PHYSICS

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MAJOR PROGRAMS IN PHYSICS

The Physics Department offers three Bachelor of Science degree options (general program, engineering concentration and secondary education) as well as a Bachelor of Arts degree in physics.

Students in these programs develop a mastery of the important theories, unifying principles, and engineering applications of physics. All students are encouraged to build active curiosity, investigative skills, and intellectual confidence and the ability to think and act independently.

Upper level students typically participate in research with faculty mentors. Projects currently in progress include nano-structured materials, atomic force and electron microscopy, correlated many-body physics, astronomical studies of binary stars, research on the learning and teaching of physics, theoretical condensed matter physics, fluorescence spectroscopy, biophysics, fiber optics, superconductivity, materials engineering, nuclear, and high-energy physics.

Since all 100-level courses are introductory, a student may not receive credit for more than one of PHY 100, 101, 103, and 111.

Bachelor of Science Degree in Physics - General

The general program emphasizes in depth inquiry into the central principles, analytical techniques, and key applications of physics. The program requirements form the core of the preparation expected for graduate study in fundamental and applied physics, or for initial positions in physics-based careers. Students can prepare for productive industrial
and governmental research, development and technical management careers, and for many other science and technology oriented professional opportunities.

Students planning to be professional physicists are encouraged to pursue additional courses, independent study, and research beyond the minimum requirement, in physics, mathematics, and other related fields.

**Bachelor of Science Degree in Physics - Engineering Concentration**

The engineering concentration is designed for students whose primary interest is in the applications of physics in engineering and advanced technology. The engineering concentration integrates intensive study of the underlying science with training in the practice of engineering. An engineering education requires a solid scientific foundation based on principles of mathematics and physics. Some of the technological fields that require a strong background in physics include materials science, nanotechnology, telecommunications, digital imaging, renewable energy systems, and microelectronics. The engineering concentration provides the opportunity to prepare for employment or graduate study in any of these critical areas of innovation. There is also an increasing emphasis on connections among scientific and engineering fields and this degree program provides excellent preparation for an interdisciplinary future. The engineering concentration also offers valuable preparation for technology-oriented careers in business management and marketing.

**Bachelor of Science in Physics - Secondary Education**

The department is actively involved in the preparation of science teachers. Students who successfully receive the B.S. degree and pass Praxis® II will be recommended for Initial Teacher Certification.

The specific professional requirements for Initial Teaching Certification in Connecticut are listed in the secondary education section of the School of Education.

**Bachelor of Arts in Physics**

This program offers students the greatest flexibility in choosing courses of interest. Imaginative combinations are possible which enable the student to relate the study of physics to wide-ranging areas such as the social sciences and the fine arts as well as the other natural sciences. It also develops advanced skills in quantitative and analytical thinking for a career in business, law, medicine, or other professions. Students may elect to pursue a double major in physics and education.
The department offers the following:

Physics, B.A.
Physics, B.S. - Concentration: Engineering
Physics, B.S. - Concentration: General
Physics 7-12, B.S.
Minor in Physics
PHYSICS, B.S. - CONCENTRATION: GENERAL

120 Overall Credits Required

LIBERAL EDUCATION PROGRAM AND WRITING REQUIREMENTS

Liberal Education Program

47 Credits Required

Students must complete a comprehensive three-tiered Liberal Education Program (LEP). View all requirements of the tiers on the Liberal Education Program.

While the choice of courses that fulfill the requirements is generally left up to students, some departments require that students select specific courses to complement their major. This major has specific Tier requirements/restrictions for the following:

Tier 1 - Quantitative Reasoning:
MAT 150 – Calculus I

Tier 2 – Natural World I: Physical Realm:
CHE 120 - General Chemistry I

Tier 3 – Capstone (select one):
EGR 471 - Capstone Experience in Engineering
PHY 471 - Capstone Experience in Physics

Writing Requirements (“W-Courses”)

Three W-courses are required. These may not be taken until after a student has passed ENG 112 — Writing Arguments. W-courses may count toward LEP, major, or cognate requirements, as well as free electives. Course sections that meet this requirement are designated by section numbers ending in “W”.

Transfer students who enter with 60 to 89 credits are required to pass two W-courses, while transfer students who enter with 90 credits or more must pass one W-course.

MAJOR REQUIREMENTS

36 Credits Required

Requirements:
PHY 230 — Physics for Scientists and Engineers I (‘C-’ or better)
PHY 231 — Physics for Scientists and Engineers II (‘C-’ or better)
PHY 309 — Modern Physics (‘C’ or better)
PHY 370 — Modern Physics Laboratory (‘C’ or better)
PHY 400 - Classical Mechanics I
PHY 401 - Classical Mechanics II
PHY 406 - Electricity and Magnetism
PHY 461 — Methods in Physics Research
Select an additional 12 credits of PHY; No more than 8 credits numbered below PHY 220

COGNATE REQUIREMENTS

11 Credits Required

Requirements:
CHE 121 - General Chemistry II
MAT 151 – Calculus II
MAT 252 – Calculus III
MAT 245 - Differential Equations
Select one CSC course numbered 102 or higher

FREE ELECTIVES

Remaining credits to reach Overall Credits Required (listed above).
PHYSICS, B.S. - CONCENTRATION: ENGINEERING

120 Overall Credits Required

LIBERAL EDUCATION PROGRAM AND WRITING REQUIREMENTS

Liberal Education Program

47 Credits Required

Students must complete a comprehensive three-tiered Liberal Education Program (LEP). View all requirements of the tiers on the Liberal Education Program.

While the choice of courses that fulfill the requirements is generally left up to students, some departments require that students select specific courses to complement their major. This major has specific Tier requirements/restrictions for the following:

Tier 1 - Quantitative Reasoning:
MAT 150 – Calculus I

Tier 2 – Natural World I: Physical Realm:
CHE 120 - General Chemistry I

Tier 3 – Capstone (select one):
EGR 471 - Capstone Experience for Engineering
PHY 471 - Capstone Experience in Physics

Writing Requirements (“W-Courses”)

Three W-courses are required. These may not be taken until after a student has passed ENG 112 — Writing Arguments. W-courses may count toward LEP, major, or cognate requirements, as well as free electives. Course sections that meet this requirement are designated by section numbers ending in “W”.

Transfer students who enter with 60 to 89 credits are required to pass two W-courses, while transfer students who enter with 90 credits or more must pass one W-course.

MAJOR REQUIREMENTS

34 Credits Required

Requirements:
PHY 230 — Physics for Scientists and Engineers I (‘C-’ or better)
PHY 231 — Physics for Scientists and Engineers II (‘C-’ or better)
PHY 309 — Modern Physics ('C-' or better)
PHY 370 — Modern Physics Laboratory ('C-' or better)
PHY 461 — Methods in Physics Research
EGR 151 - Engineering Concepts
PHY 355 - Electricity and Electronics

Select one from:
• EGR 251 - Engineering Mechanics I: Statics
• PHY 251 - Engineering Mechanics I: Statics

Select an additional 9 credits from:
• PHY 220 - Analytical Physics
• PHY 340 - Lasers and Fiber Optics
• PHY 398 - Special Topics in Physics
• PHY 400 - Classical Mechanics I
• PHY 405 - Scientific Computer Interfacing
• PHY 406 - Electricity and Magnetism
• PHY 410 - Optics
• PHY 415 - Solid State Physics
• PHY 430 - Thermodynamics
• PHY 440 - Introduction to Quantum Mechanics
• PHY 499 - Independent Study and Research
• Or other PHY courses at the 200 level or above with permission of Physics Department Chairperson

COGNATE REQUIREMENTS

33 Credits Required (minimum)

Requirements:
CHE 121 - General Chemistry II
MAT 151 – Calculus II
MAT 252 – Calculus III
MAT 245 - Differential Equations

Select two from:
• CSC 152 - Computer Programming I
• CSC 153 - Computer Programming II
• CSC 207 - Computer Systems
• CSC 341 - Digital Imaging
• CSC 370 - Computer Implementation of Statistical Methods
• CSC 375 - Simulation Techniques
• Or other CSC course with the permission of the Physics Department Chairperson

Minor or Credits (12 or 18 Credits Required)

• Minor in Computer Science
• Minor in Chemistry
• Minor in General Management
• 12 additional credits in PHY, EGR, or MAT with advisor approval
  - Since all 100-level courses are introductory, a student may not receive credit for more than one of PHY 100, 101, 103, and 111.

FREE ELECTIVES

Student must take remaining credits to reach Overall Credits Required (listed above).
PHYSICS 7-12, B.S.

This program has a separate admission process. Please consult the admission requirements for this program on the School of Education page for more information.

Overall GPA of 2.7 Required
120 Overall Credits Required

LIBERAL EDUCATION PROGRAM AND WRITING REQUIREMENTS

Liberal Education Program

47 Credits Required

Students must complete a comprehensive three-tiered Liberal Education Program (LEP). View all requirements of the tiers on the Liberal Education Program.

While the choice of courses that fulfill the requirements is generally left up to students, some departments require that students select specific courses to complement their major. This major has specific Tier requirements/restrictions for the following:

Tier 1 - Quantitative Reasoning:
MAT 150 – Calculus I

Tier 2 – American Experience (select one):
HIS 110 – United States History I
HIS 111 - United States History II

Tier 2 – Mind and Body:
SHE 203 – School Health

Tier 2 – Natural World I: Physical Realm:
CHE 120 - General Chemistry I

Tier 2 - Social Structure, Conflict and Consensus
EDU 200 - Teachers, Schools, and Society

Tier 3 – Capstone (select one):
EGR 471 - Capstone Experience for Engineering
PHY 471 - Capstone Experience in Physics

Writing Requirements (“W-Courses”)

Three W-courses are required. These may not be taken until after a student has passed ENG 112 — Writing Arguments. W-courses may count toward LEP, major, or cognate requirements, as well as free electives. Course sections that meet this requirement are designated by section numbers ending in “W”.
Transfer students who enter with 60 to 89 credits are required to pass two W-courses, while transfer students who enter with 90 credits or more must pass one W-course.

MAJOR REQUIREMENTS

54 Credits Required

**Physics Requirements**
27 Credits Required

Requirements:
PHY 230 — Physics for Scientists and Engineers I (‘C-' or better)
PHY 231 — Physics for Scientists and Engineers II (‘C-' or better)
PHY 309 — Modern Physics (‘C-' or better)
PHY 370 — Modern Physics Laboratory (‘C-' or better)
PHY 400 - Classical Mechanics I
PHY 406 - Electricity and Magnetism
PHY 461 — Methods in Physics Research
Select an additional 6 credits of PHY

Since all 100-level courses are introductory, a student may not receive credit for more than one of PHY 100, 101, 103, and 111.

**Education Requirements**
27 Credits Required

Requirements:
EDU 316 - Child Development and Psychology for Educators
EDU 413 – Secondary Education
EDU 471 – Supporting English Learners for School Success
RDG 470 – Literacy in the Content Areas
SED 482 – Teaching Exceptional Students in the Secondary Education Classroom
SCE 490 – Science (Secondary School)
SCE 494 – Student Teaching (Science)
SCE 496 – Student Teaching Seminar (Science)

COGNATE REQUIREMENTS

15 Credits Required

Requirements:
CHE 121 - General Chemistry II
MAT 151 – Calculus II
MAT 252 – Calculus III
MAT 245 - Differential Equations

FREE ELECTIVES
Students must take remaining credits to reach Overall Credits Required (listed above).
PHYSICS, B.A.

120 Overall Credits Required

LIBERAL EDUCATION PROGRAM AND WRITING REQUIREMENTS

**Liberal Education Program**

47 Credits Required

Students must complete a comprehensive three-tiered Liberal Education Program (LEP). View all requirements of the tiers on the Liberal Education Program.

While the choice of courses that fulfill the requirements is generally left up to students, some departments require that students select specific courses to complement their major. This major has specific Tier requirements/restrictions for the following:

- **Tier 1 - Quantitative Reasoning:**
  - MAT 150 – Calculus I

- **Tier 2 – Natural World I: Physical Realm:**
  - CHE 120 - General Chemistry I

- **Tier 3 – Capstone (select one):**
  - EGR 471 - Capstone Experience in Engineering
  - PHY 471 - Capstone Experience in Physics

**Writing Requirements (“W-Courses”)**

Three W-courses are required. These may not be taken until after a student has passed ENG 112 — Writing Arguments. W-courses may count toward LEP, major, or cognate requirements, as well as free electives. Course sections that meet this requirement are designated by section numbers ending in “W”.

Transfer students who enter with 60 to 89 credits are required to pass two W-courses, while transfer students who enter with 90 credits or more must pass one W-course.

**MAJOR REQUIREMENTS**

27 Credits Required

Requirements:
- PHY 230 — Physics for Scientists and Engineers I (‘C-’ or better)
- PHY 231 — Physics for Scientists and Engineers II (‘C-’ or better)
- PHY 309 — Modern Physics (‘C-’ or better)
- PHY 370 — Modern Physics Laboratory (‘C-’ or better)
PHY 400 - Classical Mechanics I  
PHY 406 - Electricity and Magnetism  
PHY 461 — Methods in Physics Research  
Select an additional 6 credits of PHY

Since all 100-level courses are introductory, a student may not receive credit for more than one of PHY 100, 101, 103, and 111.

COGNATE REQUIREMENTS

11 Credits Required

Requirements:  
MAT 151 – Calculus II  
MAT 252 – Calculus III  
MAT 245 - Differential Equations

FREE ELECTIVES

Remaining credits to reach Overall Credits Required (listed above).
COURSES

EGR 151 - Engineering Concepts
An introduction to the tools and problem solving techniques used in the engineering profession. Prerequisite(s): MAT 122 taken prior to or concurrent with EGR 151. Last Offered: Spring 2020 3 credits

EGR 232 - Materials Science and Engineering
An interdisciplinary introduction to materials science and engineering with topics including historical perspective, structure property relationships, engineering design, characterization techniques, manufacturing/synthesis, nanoscale applications and ethical/society implications. Prerequisite(s): EGR 151 and PHY 200 or PHY 230. Last Offered: Fall 2019 3 credits

EGR 251 - Engineering Mechanics I: Statics
The emphasis is on analyzing the forces and torques acting on objects and structures which are at rest. Topics include calculation of centers of mass and moments of inertia for extended bodies and the application of Newton’s second law in multiple dimensions to systems of particles and rigid bodies in equilibrium. Prerequisite(s): PHY 230 and MAT 151. Last Offered: Spring 2020 3 credits

EGR 298 - Special Topics
Examination of developments, issues, and/or creative work in the field of Engineering. Last Offered: Fall 2019 3 credits

EGR 398 - Special Topics
Topics vary. Last Offered: Fall 2016 3 credits

EGR 471 - Capstone Experience in Engineering
Culminating capstone experience for students in the engineering concentration of the physics major. A team based learning experience that incorporates a project which includes aspects of an engineering design process. A final written document and oral presentation of the chose project. Prerequisite(s): EGR 151, 6 of 8 Tier 2 complete (Honors Coll.: 15 cr. HON or 45 cr. total), and prior or concurrent completion of all Tier 1 (Honors Coll.: T1MC and T1QR only). Last Offered: not yet offered 3 credits

PHY 100 - Physics through Inquiry
Fundamental physics necessary to understand a particular contemporary social issue such as electric energy production and alternatives to fossil fuels. Laboratory activities involve genuine scientific inquiry including using observation to develop, evaluate, and refine models of the physical world. Topics are selected from electricity and magnetism, mechanics, heat, waves, and modern physics. Lecture, 2 hours; laboratory, 2 hours. Last Offered: Spring 2020 3 credits

PHY 103 - Physics and Technology for Healthcare Professionals
An introduction to physics concepts and applications associated with the medical professions. There is an emphasis on technological applications and potential ethical/societal impacts. Prerequisite(s): MAT 095 or placement in MAT 100, MAT 102, or higher. Last Offered: Spring 2020 3 credits
PHY 111 - Physics for Today
An introduction to physics concepts with emphasis on class demonstrations and everyday applications. Lecture-demonstration, 3 hours.
Last Offered: Summer 2015
3 credits

PHY 120 - Physics for Tomorrow: Nanotechnology
An introduction to the science and engineering of nanoscale materials (nanotechnology). Emphasis on technological applications and potential ethical/societal impacts.
Last Offered: Spring 2020
3 credits

PHY 123 - Critical Thinking and Science for Future Leaders
A critical analysis of contemporary science and physics topics. The primary goal of this course is development of the critical thinking skills and habits of mind necessary to think like a leader.
Last Offered: Spring 2020
3 credits

PHY 200 - General Physics I
Examines motion, force, energy, momentum, vibrations, temperature, heat, and fluids using algebra and trigonometry with an emphasis on applications. Lecture, 3 hours; laboratory, 3 hours.
Prerequisite(s): MAT 107 or higher, may be taken concurrently.
Last Offered: Spring 2020
4 credits

PHY 201 - General Physics II
A continuation of PHY 200. Electricity, magnetism, circuits, waves, optics, and the atomic and nuclear structure of matter are studied using algebra and trigonometry with an emphasis on applications.
Prerequisite(s): PHY 200.
Last Offered: Spring 2020
4 credits

PHY 210 - College Physics
Selected topics from the field of basic physics employing algebra and trigonometry. Lecture, 3 hours; laboratory, 3 hours.
Prerequisite(s): MAT 107 or higher taken prior or concurrently.
Last Offered: Spring 2017
4 credits

PHY 230 - Physics for Scientists and Engineers I
Basic principles of mechanics, heat, and oscillatory motion using calculus with an emphasis on applications. Lecture, 3 hours; laboratory, 3 hours.
Prerequisite(s): MAT 150 (may be taken concurrently).
Last Offered: Spring 2020
4 credits

PHY 231 - Physics for Scientists and Engineers II
Basic principles of electricity, magnetism, and optics are studied using calculus with an emphasis on applications.
Prerequisite(s): PHY 230 and MAT 151 (may be taken concurrently).
Last Offered: Spring 2020
4 credits

PHY 309 - Modern Physics
Relativity, atomic structure, quantum physics, and nuclear transformations are studied.
Prerequisite(s): ENG 111 or ENG 112 and C- or better in MAT 151, PHY 230, and PHY 231.
Last Offered: Fall 2019
3 credits

PHY 340 - Lasers and Fiber Optics
Coherent light and photons, fundamentals of laser theory, semiconductor lasers, laser applications. Multi-mode and single-mode optical fibers. Fiber optic systems and telecommunications. 2 hours lecture, 3 hours laboratory.
Prerequisite(s): PHY 231 and MAT 151.
Last Offered: Fall 2018
3 credits
PHY 355 - Electricity and Electronics
An operational introduction to DC and AC circuits and electronic devices (diodes and transistors) emphasizing laboratory skills. Lecture, 2 hours; laboratory, 6 hours.
Prerequisite(s): 'C-' or better in PHY 231.
Last Offered: Fall 2019
4 credits

PHY 370 - Modern Physics Laboratory
Selected major experiments from modern physics. Data analysis and presentation skills are emphasized. Lecture, 1 hour; laboratory, 3 hours.
Prerequisite(s): PHY 231 and PHY 309.
Last Offered: Spring 2020
2 credits

PHY 398 - Special Topics in Physics
Examination of developments, issues, and/or creative work in the field of physics.
Prerequisite(s): PHY 210, PHY 201, or PHY 231.
Last Offered: Spring 2016
3 credits

PHY 400 - Classical Mechanics I
Application of Newton’s laws in one and multiple dimensions, to moving coordinate systems, and to systems of particles. MAT 252 must be taken prior to, or concurrent with this course.
Prerequisite(s): PHY 231 and MAT 151.
Last Offered: Spring 2020
3 credits

PHY 401 - Classical Mechanics II
A continuation of PHY 400. A study of rigid body motion, the Lagrange and Hamilton equations of motion, and small oscillations. It is recommended that MAT 245 be taken prior to or concurrent with this course.
Prerequisite(s): PHY 400 and MAT 252.
Last Offered: Fall 2018
3 credits

PHY 405 - Scientific Computer Interfacing
Computer peripherals, interfacing method standards. Use of machine language and digital electronics for measurement and control of physical phenomena.
Prerequisite(s): PHY 355.
Last Offered: Spring 2020
3 credits

PHY 406 - Electricity and Magnetism
Basic principles of electromagnetism, electrical, and magnetic properties of matter, Maxwell’s equations. It is recommended that MAT 245 and PHY 400 be taken prior to or concurrent with this course.
Prerequisite(s): PHY 231 and MAT 252.
Last Offered: Fall 2019
3 credits

PHY 410 - Optics
Principles of physical optics and their modern applications.
Prerequisite(s): PHY 231; MAT 252 which may be taken concurrently.
Last Offered: Spring 2019
3 credits

PHY 411 - Optics Laboratory
A planned sequence of experiments in classical and modern optics. Laboratory only, 3 hours.
Last Offered: Spring 2019
1 credits

PHY 415 - Solid State Physics
Crystal structure, X-ray diffraction, lattice vibrations, band theory of metals, electrical conductivity of metals and semi-conductors, semiconductor devices, and superconductivity.
Prerequisite(s): PHY 309 and MAT 151.
Last Offered: Spring 2020
3 credits
PHY 430 - Thermodynamics
Basic principles of heat and energy transfer applied to the properties of matter.
Prerequisite(s): PHY 231; MAT 252 which may be taken concurrently.
Last Offered: Fall 2018
3 credits

PHY 440 - Introduction to Quantum Mechanics
Physical concepts and mathematical formalism of quantum mechanics. Topics include the Schrodinger equation, and eigenfunctions and approximation methods. It is recommended that MAT 245 and MAT 372 be taken prior to, or concurrent with this course.
Prerequisite(s): PHY 309 and MAT 252.
Last Offered: Spring 2019
3 credits

PHY 461 - Methods in Physics Research
Exposes students to the areas of research in which our faculty are engaged. Students carry out a series of research related activities each under the supervision of a different faculty member. 6 laboratory hours per week.
Prerequisite(s): PHY 370.
Last Offered: Fall 2019
2 credits

PHY 471 - Capstone Experience in Physics
A continuation of PHY 461, this course is the culminating capstone experience in physics and satisfies the Tier III requirement of the LEP. It requires an independent research project or design activity, an oral presentation and significant written report. Course consists of a six-hour laboratory per week and outside work.
Prerequisite(s): PHY 461, 6 of 8 Tier 2 complete (Honors Coll.: 15 cr. HON or 45 cr. total), and prior or concurrent completion of all Tier 1 (Honors Coll.: T1MC and T1QR only).
Last Offered: Fall 2019
3 credits

PHY 499 - Independent Study and Research
No Description Available
Prerequisite(s): Departmental permission.
Last Offered: Fall 2019
1 to 4 credits