Physics (PHYS)

Courses

PHYS 0834. Exploring the Cosmos. 3 Credit Hours.
This course is typically offered in Fall, Spring, and Summer I.
This GenEd course will use the fascinating science surrounding the makeup, origin, and future of our Universe to teach the methods by which scientists study nature. The course will also explore the (sometimes controversial) history of the subject, including the intersections of ethics and science as well as the role of different cultures.
Course Attributes: GS
Repeatability: This course may not be repeated for additional credits.

PHYS 0839. Powering the Future. 3 Credit Hours.
This course is typically offered in Fall and Spring.
How can we provide inexpensive, safe, environmentally clean energy supplies for the United States and the world as a whole despite rising population and increasing affluence? Study problems of our conventional fossil and nuclear fuel use, and how they might be relieved; explore the physical and technological possibilities for using energy much more efficiently; investigate various renewable-energy sources (such as solar, hydrogen cells, hydropower, and biofuels) that significantly reduce effects on the environment. In the course lab projects, you will research and develop a sustainable energy proposal for your own home, campus, or community. NOTE: This course fulfills a Science & Technology (GS) requirement for students under GenEd and Science & Technology Second Level (SB) for students under Core. Students cannot get credit for this course if they have successfully completed Physics 0939.
Course Attributes: GS
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 0701 to 0702| Required Courses:1|Minimum Grade of C|May not be taken concurrently
OR MATH 0800 to 4999| Required Courses:1|Minimum Grade of C|May be taken concurrently
OR (PM1 0916|May not be taken concurrently
AND PMC 1850|May not be taken concurrently).

PHYS 0847. How Things Work: The Physics of Everyday Life. 3 Credit Hours.
This course is typically offered in Fall, Spring, and Summer I.
As you observe films, demonstrations and photographic techniques both real and computer-simulated, and as you perform several simple in-home experiments you will gain a basic understanding of the laws of nature as they play out in everyday life. In a special project you will compare the science in different science fiction films. NOTE: This course fulfills a Science & Technology (GS) requirement for students under GenEd and Science & Technology Second Level (SB) for students under Core.
Course Attributes: GS
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 0701 to 0702| Required Courses:1|Minimum Grade of C|May not be taken concurrently
OR MATH 0800 to 4999| Required Courses:1|Minimum Grade of C|May be taken concurrently.

PHYS 0872. The Science of Sound. 3 Credit Hours.
This course is typically offered in Fall, Spring, and Summer I.
For living things the ability to hear sounds is an essential tool for survival, and sound is central to speech and languages. In the arts sound also plays a fundamental role, above all in music. The close connection between music, mathematics, and physics has long fascinated scientists. Advances in electronics and computing are revolutionizing the composition, production, and recording of sound. Science of Sound is an interdisciplinary course involving elements of physics, physiology, psychology, music, and engineering. After a four-week introduction to the fundamental physics of sound waves, we will consider human hearing and the human voice; scales, harmony, and sound production by musical instruments; architectural acoustics; and the electronic reproduction of sound. The course includes many in-class demonstrations. NOTE: This course fulfills a Science & Technology (GS) requirement for students under GenEd and Science & Technology Second Level (SB) for students under Core. Students cannot get credit for this course if they have completed Physics 1003: Acoustics.
Course Attributes: GS
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 0701 to 0702| Required Courses:1|Minimum Grade of C|May not be taken concurrently
OR MATH 0800 to 4999| Required Courses:1|Minimum Grade of C|May be taken concurrently.
PHYS 0939. Honors Powering the Future. 3 Credit Hours.
This course is typically offered in Spring.
How can we provide inexpensive, safe, environmentally clean energy supplies for the United States and the world as a whole despite rising population and increasing affluence? Study problems of our conventional fossil and nuclear fuel use, and how they might be relieved; explore the physical and technological possibilities for using energy much more efficiently; investigate various renewable-energy sources (such as solar, hydrogen cells, hydropower, and biofuels) that significantly reduce effects on the environment. In the course lab projects, you will research and develop a sustainable energy proposal for your own home, campus, or community. (This is an Honors course.) NOTE: This course fulfills a Science & Technology (GS) requirement for students under GenEd and Science & Technology Second Level (SB) for students under Core. Students cannot get credit for this course if they have successfully completed Physics 0839.
Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR
Course Attributes: GS, HO
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 0701 to 0702| Required Courses:1|Minimum Grade of C|May not be taken concurrently
OR MATH 0800 to 4999| Required Courses:1|Minimum Grade of C|May be taken concurrently
OR (PM1 0916|May not be taken concurrently
AND PMC 1850|May not be taken concurrently).

PHYS 1001. Physics: Matter and Motion. 4 Credit Hours.
This course is typically offered in Fall and Spring.
An introduction to the ideas and techniques used in the study of motion. Application to a wide variety of physical systems ranging from air molecules to footballs to black holes. Mostly descriptive using photographic techniques, films, and demonstrations. NOTE: (1) No laboratory. (2) This course can be used to satisfy the university Core Science & Technology First Level (SA) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor. (3) Students who have taken a higher number introductory physics sequence cannot take this course for credit.
Course Attributes: SA
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 0701 to 0702| Required Courses:1|Minimum Grade of C|May not be taken concurrently
OR MATH 0800 to 4999| Required Courses:1|Minimum Grade of C|May be taken concurrently
OR MC3 Y|May not be taken concurrently
OR MC4 Y|May not be taken concurrently
OR MC5 Y|May not be taken concurrently
OR MC6 Y|May not be taken concurrently
OR STAT 1001|Minimum Grade of C|May be taken concurrently
OR STAT 1102|Minimum Grade of C|May be taken concurrently
OR STAT 1902|Minimum Grade of C|May be taken concurrently.

PHYS 1004. Introduction to Astronomy. 3 Credit Hours.
This course is typically offered only in Fall, Spring, and Summer I.
After a description of local space which includes the universe of galaxies, red shift, and the big bang will be discussed. White dwarfs, red giants, pulsars, black holes, and quasars will be covered. The treatment will be mostly descriptive, utilizing slides, NASA films, and several trips to our planetarium.
NOTE: (1) No laboratory. (2) This course can be used to satisfy the university Core Science & Technology Second Level (SB) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.
Course Attributes: SB
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 1021|Minimum Grade of C|May not be taken concurrently
OR MATH 1022 to 3080| Required Courses:1|Minimum Grade of C|May be taken concurrently
OR MC5 Y|May not be taken concurrently
OR MC6 Y|May not be taken concurrently
OR STAT 1001|Minimum Grade of C|May not be taken concurrently
OR STAT 1102|Minimum Grade of C|May not be taken concurrently
OR STAT 1902|Minimum Grade of C|May not be taken concurrently.
PHYS 1005. Light, Art, and Nature. 4 Credit Hours.
This course is typically offered in Spring. 
An introduction to the properties of light, whether interpreted as rays, waves, or photons. Discussion of the basic ideas of geometric and wave optics, with application to the analysis of photography, color, vision, and modern physics. Emphasis is on factors that permit the artist and observer to understand and more fully control the design and interpretation of images of all kinds. Demonstrations, experiments, and video and computer simulations to analyze signals received by the eyes or instruments. NOTE: (1) Course is primarily designed for students interested in the visual arts, but is open to anyone. Minimal mathematics. (2) This course can be used to satisfy the university Core Science & Technology First Level (SA) requirement.
Course Attributes: SA
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 0701 to 0702 | Required Courses:1 | Minimum Grade of C- | May not be taken concurrently
OR MATH 0800 to 4999 | Required Courses:1 | Minimum Grade of C- | May be taken concurrently
OR MC3 Y | May not be taken concurrently
OR MC4 Y | May not be taken concurrently
OR MC5 Y | May not be taken concurrently
OR MC6 Y | May not be taken concurrently
OR STAT 1001 | Minimum Grade of C- | May be taken concurrently
OR STAT 1102 | Minimum Grade of C- | May be taken concurrently
OR STAT 1902 | Minimum Grade of C- | May be taken concurrently.

PHYS 1006. Medical Physics. 3 Credit Hours.
This course is not offered every year.
Medical Physics is an introductory science elective course that is open to students with little exposure to science or mathematics. With nominal (high school level) mathematics preparation, students can learn how basic principles of physics are utilized in medical processes. Topics to be examined include: the nature of radiation, radiation exposure, nuclear medicine, CT and MR imaging, and ultrasound techniques.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 1021 | Minimum Grade of C- | May not be taken concurrently
OR MATH 1022 to 3080 | Required Courses:1 | Minimum Grade of C- | May be taken concurrently
OR MC5 Y | May not be taken concurrently
OR MC6 Y | May not be taken concurrently
OR STAT 1001 | Minimum Grade of C- | May not be taken concurrently
OR STAT 1102 | Minimum Grade of C- | May not be taken concurrently
OR STAT 1902 | Minimum Grade of C- | May not be taken concurrently.

PHYS 1007. Science & Science Fiction in Film. 3 Credit Hours.
This course is typically offered in Spring.
This course takes a captivating look at physical phenomena depicted in a collection of popular science fiction films. These include Deep Impact (1998) in which Earth is threatened by a giant comet, The Peacemaker (1998) where a terrorist's atomic bomb is planted in New York City, I Robot (2007) with a detective fighting to prevent a takeover of the human race by robots, and Contact (1997) featuring an astronomer who discovers the first real message from an alien civilization. Other films deal with global warming, astronomy, electricity and magnetism.

There are no in-person meetings of this class. Students discuss films on the course web site and submit answers to weekly questions via the Internet at times that are individually convenient for each student. E-Mail the course instructor, Dr. Dubeck, at ldubeck@temple.edu for access to the course web site.
Repeatability: This course may not be repeated for additional credits.
PHYS 1021. Introduction to General Physics I. 0 or 4 Credit Hours.
This course is typically offered in Fall, Spring, and Summer I.
Open to freshmen and other students in pre-professional programs. Students who are biology majors or in pre-medical programs should take Physics 2021 (0121) instead. Not intended as a preparation for advanced courses in physics. Topics include kinematics, dynamics, work, energy, momentum, static equilibrium, fluids, vibrations, waves, sound, temperature, kinetic theory, heat, and the laws of thermodynamics. NOTE: Students cannot receive credits for both Physics 1011 and 1021. This course can be used to satisfy the university Core Science & Technology First Level (SA) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.
Two sections are required for this course. This course requires registration for a 0.0 credit Laboratory section in addition to the 4.0 credit Lecture & Recitation section. The Laboratory sections corresponding to a course are listed under the same course number as the Lecture & Recitation sections, but have unique section numbers.
Course Attributes: SA
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 1021|Minimum Grade of C-|May not be taken concurrently
OR MATH 1022 to 3080| Required Courses:1|Minimum Grade of C-|May be taken concurrently
OR MC5 Y|May not be taken concurrently
OR MC6 Y|May not be taken concurrently
OR STAT 1001|Minimum Grade of C-|May not be taken concurrently
OR STAT 1102|Minimum Grade of C-|May not be taken concurrently
OR STAT 1902|Minimum Grade of C-|May not be taken concurrently.

PHYS 1022. Introduction to General Physics II. 0 or 4 Credit Hours.
This course is typically offered in Fall, Spring, and Summer II.
Normally follows Physics 1021 (C085). Open to freshmen and others in pre-professional programs. Students who are biology majors or in pre-medical programs should take Physics 2022 (0122) instead. Topics include electricity, magnetism, optics, and modern physics. NOTE: Students cannot receive credits for both Physics 1012 and 1022. This course can be used to satisfy the university Core Science & Technology Second Level (SB) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.
Two sections are required for this course. This course requires registration for a 0.0 credit Laboratory section in addition to the 4.0 credit Lecture & Recitation section. The Laboratory sections corresponding to a course are listed under the same course number as the Lecture & Recitation sections, but have unique section numbers.
Course Attributes: SB
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 1011|Minimum Grade of C-|May not be taken concurrently
OR PHYS 1021|Minimum Grade of C-|May not be taken concurrently
OR PHYS 1061|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2021|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2921|Minimum Grade of C-|May not be taken concurrently.

PHYS 1061. Elementary Classical Physics I. 0 or 4 Credit Hours.
This course is typically offered in Fall, Spring, and Summer I.
Primarily for physics, chemistry, engineering, geology, and mathematics majors, but open to others. Topics include elementary vector algebra, one-dimensional motion, particle dynamics, work and energy, conservation of energy, conservation of linear momentum, collisions, rotational kinematics and dynamics, conservation of angular momentum, oscillations, waves, and gravitation. NOTE: Students cannot receive credits for both Physics 1061 and 2021. This course can be used to satisfy the university Core Science & Technology First Level (SA) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.
Two sections are required for this course. This course requires registration for a 0.0 credit Laboratory section in addition to the 4.0 credit Lecture & Recitation section. The Laboratory sections corresponding to a course are listed under the same course number as the Lecture & Recitation sections, but have unique section numbers.
Course Attributes: SA
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 1041|Minimum Grade of C|May be taken concurrently
OR MATH 1941|Minimum Grade of C|May be taken concurrently
OR MATH 1042|Minimum Grade of C-|May be taken concurrently
OR MATH 1942|Minimum Grade of C-|May be taken concurrently
OR MATH 1951|Minimum Grade of C-|May be taken concurrently
OR MATH 2043 to 3080| Required Courses:1|Minimum Grade of C-|May be taken concurrently
OR MA06 Y|May not be taken concurrently.
PHYS 1062. Elementary Classical Physics II. 0 or 4 Credit Hours.
This course is typically offered in Fall, Spring, and Summer II. Primarily for physics, chemistry, engineering, geology, and mathematics majors, but open to others. Topics include temperature, heat and the first law of thermodynamics, kinetic theory of gases, entropy and the second law of thermodynamics, electrical charges, the electric field, Gauss's Law, electrostatic potential, capacitors and dielectrics, current, resistance, the magnetic field, Ampere's Law, Faraday's Law, inductance, geometrical optics, and interference and diffraction of light. NOTE: Students cannot receive credits for both Physics 1062 and 2022. This course can be used to satisfy the university Core Science & Technology Second Level (SB) requirement. To determine if this course in combination with another course can satisfy the GenEd Science & Technology requirement, see your advisor.

Two sections are required for this course. This course requires registration for a 0.0 credit Laboratory section in addition to the 4.0 credit Lecture & Recitation section. The Laboratory sections corresponding to a course are listed under the same course number as the Lecture & Recitation sections, but have unique section numbers.

Course Attributes: SB
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
(PHYS 1061|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2021|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2921|Minimum Grade of C-|May not be taken concurrently
AND (MATH 1042|Minimum Grade of C-|May be taken concurrently
OR MATH 1942|Minimum Grade of C-|May be taken concurrently
OR MATH 1951|Minimum Grade of C-|May be taken concurrently
OR MATH 2043 to 3080| Minimum Grade of C-|May be taken concurrently).

PHYS 1083. Directed Reading/Study. 1 to 4 Credit Hour.
This course is typically offered in Fall, Spring, and Summer I. Independent study in physics. NOTE: This course may be repeated for credit.
Repeatability: This course may be repeated for additional credit.

PHYS 2021. General Physics I. 0 or 4 Credit Hours.
This course is typically offered in Fall, Spring, and Summer I. Topics include mechanics, gravitation, energy conservation, fluids and waves. Biological applications discussed where appropriate. NOTE: Students cannot receive credits for both Physics 1061 and 2021. Primarily for biology majors, but open to others.

Two sections are required for this course. This course requires registration for a 0.0 credit Laboratory section in addition to the 4.0 credit Lecture & Recitation section. The Laboratory sections corresponding to a course are listed under the same course number as the Lecture & Recitation sections, but have unique section numbers.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 1042|Minimum Grade of C-|May not be taken concurrently
OR MATH 1942|Minimum Grade of C-|May not be taken concurrently
OR MATH 1951|Minimum Grade of C-|May not be taken concurrently
OR MATH 2043 to 3080| Minimum Grade of C-|May be taken concurrently.

PHYS 2022. General Physics II. 0 or 4 Credit Hours.
This course is typically offered in Fall, Spring, and Summer II. Normally follows Physics 2021 (0121). Topics include electricity and magnetism, optics, atomic, molecular, and nuclear physics. Biological applications discussed where appropriate. NOTE: Students cannot receive credits for both Physics 1062 and 2022. Primarily for biology majors but open to others.

Two sections are required for this course. This course requires registration for a 0.0 credit Laboratory section in addition to the 4.0 credit Lecture & Recitation section. The Laboratory sections corresponding to a course are listed under the same course number as the Lecture & Recitation sections, but have unique section numbers.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
(PHYS 1061|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2021|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2921|Minimum Grade of C-|May not be taken concurrently
AND (MATH 1042|Minimum Grade of C-|May not be taken concurrently
OR MATH 1942|Minimum Grade of C-|May not be taken concurrently
OR MATH 1951|Minimum Grade of C-|May not be taken concurrently
OR MATH 2043 to 3080| Minimum Grade of C-|May be taken concurrently).
PHYS 2083. Directed Reading/Study. 2 to 4 Credit Hours.
This course is typically offered in Fall, Spring, Summer I and Summer II.
Undergraduate independent study in physics. NOTE: This course may be repeated for credit.
Repeatability: This course may be repeated for additional credit.

PHYS 2101. Classical Mechanics. 3 Credit Hours.
This course is typically offered in Spring.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
(Phys 1062|Minimum Grade of C-|May not be taken concurrently
OR Phys 2022|Minimum Grade of C-|May not be taken concurrently
OR Phys 2922|Minimum Grade of C-|May not be taken concurrently)
AND (Math 2043|Minimum Grade of C-|May not be taken concurrently).

PHYS 2501. Computing for Scientists. 3 Credit Hours.
This course is typically offered in Fall.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
(Phys 1062|Minimum Grade of C-|May not be taken concurrently
OR Phys 2022|Minimum Grade of C-|May not be taken concurrently
OR Phys 2922|Minimum Grade of C-|May not be taken concurrently)
AND (Math 1042|Minimum Grade of C-|May not be taken concurrently
OR Math 1942|Minimum Grade of C-|May not be taken concurrently
OR Math 1951|Minimum Grade of C-|May not be taken concurrently
OR Math 2043 to 3080| Required Courses:1|Minimum Grade of C-|May be taken concurrently).

PHYS 2502. Mathematical Physics. 4 Credit Hours.
This course is typically offered in Spring.
Infinite series, determinants and matrices, ordinary differential equations, vector analysis, curvilinear coordinate systems, Fourier series, properties of Legendre and Bessel functions, partial differential equations. Laboratory portion of course provides training in use of Mathematica, an integrated environment for technical computing, to solve problems in mathematical physics. NOTE: No prior computer experience is necessary.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
(Phys 1062|Minimum Grade of C-|May not be taken concurrently
OR Phys 2022|Minimum Grade of C-|May not be taken concurrently
OR Phys 2922|Minimum Grade of C-|May not be taken concurrently)
AND (Math 2043|Minimum Grade of C-|May not be taken concurrently).

PHYS 2796. Introduction to Modern Physics. 4 Credit Hours.
This course is typically offered in Spring.
The course will provide an introduction to the special theory of relativity and quantum mechanics, with emphasis of their applications to atomic, molecular and solid state physics. The course is calculus based and writing intensive; it relies heavily on problem solving and technical writing.
Course Attributes: WI
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
(Phys 1062|Minimum Grade of C-|May not be taken concurrently
OR Phys 2022|Minimum Grade of C-|May not be taken concurrently
OR Phys 2922|Minimum Grade of C-|May not be taken concurrently)
AND (Math 2043|Minimum Grade of C-|May not be taken concurrently).
PHYS 2921. Honors General Physics I. 0 or 4 Credit Hours.
This course is typically offered in Fall.
This is the honors version of Physics 2021. Topics include mechanics, gravitation, energy conservation, fluids and waves. Biological applications discussed where appropriate.

Two sections are required for this course. This course requires registration for a 0.0 credit Laboratory section in addition to the 4.0 credit Lecture & Recitation section. The Laboratory sections corresponding to a course are listed under the same course number as the Lecture & Recitation sections, but have unique section numbers.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR
Course Attributes: HO
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
MATH 1042|Minimum Grade of C-|May not be taken concurrently
OR MATH 1942|Minimum Grade of C-|May not be taken concurrently
OR MATH 1951|Minimum Grade of C-|May not be taken concurrently
OR MATH 2043 to 3080| Required Courses:1|Minimum Grade of C-|May be taken concurrently.

PHYS 2922. Honors General Physics II. 0 or 4 Credit Hours.
This course is typically offered in Spring.
This is the honors version of Physics 2022 and normally follows Physics 2921. Topics include electricity and magnetism, optics, atomic, molecular, and nuclear physics. Biological applications discussed where appropriate.

Two sections are required for this course. This course requires registration for a 0.0 credit Laboratory section in addition to the 4.0 credit Lecture & Recitation section. The Laboratory sections corresponding to a course are listed under the same course number as the Lecture & Recitation sections, but have unique section numbers.

Cohort Restrictions: Must be enrolled in one of the following Cohorts: SCHONORS, UHONORS, UHONORSTR
Course Attributes: HO
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
(PHYS 1061|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2021|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2921|Minimum Grade of C-|May not be taken concurrently
AND (MATH 1042|Minimum Grade of C-|May not be taken concurrently
OR MATH 1942|Minimum Grade of C-|May not be taken concurrently
OR MATH 1951|Minimum Grade of C-|May not be taken concurrently
OR MATH 2043 to 3080| Required Courses:1|Minimum Grade of C-|May be taken concurrently).

PHYS 3083. Directed Reading/Study. 3 Credit Hours.
This course is typically offered in Fall, Spring, Summer I and Summer II.
This course offers the opportunity for more advanced independent study. NOTE: This course may be repeated for credit.
Repeatability: This course may be repeated for additional credit.

PHYS 3091. Research Methods. 3 Credit Hours.
This course is typically offered in Spring.
Research Methods is required for all of the TUteach with Teaching majors. It is one of several content courses specially designed to meet the needs of future teachers. Sections meet two hours per week for non-traditional, interactive lectures and two hours per week for lab. The course is cross-listed in Biology, Chemistry, Earth and Environmental Science, and Physics. The goals of the course are (1) to provide students with the tools that scientists use to solve scientific problems; (2) to give students the opportunity to use these tools in a laboratory setting; (3) to make students aware of how scientists communicate with each other through peer-reviewed scientific literature; and (4) to enable students to understand how scientists develop new knowledge and insights, the most important of which are eventually presented in textbooks and taught in conventional science classes. Students design and carry out four independent inquiries, which they write up and present in the manner that is common in the scientific community. The inquiries incorporate mathematics and the various science disciplines, thus the team of instructors teaching this course have expertise in different disciplines and are available to supervise all students as they work on their inquiries in the lab. The combination of Research Methods and the TUteach course “Perspectives on Science and Mathematics” (Philosophy 2196) provides prospective science and mathematics teachers with an in-depth understanding of how the scientific enterprise works. NOTE: Physics 3091 is only available for major credit in the Physics with Teaching BS program.

College Restrictions: Must be enrolled in one of the following Colleges: Science & Technology
Repeatability: This course may be repeated for additional credit.
Pre-requisites:
SCTC 1289|Minimum Grade of C-|May not be taken concurrently.
PHYS 3101. Analytical Mechanics. 3 Credit Hours.
This course is typically offered in Fall.
Moving coordinate systems, three-body problems, partial differential equations, wave propagation (strings, membranes, fluids), boundary value problems, normal modes, fluid equations of motion, viscosity; virtual work, Lagrange's equations, Hamilton's equations; angular momentum of a rigid body, inertia tensor, Euler's equations, Euler angles, tops and gyroscopes, small vibrations.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 2101|Minimum Grade of C-|May not be taken concurrently.

PHYS 3301. Electricity and Magnetism. 4 Credit Hours.
This course is typically offered in Fall.
Electrostatics, magnetostatics, microscopic interpretation of polarization P and magnetization M, electrostatic and magnetostatic energy, Faraday's Law, self and mutual inductance, magnetic circuits; integral and differential forms of Gauss, Ampere, and Faraday laws; AC circuits; introduction to the displacement current and Maxwell's equations. Laboratory portion of the course provides investigation on DC and AC circuits, bridge circuits, sources of emf, Hall effect, and operational amplifier circuits.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
(PHYS 1062|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2022|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2922|Minimum Grade of C-|May not be taken concurrently)
AND (MATH 2043|Minimum Grade of C-|May not be taken concurrently).

PHYS 3302. Classical Electromagnetism. 3 Credit Hours.
This course is typically offered in Spring.
Solutions to the equations of Poisson and Laplace; multipole expansions; electrostatic and magnetostatic energy, forces, and torques; Maxwell's equations; the wave equation; radiation fields, Poynting's Theorem, microwave and optical waveguides.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
(PHYS 3301|Minimum Grade of C-|May not be taken concurrently
AND (PHYS 2502|Minimum Grade of C-|May not be taken concurrently
OR MATH 4041|Minimum Grade of C-|May not be taken concurrently).

PHYS 3701. Introduction to Quantum Mechanics. 3 Credit Hours.
This course is typically offered in Spring.
Dual nature of light and matter, de Broglie waves, Schrodinger equation, one-dimensional systems, Hermitian operators, eigenfuctions and eigenvalues. Spin and isospin. Two- and three-dimensional systems. Approximation methods. Theory of scattering.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
(PHYS 2701|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2796|Minimum Grade of C-|May not be taken concurrently
AND (PHYS 2502|Minimum Grade of C-|May not be taken concurrently
OR MATH 4041|Minimum Grade of C-|May not be taken concurrently).

PHYS 4091. Undergraduate Research. 2 to 3 Credit Hours.
This course is typically offered in Fall, Spring, Summer I and Summer II.
This course offers the opportunity for undergraduate research in physics.
Repeatability: This course may be repeated for additional credit.

PHYS 4101. Thermodynamics and Kinetic Theory. 3 Credit Hours.
This course is typically offered in Fall.
First, second, and third laws, thermodynamic potentials, kinetic theory, and applications to simple systems. The basic ideas of statistical mechanics.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
(PHYS 1062|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2022|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2922|Minimum Grade of C-|May not be taken concurrently)
AND (MATH 2043|Minimum Grade of C-|May not be taken concurrently).
PHYS 4301. Electronics. 3 Credit Hours.
This course is typically offered in Spring of odd years.
Basic circuit ideas, Thevenin/Norton theorems, input/output impedance, diodes, transistors, feedback, operational amplifiers, elements of digital electronics, transducers for physical measurements. NOTE: Course offered on odd-numbered years.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 3301|Minimum Grade of C-|May not be taken concurrently.

PHYS 4302. Optics. 3 Credit Hours.
This course is typically offered in Fall.
The emphasis of this course is on physical and laser optics. Topics include review of geometric optics, matrix methods in paraxial optics, fiber optics, wave equations, superposition and interference of light, diffraction, polarization of light, coherence, laser operation, characteristics of laser beams and selected modern optics applications.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 2701|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2796|Minimum Grade of C-|May not be taken concurrently
OR CHEM 3301|Minimum Grade of C-|May not be taken concurrently
OR CHEM 3302|Minimum Grade of C-|May not be taken concurrently.

PHYS 4701. Introduction to Solid State Physics. 3 Credit Hours.
This course is typically offered in Spring of even years.
Elementary theory of the solid state. Survey of mechanical, thermal, optical, electrical, and magnetic properties of solids. NOTE: Course offered on even-numbered years.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 3701|Minimum Grade of C-|May not be taken concurrently.

PHYS 4702. Introduction of Atomic, Nuclear, and Particle Physics. 3 Credit Hours.
This course is typically offered in Fall.
Properties atomic structure, atomic spectra, selection rules, atoms in electric and magnetic fields; nuclear properties, radioactive decays, nuclear reactions, fission and fusion, and fundamental properties of elementary particles and their interactions.
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 3701|Minimum Grade of C-|May not be taken concurrently.

PHYS 4796. Experimental Physics. 3 Credit Hours.
This course is typically offered in Spring.
An intermediate laboratory course with an introduction to data analysis and error estimation. Students independently perform two or three experiments, with suitable reports. NOTE: Capstone writing course.
Course Attributes: WI
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 2701|Minimum Grade of C-|May not be taken concurrently
OR PHYS 2796|Minimum Grade of C-|May not be taken concurrently.

PHYS 5001. Introduction to Quantum Computing. 3 Credit Hours.
This course will give an elementary introduction to some basics of quantum information and quantum computing that are accessible to not only physicists but also people with a variety of backgrounds. It will introduce the students to the latest scientific and technological advancement, and prepare for further study and/or initiating research if one wishes to pursue in this field.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits.

PHYS 5101. Analytical Mechanics I. 3 Credit Hours.
Variational principles, Lagrange's and Hamilton's equations; canonical transformations; small oscillations; dynamics of particles, rigid bodies, strings and membranes; hydrodynamics; chaos in deterministic systems.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits.

PHYS 5301. Electromagnetic Theory. 3 Credit Hours.
Boundary value problems of the electrostatic and magnetostatic fields; Maxwell's equations; plane waves at boundaries in dielectric and conducting media; potentials in the Lorentz gauge; Green's functions for wave and Helmholtz equations; multipole radiation; material dispersion; diffraction.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits.
PHYS 5302. Electromagnetic Theory. 3 Credit Hours.
Maxwell stress tensor; relativistic dynamics; Lagrangian formulation of electrodynamics; Noether's theorem; laser resonant cavities and optics of Gaussian beams; Eikonal and geometrical optics limit; synchrotron radiation.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 5301

PHYS 5501. Mathematical Physics I. 3 Credit Hours.
Tensor analysis; group theory; complex variable theory; partial differential equations; Sturm-Liouville systems; integral transforms; integral equations and Green's function methods.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits.

PHYS 5502. Mathematical Physics II. 3 Credit Hours.
Preliminaries; numerical applicability, survey of algorithms, computer modeling, programming considerations; basic numerical methods; numerical linear algebra; numerical solution to ordinary and partial differential equations; molecular dynamics; Monte Carlo simulations; nonlinear methods.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits.

PHYS 5701. Quantum Mechanics I. 3 Credit Hours.
Fundamental principles of quantum mechanics; relation to classical mechanics; Schroedinger and operator formulations; path integrals; Aharonov-Bohm effect; examples of exact solutions; central forces and angular momentum; scattering theory; Bell's theorem.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 5101
AND PHYS 5501

PHYS 5702. Quantum Mechanics II. 3 Credit Hours.
Matrix mechanics; theory of electron spin; Hilbert space formulation of quantum mechanics; transformation theory; theory of rotations; spin and statistics; stationary approximation methods with application to atomic systems; time-dependent perturbation theory; exponential decay.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 5701

PHYS 8001. Practicum Teaching of Physics. 1 Credit Hour.
Required of all graduate teaching assistants in their first semester. Consists of supervised instruction in undergraduate laboratories and a weekly two-hour class.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits.

PHYS 8004. Problems in Experimental Physics. 1 to 6 Credit Hour.
Special problems in the field of experimental physics. The course is designed to acquaint the student with the research techniques employed in experimental physics.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may be repeated for additional credit.

PHYS 8005. Problems in Theoretical Physics. 1 to 6 Credit Hour.
Special problems in the field of theoretical physics. The course is designed to acquaint the student with the research techniques employed in theoretical physics.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may be repeated for additional credit.

PHYS 8020. Topical Seminar II. 3 Credit Hours.
This course considers special topics in Physics, not considered in depth in our other courses.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may be repeated for additional credit.

PHYS 8030. Topical Seminar III. 3 Credit Hours.
This course considers special topics in Physics, not considered in depth in our other courses.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may be repeated for additional credit.
PHYS 8050. Physics Seminar. 0 Credit Hours.
This course provides the graduate students with the state of the field knowledge about Physics. Students attend 10 to 12 Colloquium/Seminars per semester given by the experts, mostly drawn from national and international authorities in the field. The students are graded on the basis of their attendance in these seminars, and are encouraged to discuss their research with these visiting experts. Last year's colloquium included among other experts, a Nobel Laureate, Sir Anthony Leggett, 2003.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may be repeated for additional credit.

PHYS 8102. Statistical Mechanics. 3 Credit Hours.
Review of thermodynamics; kinetic theory; statistical definition of entropy; microcanonical, canonical, and grand canonical ensembles; applications to gases, diatomic molecules, magnetic systems, phase transitions; quantum statistics; ideal boson and fermion systems; Bose-Einstein condensation; black body radiation; models of solids; properties of liquid helium.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 5501|Minimum Grade of B-|May not be taken concurrently
AND PHYS 5701|Minimum Grade of B-|May not be taken concurrently.

PHYS 8701. Advanced Quantum Mechanics. 3 Credit Hours.
Properties of quantized radiation field; emission, absorption and scattering of photons by atoms; nonrelativistic Lamb shift; Dirac equation: nonrelativistic limit, Lorentz covariance, exact solutions; hole theory; Lagrangian field theory; field quantization; S-matrix; covariant perturbation theory; Feynman rules for QED with application to various processes.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 5702|Minimum Grade of B-|May not be taken concurrently
AND PHYS 8702|Minimum Grade of B-|May not be taken concurrently.

PHYS 8702. Solid State Physics. 3 Credit Hours.
Crystal and x-ray diffraction; lattice vibrations and thermal properties; energy bands and electronic properties; semiconductors; optical and dielectric properties; para-, ferro-, and antiferromagnetism; introduction to superconductivity and superfluidity.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 5701|Minimum Grade of B-|May be taken concurrently
AND PHYS 5702|Minimum Grade of B-|May be taken concurrently.

PHYS 8703. Introduction to Elementary Particles Physics. 3 Credit Hours.
The Standard Model (SM); gauge invariance, non-Abelian gauge theories, SM Lagrangian, electroweak theory and QCD, Higgs mechanism, confinement; experimental considerations: accelerators and detectors, elastic scattering and form factors, deep inelastic scattering and structure functions; advanced topics in the SM: grand unification, neutrino mass, big bang cosmology, dark matter.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 5702|Minimum Grade of B-|May not be taken concurrently
AND PHYS 8702|Minimum Grade of B-|May not be taken concurrently.

PHYS 8704. Many Electron Theory. 3 Credit Hours.
The course is at an intermediate level and is appropriate for students of experimental and theoretical condensed matter and AMO physics. The course familiarizes students with the theory of correlated electrons and states with broken electron symmetry, it also provides a framework for the description of experimental properties in materials with electron correlations. Many-electron wavefunctions, Functionals and their extrema, Wavefunction variational principles, Hellmann-Feynman theorem, One- and two-particle density matrices, and the electron density Wavefunction vs. density functional methods, Hohenberg-Kohn theorem, Functional derivatives, Uniform electron gas Kohn-Sham spin-density functional theory, Approximate functionals, Linear Response Theory and Stability, Collective Excitations, Superconducting Instability, Magnetic Instabilities, Charge Density Wave Instabilities in low-dimensional systems, Ferromagnetic, Spin and Orbital density wave phases, Instabilities of the Half-Filled Band, BCS Theory of Superconductivity, s, p and d wave pairing, the Integer and Fractional Quantum Hall States, Collective Excitations and Goldstone Modes.

Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
College Restrictions: Must be enrolled in one of the following Colleges: Science & Technology
Repeatability: This course may not be repeated for additional credits
Pre-requisites:
PHYS 8702|Minimum Grade of B-|May not be taken concurrently.
PHYS 8985. Teach in Higher Ed: Phys. 2 Credit Hours.
Teaching in Higher Ed: Physics. This course focuses on learning theory and the best teaching practices, with the aim of preparing students for effective higher education teaching.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may not be repeated for additional credits.

PHYS 9994. Preliminary Examination Preparation. 1 to 6 Credit Hour.
Comprehensive systematic study in preparation for the Ph.D. preliminary examination.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may be repeated for additional credit.

PHYS 9996. Master’s Thesis. 1 to 6 Credit Hour.
Master’s thesis research under the supervision of a member of the Graduate Faculty.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may be repeated for additional credit.

PHYS 9998. Pre-Dissertation Research. 1 to 6 Credit Hour.
Preliminary proposal research in a sub-field of physics designed to enable the student to identify a topic suitable for Ph.D. dissertation.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Repeatability: This course may be repeated for additional credit.

PHYS 9999. Ph.D. Dissertation. 1 to 12 Credit Hour.
Ongoing, post-candidacy research for the Ph.D. dissertation.
Level Registration Restrictions: Must be enrolled in one of the following Levels: Graduate
Student Attribute restrictions: Must be enrolled in one of the following Student Attributes: Dissertation Writing Student
Repeatability: This course may be repeated for additional credit.