PHYSICS

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Applied Physics, M.S.
The Master of Science program in Applied Physics is an interdisciplinary program that offers students the opportunity to complete graduate studies in physics with a particular emphasis on applied research and technology development for industry. The program is a formally recognized Professional Science Master's degree program, meaning that in addition to science courses, students are also required to take courses in management. The program in Applied Physics has two tracks — materials science/nanotechnology and optics/optical instrumentation — intended to develop the state's workforce in the established optics and materials science industries, as well as in the emerging nanotechnology sector.

Physics Nanotechnology, Graduate Certificate
The Graduate Certificate in Nanotechnology (GCNT) is a three-course graduate certificate program with a prerequisite of one foundational science, technology, engineering, or mathematics (STEM) course at the advanced undergraduate level. The GCNT program provides high quality education and training experiences in the general concepts of nanotechnology and detailed knowledge and practice in the areas of characterization and synthesis of nanoscale materials. The certificate program is designed to be synergistic with the undergraduate and master's programs in the Department of Physics and is closely linked with the establishment of the Connecticut State Colleges & Universities Center for Nanotechnology (ConnSCU-CNT) at SCSU. The GCNT program is multi-institutional in its structure because select faculty from all four CSU campuses (Central, Eastern, Southern, and Western) are involved in the program, but the certificate is issued by the Department of Physics at SCSU.
**PHYSICS NANOTECHNOLOGY, GRADUATE CERTIFICATE**

For further information: PhysicsGrad@southernct.edu

**Application Deadline**
Rolling Admissions

Graduate Certificate in Nanotechnology

The Graduate Certificate in Nanotechnology (GCNT) is a three-course graduate certificate program with a prerequisite of one foundational science, technology, engineering, or mathematics (STEM) course at the advanced undergraduate level. The GCNT program provides high quality education and training experiences in the general concepts of nanotechnology and detailed knowledge and practice in the areas of characterization and synthesis of nanoscale materials. The certificate program is designed to be synergistic with the undergraduate and master's programs in the Department of Physics and is closely linked with the establishment of the Connecticut State Colleges & Universities Center for Nanotechnology (ConnSCU-CNT) at SCSU. The GCNT program is multi-institutional in its structure because select faculty from all four CSU campuses (Central, Eastern, Southern, and Western) are involved in the program, but the certificate is issued by the Department of Physics at SCSU.

**Program Requirements**

The GCNT program consists of three required core courses at the graduate level (9 credits) and one prerequisite course. The three required graduate courses are PHY 519, PHY 521, and PHY 523, described below. Advanced undergraduate or graduate courses in biology, chemistry, engineering, materials science, physics, and others will be considered to meet the three credit prerequisite requirement.

**Program Sequence**

*As sequencing changes, it is highly recommended that students meet with their program advisor to finalize a list of requirements for graduation.*

*The GCNT program consists of three required core courses at the graduate level (9 credits) and one prerequisite course

**Required Courses**

- PHY 519 – Nanotech I-Fundamentals of Nanoscience – 3 credits
- PHY 521 – Nanotech II-Characterization of Nanomaterials – 3 credits
- PHY 523 – Nanotech IV-Nanosystems Laboratory – 3 credits
*Advanced undergraduate or graduate courses in biology, chemistry, engineering, materials science, physics, and others will be considered to meet the three credit prerequisite requirement.

This program is not eligible for financial aid (Title IV and/or State funds).

APPLIED PHYSICS, M.S.

For further information: PhysicsGrad@southernct.edu

Application Deadline

Rolling admissions.

Master of Science Degree in Applied Physics

The Master of Science program in Applied Physics is an interdisciplinary program that offers students the opportunity to complete graduate studies in physics with a particular emphasis on applied research and technology development for industry. The program is a formally recognized Professional Science Master's degree program, meaning that in addition to science courses, students are also required to take courses in management. The program in Applied Physics has two tracks — materials science/nanotechnology and optics/optical instrumentation — intended to develop the state's workforce in the established optics and materials science industries, as well as in the emerging nanotechnology sector.

In addition to the Applied Physics program, students pursuing the Master of Science in Science Education (Secondary) may choose their concentration in physics. Admission to that program is through the Department of Science Education and Environmental Studies. For information concerning physics courses and research opportunities in physics that are applicable toward the Master's degree in Science Education, contact Professor Karen Cummings, Physics Department adviser for students in the M.S. in Science Education. Refer to the section entitled "Admission to Teacher Certification Programs" in the beginning of this catalog under "Application and Admission" for additional information.

Departmental Admission Requirements

In addition to the admission requirements of the School of Graduate and Professional Studies found in the Application and Admission section of this catalog, all applicants must submit the following documents to complete their application to the M.S. in Applied Physics program:

A one page statement indicating their academic background, area of interest, and their career plans, and
Two letters of recommendation.

Course work in the program, except in unusual circumstances, cannot begin until the student has completed an undergraduate degree in science, mathematics, engineering, or a related field with grade point average of 3.0 or higher, and until the student has completed the equivalent of 18 credits of Physics at the undergraduate level. The general GRE test is recommended for admission, but not required.
Program Sequence - 36 Credits

As sequencing changes, it is highly recommended that students meet with their program advisor to finalize a list of requirements for graduation.

The Master of Science degree in Applied Physics requires completion of a total of 36 credits (or approximately 12 courses) with a "B" or better average. All students in the program must complete a core consisting of the following six courses with a "B" or better average.

Core Courses
PHY 507 – Applied Physics graduate Seminar – 3 credits
PHY 512 – Methods of Theoretical Physics I – 3 credits
CHE 520 – Advanced Physical chemistry I – 3 credits
CSC 541 – Digital Image Processing – 3 credits
MBA 500 – Management Process – 3 credits
MBA 505 – Marketing Management – 3 credits

Choose One Track

Materials Science/Nano Track
PHY 519 – Nanotech I: Fundamentals of Nanoscience – 3 credits
PHY 521 – Nanotech II: Characterization of Nanomaterials – 3 credits

Optics/Optical Instrumentation Track
PHY 530 – Optics and Detector Physics – 3 credits
PHY 531 – Interferometric Methods in Imaging and Precision Measurement – 3 credits

Elective Courses (Choose two)
PHY 513 – Methods of Theoretical Physics II – credits
PHY 522 – Nanoscale Fabrication and Synthesis – 3 credits
CSC 551 – Pattern Recognition – 3 credits
CSC 561 – Scientific Visualization – 3 credits
CHE 532 – Advanced Inorganic Chemistry
MBA 507 – Legal Issues in Business & Management
MBA 510 – Project Management – 3 credits
MBA 512 – Strategic Factors in Marketing – 3 credits
MBA 515 – International Entrepreneurship – 3 credits
MBA 537 – Product Management – 3 credits
MBA 538 – Marketing Analysis and Measurement – 3 credits
MBA 548 – Business Process Excellence – 3 credits

Thesis (completion of six core courses, two track requirements, and two elective courses)

Special Project (six core courses, two track requirements, and two or three elective courses)

After the core, the student will select one of two focus areas in the program: (1) Materials Science/Nanotechnology, or Optics/Optical Instrumentation. Each track has two further required courses (PHY 519, PHY 521 and PHY 530, PHY 531,
respectively). The remaining courses are selected from the list of approved courses with the consent of the adviser. The program has a requirement for the successful completion of a research project, which can take one of two forms as detailed below, and an internship with a local company, which is not for course credit.

**Master's Thesis**

The thesis track requires the completion of the six core courses (18 credits), two track requirements (6 credits), two elective courses (6 credits), and a thesis (PHY 590, 591) based on research acceptable to the department. Students must complete these two courses in sequence; that is, the thesis proposal and initial research (PHY 590) must be completed prior to enrolling in PHY 591. A student must apply to the department for the thesis defense and provide a final draft of the completed thesis at least two weeks prior to the defense date.

**Research Project**

Students may also satisfy the degree requirements with the six core courses (18 credits), the two track requirements (6 credits), two or three elective courses (6 or 9 credits), and a special project (PHY 580) (3 or 6 credits). In this case, the research project work may in some cases be completed with a host company where the student will complete the work and be overseen by an on-campus adviser.
COURSES

**PHY 507 - Applied Physics Graduate Seminar**
An overview of current topics in Applied Physics Research. An introduction of scientific writing, speaking and professional topics.
Prerequisite(s): graduate status in Applied Physics or departmental permission.
Last Offered: Fall 2020
3 credits

**PHY 512 - Methods of Theoretical Physics**
The development of the laws of physics in mathematical form. The application of these laws to physical problems and a discussion of the mathematical methods employed.
Prerequisite(s): two semesters of college calculus and eighteen credits of undergraduate physics or departmental permission.
Last Offered: Spring 2021
3 credits

**PHY 519 - Fundamentals of Nanoscience**
Provides a highly interdisciplinary introduction to the science of nanoscale materials (nanoscience). Topics will include historical background, characterization techniques, physics and chemistry of nanoscience materials, fabrication techniques, nanoscale applications and ethical/societal considerations.
Prerequisite(s): PHY 309 and CHE 121 or equivalents.
Last Offered: Fall 2020
3 credits

**PHY 521 - Characterization of Nanomaterials**
Introduces the state-of-the-art techniques commonly used in the characterization of nanomaterials. Two important aspects of characterization, imaging and chemical analysis, are included. Emphasizes force, transmission and scanning electron microscopy.
Prerequisite(s): PHY 519 or departmental permission.
Last Offered: Spring 2021
3 credits

**PHY 530 - Optics and Optical Detectors**
Provides the student with a basic understanding of the scientific principles associated with optics and optical image formation, as well as image capture, processing and analysis. An end-to-end treatment of the imaging system is employed to illustrate the inter-relationships of the concepts introduced. The student will become familiar with systems analyses of simple imaging systems and image analysis methods.
Prerequisite(s): PHY 309 or equivalent.
Last Offered: Fall 2019
3 credits

**PHY 531 - Interferometric Methods in Imaging and Precision Measurement**
The interference of light is discussed in detail. Applications to high-resolution imaging and precision measurement are covered, including techniques such as electronic speckle pattern interferometry, long baseline optical interferometry and related techniques. The student will become familiar with the basic performance metrics and main types of interferometers in use today.
Prerequisite(s): PHY 530.
Last Offered: Spring 2020
3 credits
PHY 580 - Special Project
The student will conduct a research project in physics either on campus or in the context of an internship with a local company. The special project may either be a technological special project or an entrepreneurial special project. There will be a product as defined in the School of Graduate Studies guidelines for special projects at the conclusion of the course.
Prerequisite(s): departmental permission.
Last Offered: Fall 2017
3 or 6 credits

PHY 590 - Thesis Research I
The student will develop a thesis proposal according to accepted style guidelines, including a current literature review of the thesis topic and a description of the project design, and begin the research.
Prerequisite(s): departmental permission.
Last Offered: Fall 2019
3 credits

PHY 591 - Thesis Research II
Thesis investigation conducted under the supervision of an approved adviser. Completion of the written thesis and oral defense of the research work in the thesis.
Prerequisite(s): departmental permission.
Last Offered: Spring 2019
3 credits

PHY 600 - Independent Study and Research
Prerequisite: departmental permission.
Prerequisite(s): departmental permission.
Last Offered: Fall 2019
3 credits