PHYSICS MS

PHYSICS EDUCATION MS

(DISCIPLINE-BASED)

College of Science, Engineering, & Technology
Department of Physics & Astronomy
141 Trafton Science Center N • 507-389-5743

The Department of Physics and Astronomy presents several opportunities for study at the graduate level. The Master of Science is offered as the professional degree in physics. This degree is designed for students wishing to prepare themselves for doctoral study, or for work in a research/industrial position. Students interested in teaching at a community college may elect the MS Community College track. Teacher certification is not required for this track.

The Master of Science in Physics Education is designed for individuals interested in strengthening their background in secondary school teaching. Previous teacher licensure is usually required.

Admission. In addition to meeting the general admission requirements of the College of Graduate Studies and Research, applicants must have an undergraduate degree in physics or a related field. Applicants must also provide the following:

1. A one-page personal statement of career interests and goals.
2. Two letters of recommendation from professors in colleges where the applicant did undergraduate study.
3. For international students, a minimum TOEFL score of 530 is required.

Financial Assistance. The Department of Physics and Astronomy has a limited number of graduate teaching assistantship available. Preference is given to those with a good command of spoken English. For students whose native language is not English, a minimum of TOEFL score of 550 is required. Application materials can be obtained on the web page of the Office of Graduate Studies and Research.

Consult the front of this bulletin for more information on financial aid.

PHYSICS MS
(Thesis Plan-30 credits)
(Alternate Plan Paper -34 credits)

Required Core (13-16 credits)
PHYS 607 Introduction to Research (2)
PHYS 692 Seminar (1-2) must be taken the first 2 spring semesters for a minimum of 2 credits

and at least three of the four following courses:
PHYS 640 Math. Methods for Physicists (3)
PHYS 650 Classical Mechanics (3)
PHYS 660 Quantum Mechanics (3)
PHYS 670 Electricity & Magnetism (3)

Required General Electives (11-20 credits)
Choose any CSET 500/600 level courses approved by the student's advisor.

Required Thesis or Alternate Plan Paper
Phys 694 Alternate Plan Paper (1-2)
Phys 699 Thesis (3-6)
Student must be registered for a minimum of one credit of thesis or APP for every semester that they are working on their paper.

Additional Requirements

- A new graduate students is required to take a physics placement test prior to the start of his or her first semester of study.
- A graduate student should complete a Plan of Study during the first part of the second semester. This will require close consultation between the student and the initial advisor.
- At least half of the credits applied to the degree must be earned in 600-level courses excluding thesis or alternate plan paper credits.
- A reading knowledge of a foreign language or a demonstrated ability in computer programming is required.
- All student must pass a written comprehensive examination. The comprehensive exam must be taken by the end of the second semester. A student cannot start his or her thesis research before passing the comprehensive written exam.
- An oral defense of thesis is required for thesis plan.

COMMUNITY COLLEGE TRACK
(Thesis Plan - 30 credits)
(Alternate Plan Paper - 34 credits)

Required Physics Electives Core (9-17 credits)
PHYS 697 Internship (4-8)

In addition, choose any 500/600 level Physics elective courses approved by the student's advisor. Students who would like to have "internship" listed as "Internship in College Teaching" should contact the Graduate Dean.

Required Education Electives (minimum 6 credits)
KSP 625 Philosophy of Education in Historical Context (3)
KSP 670 Collegiate Institutions in the United States (3)
KSP 671 Learning and Teaching in Higher Education (3)
Required General Electives (6 credits)
Choose any 500/600 level elective courses from outside of physics and outside of professional education, approved by the student's advisor.

Required Research Methods (3 credits)
Choose a research methods course approved by the student's advisor.

Required Thesis or Alternate Plan Paper
PHYS 694 Alternate Plan Paper (1-2)
PHYS 699 Thesis (1-6) minimum 3 credits
Additional Requirements
A reading knowledge of a foreign language or a demonstrated ability in computer programming is required. Fifty percent of all courses must be taken at the 600 level excluding the thesis or APP credits. A written exam is required. A thesis and its oral defense are required if the thesis option is chosen.

PHYSICS EDUCATION MS
(DISCIPLINE-BASED)
(Thesis Plan - 30 credits)
(Alternate Plan Paper - 34 credits)

Teaching licensure is usually a prerequisite to pursuing this degree, since this degree does not lead to initial teaching licensure. Students who desire initial licensure should consult the Master of Arts in Teaching (MAT) program.

Required Physics Electives (9-17 credits)
Choose any 500/600 level elective courses approved by the student's advisor.

Required Education Electives (6 credits)
Choose any 500/600 level Education elective courses approved by the student's advisor from the following:
KSP 507, 605, 609, 612, 621, 625, 632, 640, 645, 654, 665, 666, 677, 681
EEC 520, 522, 602, 617, 631, 676
CSP 570
EDAD 652, 665

Required General Electives (6 credits)
Choose any 500/600 level elective courses approved by the student's advisor.

Required Research Methods (3 credits)
Choose a research methods course approved by the student's advisor.

Required Thesis or Alternate Plan Paper
PHYS 694 Alternate Plan Paper (1-2)
PHYS 699 Thesis (1-6) minimum 3 credits

Additional Requirements
Fifty percent of all courses must be taken at the 600 level excluding the thesis or APP credits. A written exam is required. A thesis and its oral defense is required, if the thesis option is chosen.

COURSE DESCRIPTIONS

PHYSICS

PHYS 504 (2) Physics & Society
Relations between physics and other intellectual communities: e.g., philosophy, humanities, social sciences, the arts.
V Prerequisite: consent

PHYS 517 (2) Biophysics
Thermodynamic relationships; energy flow in living systems; metabolic heat generation and loss; homeostasis; atomic and molecular bonds in nucleic acids, proteins, and carbohydrates; hormonal regulation; cell metabolism; negative feedback control in living systems; cancer therapy; imaging; disease states; new theories and paradigms.
V Prerequisite: PHYS 212 or 222 and MATH 122

PHYS 541 (4) Mechanics
Rectilinear motion of a particle, general motion of a particle in three dimensions. Newtonian mechanics including harmonic oscillations, forced oscillations, central forces and orbital motion, collisions, noninertial reference systems, dynamics of a system of particles, rigid body motion, Lagrangian and Hamiltonian mechanics, normal coordinates.
F Prerequisite: PHYS 212 or 222 and MATH 223 and 321

PHYS 547 (3) Electricity & Magnetism I
Electrostatic fields, magnetostatic fields, steady currents, electromagnetic induction. Review of vector algebra.
F Prerequisite: PHYS 212 or 222 and MATH 223, 321, or 422

PHYS 548 (3) Electricity & Magnetism II
Electromagnetic waves, propagation and radiation of waves, electrodynamics and relativity.
S Prerequisite: PHYS 447 or 547

PHYS 553 (3) Solid State Physics
Atoms in crystals, wave in crystals, thermal vibrations of the crystal lattice, free electron model, band theory of solids, semiconductors and PN junctions, magnetism, and superconductivity.
S (of odd calendar years) Prerequisite: PHYS 435 or 535

PHYS 557 (3) Optics
Geometric optics, wave optics, properties of light and matter, optics of transformations, and quantum optics. Lecture and laboratory.
S (of odd calendar years) Prerequisite: PHYS 222 and MATH 122

PHYS 561 (4) Quantum Mechanics
A systematic development of foundations of quantum mechanics. Observables, operators, state functions, expectation values. Matrix formulation of eigenvalue problems. The hydrogen atom, electron spin, angular momentum, and perturbation theory.
F Prerequisite: PHYS 435/535, 441/541, and MATH 321

PHYS 565 (3) Computer Applications in Physics
Numerical solutions of physics problems and computer simulations of physical systems. Lecture and laboratory.
F Prerequisite: PHYS 212 or 222, and MATH 122, and familiarity with some programming language, or consent

PHYS 573 (3) Statistical Physics
Statistical mechanics, kinetic theory, thermodynamics.
S (of even calendar years) Prerequisite: PHYS 212 or 222 and MATH 223 and 321

PHYS 575 (2) Advanced Laboratory
Experiments in modern physics, including solid-state physics and optics. Requires more independent work than introductory laboratories.
S Prerequisite: PHYS 436 or 536 or consent

PHYS 580 (2) Laboratory Experiences in Physical Science
For prospective teachers in elementary schools. Topics include weather, weather forecasting and record keeping, simple machines, electricity, chemistry, sound, light, and others. May not count as a physics elective. Not available for P/N grading.
F, S, SS Prerequisite: PHYS 101

PHYS 582 (4) Teaching Methods and Materials in Physical Science
Current methods of teaching all physical sciences with emphasis on physics and chemistry. For students planning to teach at a middle school, secondary school, college, or university. May not count as a physics elective.
S Prerequisite: one year of chemistry and one year of physics or consent

PHYS 584 (2) Middle/Junior High Science Teaching
Current methods of teaching all sciences with emphasis on physical science, physics, chemistry, and earth science.
V Prerequisite: majority of required courses completed or consent

PHYS 590 (2-4) Workshop
A short course devoted to a specific topic in physics. May be repeated for credit on each new topic.
V

PHYS 591 (1-8) In-Service
A course designed to upgrade the qualifications of a person on-the-job.
V

PHYS 595 (1-3) Selected Topics
A course in an area of physics not regularly offered. Topic and credit assigned by department each time offered.
V

PHYS 607 (2) Intro to Research
Use of the library, electronic and machine shop practices, vacuum and cryogenic techniques, research interests of faculty.
F

PHYS 640 (3) Mathematical Methods for Physicists
Mathematical methods necessary for advanced study in physics. Topic include functions of complex variables, calculus or residues, integral transforms and special functions.

PHYS 650 (3) Classical Mechanics
Variational calculus, Lagrangian mechanics, the motions of particles and rigid bodies, the dynamics of oscillating systems and Hamilton-Jacobi theory.
Prerequisite: PHYS 441 or equivalent

PHYS 660 (3) Quantum Mechanics
Bound state and scattering problems in one, two, and three dimensions. Approximation methods for stationary states. Time-independent and time-dependent perturbation theory. General formalism of quantum theory.
Prerequisite: PHYS 461 or equivalent.

PHYS 670 (3) Electricity and Magnetism
Electrostatics, magnetostatics, boundary-value problems, Green functions, time-varying fields, Maxwell equations, conservation laws.
Prerequisite: PHYS 448 or equiv.

PHYS 675 (1-4) Selected Topics
A course in an area of physics not regularly offered. Topic and credit assigned by department each time offered.
V

PHYS 677 (1-4) Individual Study
Special arrangements must be made with an appropriate faculty member or the department office. May be repeated for credit on each new topic.
V

PHYS 680 (1) Curriculum Study in Physics
Presentation and discussion of curricular developments.
V

PHYS 681 (2) Demonstration in Physics
Materials, techniques, and procedures.
V

PHYS 691 (1-4) In-Service
A course designed to upgrade the qualifications of persons on-the-job.
V

PHYS 692 (1-2) Seminar
May be repeated for credit on each new topic.
V

PHYS 694 (1-2) Alternate Plan Paper
V

PHYS 695 (1-6) Research
V

PHYS 696 (1-2) Independent Reading
Special arrangements must be made with an appropriate faculty member or the department office. May be repeated for credit on each new topic.
V

PHYS 698 (1-8) Internship
Provides student the opportunity to gain expertise and experience in a special field under the supervision of a qualified person.
V

PHYS 699 (1-6) Thesis
V

ASTRONOMY

AST 520 (3) Stellar Astrophysics
Blackbody radiation; radiative transfer; atomic structure; spectroscopic notation; excitation; ionization; absorption and emission coefficients; line profiles; analysis of stellar spectra.
ALT-F Prerequisite: AST 225 and PHYS 222

AST 521 (3) Stellar Structure
The gaseous state; degenerate matter; equations of stellar structure; polytropes; models of stellar interiors and atmospheres; stellar evolution; nucleosynthesis; stellar endpoints.
ALT-S Prequisite: AST 520

AST 530 (3) Galactic Structure
Structure, kinematics, and dynamics of our galaxy.
ALT-F Prerequisite AST 225, PHYS 222, and MATH 223

AST 531 (3) Extragalactic Astronomy
Normal galaxies; groups and clusters of galaxies; galaxy interactions and mergers; active galactic nuclei; large-scale structure; galaxy formation and evolution; cosmology.
ALT-S Prerequisite: AST 530

AST 591 (1-6) In-Service
A course designed to upgrade the qualifications of persons on-the-job.
V

AST 594 (1-6) Workshop
A short course devoted to a specific astronomical topic. May be repeated for credit on each new topic.
V Prerequisite: consent

AST 595 (1-4) Selected Topics

AST 677 (1-6) Individual Study
Special arrangements must be made with an appropriate faculty member or the departmental office. May be repeated for credit on each new topic.
V Prerequisite: consent

AST 691 (1-6) In-Service
A course designed to upgrade the qualifications of persons on-the-job.
V Prerequisite: consent

AST 694 (1-2) Alternate Plan Paper
V Prerequisite: consent

AST 695 (1-6) Research
Students will conduct supervised research in astronomy.
V Prerequisite: consent