Degree plan for M.S. in Physics

Two options are available for the degree plan leading to the Master of Science in Physics, and the candidate must declare one of the options at the time of admission. Both options require 30 semester credit hours for successful completion.

- Thesis Option
- Non-Thesis Option with Comprehensive Exam

Both plans are laid out below.

Thesis Option

The Master of Science program thesis option requires the successful completion of a minimum of 30 semester credit hours of Physics courses.

Required courses (18 sch)
PHYS 5310, PHYS 5320, PHYS 5330 and PHYS 5340;
PHYS 7300 and 7301 - Thesis I and II
Students must enroll in the Thesis course when recommended to do so by their adviser. They must take this course until final approval has been granted by the adviser. However, no more than six hours of this course will count toward the M.S. degree. All candidates must comply with Office of Graduate Studies guidelines regarding thesis application, submission and defense.

Elective courses (12 sch)
Twelve semester credit hours of Physics courses are required to complete the 30 credit hours. These courses will form part of the students "Program of Study", with courses chosen to be appropriate for the background and research interests of each student.

Non-Thesis Option

This option requires the successful completion of a minimum of 30 semester credit hours of Physics courses.

Comprehensive Exam: Non-thesis students must take a comprehensive written or oral examination covering the student ' s understanding of graduate level Physics concepts. The comprehensive exam will be administered by a departmental committee and the student shall choose between a written or oral examination in consultation with this committee. The semester in which the comprehensive exam is to be taken will appear on the program of study of non-thesis students. It will not be scheduled prior to the student's final semester of coursework.

Required courses (12 sch)
PHYS 5310, PHYS 5320, PHYS 5330 and PHYS 5340;
Students must enroll in the Thesis course when recommended to do so by their adviser. They must take this course until final approval has been granted by the adviser. However, no more than six hours of this course will count toward the M.S. degree. All candidates must comply with Office of Graduate Studies guidelines regarding thesis application, submission and defense.

Elective courses (18 sch)
Eighteen semester credit hours of Physics courses are required to complete the 30 credit hours. These courses will form part of the students "Program of Study", with courses chosen to be appropriate for the background and research interests of each student.

Graduate Courses in Physics

Students wishing to enroll in the UTRGV-UT Arlington (UTA) Cooperative PhD (Physics) Program may be required to take: PHYS 5310, PHYS 5320, PHYS 5330, PHYS 5340, PHYS 6350 and PHYS 6330 as these are required courses in the UTA PhD degree program.

PHYS 5310 Classical Mechanics I
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
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
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 5360 Optics (elective)
This course is an introduction to the field of optics and its modern applications. The course will start with Huygens principle, the wave equation, and the superposition principle. Fraunhofer and Fresnel diffraction, coherence theory, interferometry, and Gaussian optics are among the topics that will also be covered. Co-requisite: PHYS 5320 or consent of instructor.

PHYS 5361 Applied Electromagnetics (elective)
This is an advanced graduate course in electromagnetic field theory and electrodynamics, with particular emphasis on EM wave interaction with materials, scattering and guided waves. The course will cover in great details the physics underlying electromagnetic wave propagation and the engineering of devices such as antennas, arrays, and periodic passive structures that take advantage of these concepts. Prerequisites: PHYS 5320 and PHYS 5360.

PHYS 5375 Structure and Function of Biological Molecules (elective)
This course will provide in-depth assessment of structure of biological molecules, with emphasis on structure-function relationship. Physical principles underlying formation of secondary and tertiary structure of proteins, structural dynamics of DNA, and DNA-protein interactions will be reviewed. Prerequisites: Consent of the instructor. Mastery of differential equations and mathematical methods at

an undergraduate level is expected.

PHYS 5387 Special Topics in Physics (elective)
This graduate course will introduce students to different topics. The topics will be announced. May be repeated for credit. Prerequisites: Instructor approval.

PHYS 5392 Gravitational Wave Astronomy (elective)
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 (elective)
This graduate course introduces Einstein's theory of relativity and other topics in the field of gravitation. Topics covered are the Principle of Equivalence, Introduction to Differential geometry and tensor analysis. Also studied are physics on curved manifolds, Einstein's equations of General Relativity, exact solutions of Einstein's equations, the Schwarzschild and Kerr solutions, Black Hole Physics and Cosmology, Gravitational radiation and its detection. Prerequisites: PHYS 3310, PHYS 3390, PHYS 3400, PHYS 4330.

PHYS 5394 Advanced Statistical Methods for Modern Astronomy (elective)
This course will introduce the student to: gravitational wave astronomy and the detectors, advanced 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. Prerequisites: MATH 3447 Calculus III and PHYS 3490 Mathematics for scientists and engineers I, or consent of instructor.

PHYS 6320 Electrodynamics II (elective)
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 (elective)
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 (elective)
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 (elective)
This graduate course will include linear algebra, ordinary and partial differential equations, special functions, eigenvalue problems, complex analysis, group theory.

PHYS 6351 Mathematical Physics II (elective)
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 (elective)

The course will cover introduction to numerical techniques for solving physics problems, theory of computation and applications to various branches of physics, sample problems might include chaotic motion and nonlinear dynamics, particle trajectories, Monte Carlo simulations, dynamical and statistical descriptions of many body problems, hyperbolic, parabolic, and elliptic differential equations.

PHYS 6362 Quantum Optics (elective)
This course introduces the student to non-linear optics and the new field of observing quantum effects in small groups of atoms, starting from a few and down to one. Topics include fiel quantization; emission and absorption of radiation by atoms; nonlinear optics and parametric conversion; non-classical light; optical tests of quantum mechanics; and experiments with trapped atoms. Prerequisites: PHYS 5360 and PHYS 5340 or consent of instructor.

PHYS 6363 Electromagnetic Matematerials (elective)
This course covers the electromagnetic characterization of matematerials that is engineered materials with characteristics which may not be found in nature, with particular emphasis on technological applications. The course provides a deep insight into the fundamental physics needed to fully grasp the technology of antennas, arrays, and frequency selective surfaces using non-conventional materials. Prerequisite: PHYS 5361 or consent of instructor

PHYS 6364 Nanophotonics: materials and devices (elective)
This course will cover general concepts of nanophotonics which is a new field of physics focused on studies of interaction of light with matter on the nanometer scale. Topics covered will include near-field optics, photonic crystals, negative index materials, nanocavities, integrated photonic circuits, and their fabrication techniques. Prerequisites: PHYS 5320 and PHYS 5360 or consent of instructor.

PHYS 6371 Thermodynamics and Kinetics of Biological Systems (elective)
This course provides students with fundamentals of statistical thermodynamics, electrostatics and electrochemistry, enzyme kinetics, and molecular driving forces. Prerequisites: Consent of the instructor.

PHYS 6373 Statistical Physics of Molecular Cell Biology (elective)
This course introduces students to the basic physical laws governing the life of cells and its material and explains the latest research regarding physical aspects of molecular cell biology, and discusses physical methods used in today's laboratories. Prerequisites: Consent of instructor.

PHYS 6381 Introduction to Astrophysics (elective)
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. Prerequisites: PHYS 5320 and PHYS 5310.

PHYS 6386 Research Problems in Physics (elective)
This graduate course is required for the 30-hour non-thesis option. To pass the course students have to present a typewritten report. May be repeated for credit; maximum credit allowed is 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.

PHYS 6396 Graduate Research in Physics (thesis option only, elective)
This graduate course is a research in physics course in preparation for thesis work (Research I). Prerequisite: graduate advisor approval.

PHYS 7300 Thesis I (Thesis Option only)
This graduate course initiates students in their thesis work. Prerequisites:

graduate advisor approval.

PHYS 7301 Thesis II (Thesis Option only)
This graduate course initiates students in their thesis work. Prerequisites: Thesis I.