbert space formulation of quantum mechanics; transformation theory; theory of rotations; spin and statistics; stationary approximation methods with application to atomic systems; time-dependent perturbation theory; exponential decay.

Statistical Mechanics – Review of thermodynamics; kinetic theory; statistical definition of entropy; microcanonical, canonical, and grand canonical ensembles; applications to gases, diatomic molecules, magnetic systems, phase transitions; quantum statistics; ideal boson and fermion systems; Bose-Einstein condensation; black body radiation; models of solids; properties of liquid helium.

Additional Coursework (6 credits)

Courses:

Click HERE for more information on the courses below.

- Introduction to Quantum Computing
- Physics Research and Ethics
- Analytical Mechanics
- Electromagnetic Theory
- Mathematical Physics
- Mathematical Physics II
- Quantum Mechanics I
- Quantum Mechanics II
- Practicum Teaching of Physics
- Problems in Experimental Physics

- Topical Seminar II
- Topical Seminar III
- Physics Seminar
- Statistical Mechanics
- Advanced Quantum Mechanics
- Solid State Physics
- Introduction to Elementary Particles Physics
- Many Electron Theory
- Advanced Topics in Nuclear and Particle Physics
- Teach in Higher Ed: Phys
- Master's Research Projects
- Preliminary Examination Preparation
- Capstone Project
- Master's Thesis Research