
Master of Science in Engineering Physics
Graduate Minor in Physics
Department of Physics and Astronomy
College of Arts and Sciences

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The Department of Physics and Astronomy offers the following graduate programs

Master of Science degree in **Engineering Physics (113*/40.0801)** with two concentrations:
Systems and Laboratory Automation (113B)
Professional Science Master's in Instrumentation and Automation (113C)
Minor in Physics (272/40.0801)

The MS program is designed to prepare individuals for technical careers in industrial, governmental, and independent laboratories as well as for teaching positions at the community college level. It may also serve as an intermediate step for those who later elect to pursue more advanced study in applied physics, engineering physics, engineering, or a related area.

Graduate students will choose a research area of Applied Physics, Electronics Instrumentation or Astronomical Instrumentation and Observations.

The concentration in Systems and Laboratory Automation is a more traditional MS program that contains thesis and non-thesis options. The other concentration, the Professional Science Master's in Instrumentation and Automation, is a professional science master's program as described by the A. P. Sloan Foundation. In addition to 25-26 semester hours of required physics courses, the PSM concentration includes a required core of business and communications courses (12 semester hours). The PSM concentration does not have a thesis option, but requires a three semester hour internship.

Courses in the following disciplines are offered through the Department of Physics and Astronomy:

PHY: physics courses

PROGRAM OF STUDY FOR THE MINOR IN PHYSICS (272/40.0801)

A graduate minor in Physics consists of 8-12 semester hours selected from PHY offerings numbered 5000 and above, except PHY 5989.

PROGRAM OF STUDY FOR THE MASTER OF SCIENCE IN ENGINEERING PHYSICS WITH A CONCENTRATION IN SYSTEMS AND LABORATORY AUTOMATION (Major Code: 113*/40.0801; Concentration Code: 113B)

Admission Requirements: Baccalaureate degree in physics, astronomy or any science or related area such as mathematics, computer science or engineering from an accredited college or university; complete application to the Cratis Williams Graduate School (<http://www.graduate.appstate.edu>), including resume, three letters of recommendation, official GRE general exam scores, and official transcripts from all colleges attended.

Basic Criteria for Consideration: (Undergraduate GPA X 400) + GRE Verbal + GRE Quantitative = 2000

Hours: 30 semester hours with thesis, 36 without thesis **Location:** On Campus

Required Courses:

PHY	5002	Applied Physics Literature.....	1
PHY	5010	Applied Physics Colloquium.....	1
PHY	5430	Digital Systems	4
PHY	5435	Laboratory Automation.....	4
PHY	5510	Physics of Transducers	4
PHY	5550	Directed Research in Applied Physics	1-3
REQUIRED HOURS.....			15-17

Thesis Options (CHOOSE ONE):

THESIS

PHY	5999	Thesis.....	6
Physics Electives (5000 level or above)			3
Other Electives (5000 level or above)			4-6
THESIS OPTION HOURS			13-15

NON-THESIS

Physics Electives (5000 level or above)			12
Other Electives (5000 level or above)			7-10
NON-THESIS OPTION HOURS			19-21

**TOTAL HOURS FOR THE MS DEGREE 30 (with thesis)
or 36(without thesis)**

Thesis: Optional

Proficiency: None required

Comprehensive: A written comprehensive examination is required for the non-thesis option. An oral defense of the thesis is required for the thesis option (satisfies the comprehensive requirement).

Product of Learning: None required

PROGRAM OF STUDY FOR THE MASTER OF SCIENCE IN ENGINEERING PHYSICS WITH A CONCENTRATION IN INSTRUMENTATION AND AUTOMATION (Major Code: 113* /40.0801; Concentration Code: 113C)

Admission Requirements: Baccalaureate degree in physics, astronomy or any science or related area such as mathematics, computer science or engineering from an accredited college or university; complete application to the Cratis Williams Graduate School (<http://www.graduate.appstate.edu>), including resume, three letters of recommendation, official GRE general exam scores, and official transcripts from all colleges attended.

Basic Criteria for Consideration: (Undergraduate GPA X 400) + GRE Verbal + GRE Quantitative = 2000

Hours: 37-38 semester hours

Location: On Campus

Required Courses:

PHY	5002	Applied Physics Literature.....	1
PHY	5010	Applied Physics Colloquium	1
PHY	5020	Computational Methods in Physics and Engineering	3
PHY	5330	Digital Electronics	3
PHY	5510	Physics of Transducers	4
PHY	5635	Advanced Microprocessor Interfacing and Robotics	4
PHY	5735	Microcontrollers	3
PHY	5900	Internship	3
Choose one of the following courses			3-4
	PHY 5435	Laboratory Automation (3 s.h.)	
	PHY 5520	Data Transmission and Signal Processing (4 s.h.)	
REQUIRED HOURS.			25 or 26

Professional Core:

Three courses from the College of Business chosen in consultation with the PSM advisor	9
One course from the Department of English on Professional Writing.....	3
THESIS OPTION HOURS	12

TOTAL HOURS FOR THE MS DEGREE WITH PSM CONCENTRATION 37 or 38

Thesis: Optional

Proficiency: None required

Comprehensive: The internship project report satisfies the comprehensive requirement for students in the PSM concentration.

Product of Learning: None required

GRADUATE COURSES IN PHYSICS (PHY)

PHY 5002. Applied Physics Literature/(1).F. An introduction to technical and research journals in the areas of physics, electronics and astronomy. Methods and references for use in literature searches, including computer methods, and the preparation of technical papers will be examined. To be taken fall term of first year.

PHY 5010. Applied Physics Colloquium/(1).F;S. Presentation of one research topic is required of all graduate students. Credit is earned during the semester in which the presentation is made. All graduate students are expected to attend all departmental and other designated colloquia.

PHY 5020. Computational Methods in Physics and Engineering/(3).F. A course designed to introduce the student to modern techniques and algorithms in computational physics, involving solutions of real physical systems using techniques from interpolation, optimization, non-linear least squares, the numerical integration of ordinary and partial differential equations, Monte Carlo methods, Fourier analysis and stability analysis. Applications of these techniques will be selected from the areas of mechanics, optics, modern physics, astrophysics, engineering, signal processing, and electromagnetism. Graduate

students will, in addition to the lab, carry out a major computational project which will address an important or relevant problem in physics, astrophysics or engineering. Programming will be carried out in a computer language such as 'C' or Fortran. Lecture two hours, laboratory two hours. [Dual-listed with PHY 4020.]

PHY 5330. Digital Electronics/(3).F. This course provides an introduction to digital electronics, with an emphasis on the study of components that are building blocks for digital devices and equipment, especially microcomputers. Emphasis will be placed on the design of combinatorial, sequential, and state machine (ASM) circuits, including simplification by Boolean algebra, Karnaugh maps, and computer-aided tools. Hardware description languages will be used to implement designs on programmable logic devices (PLD). Topics to be covered include: number systems, Boolean algebra, logic families, gates, flip-flops, medium scale integration devices, combinatorial and sequential circuits, ASM, PLD, arithmetic logic units, memory, input-output, D/A, A/D, and a generic CPU. The industry-oriented, hands-on labs involve circuit construction, testing and trouble-shooting using modern test equipment. Lecture two hours, laboratory three hours. [Dual-listed with PHY 4330.]

PHY 5430. Digital Systems/(4).F. Design and implementation of digital systems. This applications-oriented course covers designing digital systems and using hardware description languages such as VHDL to implement them with complex programmable logic devices (CPLD) or field programmable gate arrays (FPGA). Topics covered include CPLD and FPGA architectures, real-world digital design difficulties (timing, noise, etc.), the design and implementation of combinatorial, sequential, and SSI / MSI / LSI circuits, algorithmic state machines, and simple CPUs. Lecture three hours, laboratory three hours. Prerequisite: PHY 4330 or PHY 5330 or the equivalent.

PHY 5435. Laboratory Automation/(4).S. A rigorous applications-oriented course designed to foster an in-depth understanding of both the hardware and software aspects of laboratory automation. The IBM-PC is used to control laboratory instruments, collect and analyze data, and plot results. Topics covered include the use of data acquisition and control cards, RS232-C and IEEE-488 interfacing, coordinated data collection and control and the use of assembly language to increase speed. State-of-the-art data acquisition languages are used extensively in the laboratory. Lecture three hours, laboratory three hours. Prerequisite: PHY 5430 or equivalent.

PHY 5440. Modern Instrumentation Design/(4).On Demand. A study of the role of microprocessors and microcontrollers in modern instrumentation. Students will utilize hardware/software real time development systems in the design and construction of basic instruments. Lecture three hours, laboratory three hours.

PHY 5500. Independent Study/(1-4).F;S.

PHY 5510. Physics of Transducers/(4).On Demand. A study of various transducers commonly employed in instrumentation. Topics include piezo- electronic, photoelectric, thermoelectric and electro-optical transducers. Use of transducers for the measurement of pressure, temperature, light intensity, electrical conductivity, radiation level, and acceleration are discussed. Lecture three hours, laboratory three hours. Prerequisites: PHY 5640, PHY 5430 or equivalent.

PHY 5520. Data Transmission and Signal Processing/ (3).F. A study of local area networks, broad band and base band transmission, optical fiber transmission, analog signal analysis and filtering, and discrete signal processing. Lecture two hours, laboratory three hours. Prerequisites: PHY 5620, PHY 5440 or equivalent.

PHY 5530-5549. Selected Topics/(1-4).On Demand. An intensive study of a single topic in physics.

PHY 5550. Directed Research in Applied Physics/(1-3). F;S. An original research project will be chosen, formulated and executed by the student under the guidance of a faculty member. Upon completion of the project, a final report will be written in the style and format of a research article.

PHY 5620. Optics/(4).S. A study of classical and modern optical phenomena including geometrical, Fresnel and Fourier optics, lasers, fiber optics and optoelectronic devices. Lecture three hours, laboratory three hours. Prerequisite: MAT 3130. Corequisite: PHY 3020. [Dual-listed with PHY 4620.]

PHY 5635. Advanced Microprocessor Interfacing and Robotics/(4).S. A study of the architecture, programming, and interfacing of Intel microprocessors and microcomputers. Topics to be covered include: Intel microprocessor architectures, support chips, decoding memory and I/O, microcomputer architecture and interfacing, microcomputer busses (such as PCI, PCIX, USB, Firewire, wireless), digital I/O, D/A, A/D, and robotics. Most labs will involve interfacing microcomputers to an assortment of transducers such as switches, sensors, LEDs, 7-segment displays, solid state relays, stepper motor, five-axis robotic arm, etc. Assembly language, high-level language, and/or commercial software (e.g., Lab

View) will be used in lab. Lecture three hours, laboratory three hours. Prerequisite: PHY 4330 or PHY 5330. [Dual-listed with PHY 4635.]

PHY 5640. Quantum Mechanics/(3).S. A study of the Schroedinger equation and its solutions for various common potentials. Prerequisites: PHY 3010, PHY 3210, and MAT 3130. [Dual-listed with PHY 4640.]

PHY 5730. Analog Systems/(3).F. The theory and operation of DC and AC circuits with discrete passive and active components. Included are resistors, capacitors, inductors, diodes, bipolar transistors, field effect transistors, and operational amplifiers. An in-depth analysis of circuit theorems, phasors, differential equations, and simulations predicting the behavior of systems of analog devices will be explored in lecture and laboratory. The use and limitations of common electronics instrumentation such as multimeters, oscilloscopes, function generators, modulators/demodulators, lock-in amplifiers, and phase detection will also be explored. Lecture two hours, laboratory three hours. [Dual-listed with PHY 4730.]

PHY 5735. Microcontrollers/(3).S. An in-depth study of the architecture, programming and interfacing of microcontrollers. Topics to be covered include: introduction to microcontrollers, architectures, internal hardware (such as timers, serial ports, A/Ds, D/As, I2C), instruction sets, assembly language programming, interrupt-driven code, and interfacing. Both stand-alone microcontrollers and single board computers will be used in lab. Most labs will involve interfacing microcontrollers to devices such as switches, LEDs, keypads, 7-segment displays, LCD displays, motors, sensors, etc. Microcontroller simulators and in-circuit-emulators (ICE) will be used for debugging. Lecture two hours, laboratory three hours. Prerequisite: PHY 4330 or PHY 5330 or the equivalent. [Dual-listed with PHY 4735.]

PHY 5820. Medical Physics/(3).F. A study of the application of the basic principles of physics to a selection of medical topics involving human body characteristics and functions and to instrumentation used to diagnose and treat illness and injury. Lecture three hours. Prerequisite: PHY 1104 or PHY 1151. [Dual-listed with PHY 4820.]

PHY 5900. Internship/(3-12).F;S. Supervised work in applied physics in an industrial or other laboratory setting. Students must obtain approval of the departmental internship coordinator prior to enrolling. Graded on an S/U basis.

PHY 5989. Graduate Research/(1-9).F;S. This course is designed to provide access to University facilities for continuing graduate research at the master's and specialist's levels. Graded on an S/U basis. PHY 5989 does not count toward a degree.

PHY 5999. Thesis/(3-6).F;S. Course may be repeated for a total of 6 semester hours. Graded on an S/U basis.