A Certain Slant on Light

PHYS 100 CREDITS: 0.5 QR

For many centuries, both scientists and artists have pondered on the myriad compositions of light, including rainbows, shadows, colors and mirages. While the beauty of these phenomena are fascinating, it is also rewarding to grapple with the underlying theory that explains them. In this course, students will explore how light can be modelled as a ray, wave or a particle, and use these ideas to explain concepts such as reflection, refraction, scattering, diffraction and absorption. Several in-class laboratory exercises will be performed in order to strengthen the conceptual understanding of light. Throughout the course, the focus will be to explain various phenomena, ranging from fiber-optic technology to pointillism. A final project, which synthesizes the conceptual understanding of light, is required, and students will be encouraged to follow their interests, through various forms, in order to fulfill it. While the course will have some mathematical content -- simple algebra and geometry -- it is open to any student and does not count toward the physics major. No prerequisite.

Rocket Science

PHYS 101 CREDITS: 0.5 QR

"Rocket science" may be proverbial as a complex subject impossible for the ordinary person to understand, but in fact its essential principles are entirely accessible to any Kenyon student. Our course explores the basic concepts of rocket propulsion and spaceflight, including Newton's laws of motion, ballistics, aerodynamics, the physics and chemistry of rocket motors, orbital mechanics and beyond. Simple algebra, numerical calculations and data analysis help us apply the principles to real situations. We also delve into the history of astronautics, from the visionary speculations of Tsiolkovsky and Goddard to the missiles and space vehicles of today. Finally, we take a look at some of the developments in technology and space exploration that may lie just around the corner. In addition to the regular class meeting, there will be several evening and weekend lab sessions, during which we will design, build, test and fly model rockets powered by commercial solid-fuel engines. A willingness to build upon high school science and mathematics is expected. This course does not count toward the physics major. No prerequisite.

Good Nukes, Bad Nukes

PHYS 102 CREDITS: 0.5 QR

Nuclear power produces needed energy, but nuclear waste threatens our future. Nuclear weapons make us strong, but dirty bombs make us vulnerable. Nuclear medicine can cure us, but nuclear radiation can kill us. Radiocarbon dating tells us about the past, but it can challenge religious faith. This course is designed to give each student the scientific knowledge necessary to understand and participate in public discussions of nuclear issues. The concepts include classification of nuclei, the types

of energy (radiation) released in nuclear reactions, the interactions of that radiation with matter, including human health effects, and the design of nuclear reactors and nuclear weapons. Hands-on demonstrations and experiments will explore radioactive decay, antimatter, transmutation of atoms, nuclear detectors and interactions of radiation with matter. We will apply the core concepts to understanding contemporary issues, such as electric power generation using nuclear energy, including its environmental effects; advances in nuclear medicine; the challenges of preventing nuclear weapons proliferation; the threat of "dirty bombs"; and dating the universe. We also will cover the history of the Manhattan Project and the use of nuclear weapons that brought an end to World War II. The course will offer a field trip to at least one significant nuclear site in Ohio. This course is ~~designed to be~~ accessible to any student and does not count toward the physics major. No prerequisite.

Creating with Gadgets

PHYS 103 CREDITS: 0.25

In this course, students will learn to use motors, relays, microcontrollers and electronic components to design and build computer-controlled devices, small robots and interactive gizmos increasingly employed in projects by artists, designers and scientists. The primary tool will be the Arduino open source microcontroller environment. Developed for use by designers, artists and hobbyists, the Arduino environment provides a wide array of options for implementing automation and interaction between a physical device and its environment. It is used in applications ranging from interactive installation art to smart home technologies and hardware control in scientific applications. The course will combine laboratory exercises, homework assignments, individual and group project work, and a culminating public presentation. The course does not count toward the physics major. No prerequisite.

Einstein

PHYS 104 CREDITS: 0.5 QR

Over one hundred years ago, Albert Einstein helped launch a far-reaching revolution in physics. His relativity theories are justly famous, but he also made amazing discoveries about quantum mechanics and the statistical properties of matter and radiation. This course will focus on Einstein's life, his scientific contributions and his role in the creation of modern physics. We will find that his insights are significant, not just for microscopic particles or distant galaxies, but for the phenomena of everyday life. Lectures, discussions and readings (including Einstein's own works) will be supplemented by laboratory experiments. The course will have some mathematical content, simple algebra and geometry, but is accessible to any student. ~~and~~ This course does not count toward the physics major. No prerequisite.

Frontiers of Gravity

PHYS 105 CREDITS: 0.5 QR

Gravity is at once the most familiar and most mysterious of the basic forces of nature. It shapes the formation, structure and motion of stars, galaxies and the cosmos itself. Also, because gravity affects everything, it enables us to investigate parts of the universe that are otherwise invisible to us. This course will explore the role of gravity in a few vibrant areas of contemporary astrophysics: the search for planets beyond our solar system, the discovery of giant black holes in the nuclei of galaxies, the generation and detection of gravitational waves and the evidence for dark matter and dark energy in our universe. In addition to the scheduled class lectures and discussions, students will be required to meet a few times during the semester for evening laboratories. This course does not count toward the physics major. No prerequisite.

Astronomy: Planets and Moons

PHYS 106 CREDITS: 0.5

This course introduces the modern understanding of the solar system, including planets, moons and smaller bodies (asteroids, comets, meteorites). Topics include planetary interiors, surface modification processes, planetary atmospheres and the evolution of the solar system. Evening laboratory sessions will utilize a variety of methods for exploring space-science topics, including telescopic observations, computer simulations and laboratory investigations. This course does not count toward the physics major. No prerequisite.

Astronomy: Stars and Galaxies

PHYS 107 CREDITS: 0.5 QR

This course surveys current knowledge of the physical nature of stars and galaxies. Topics include the sun and other stars, the evolution of stars, interstellar matter, the end products of stellar evolution (including pulsars and black holes), the organization of stellar systems such as clusters and galaxies, and the large-scale structure of the universe itself. Evening laboratory sessions will include telescopic observation, laboratory investigations of light and spectra, and computer modeling and simulation exercises. This course does not count toward the physics major. No prerequisite.

Geology

PHYS 108 CREDITS: 0.5

As an introduction to the geosciences designed for all students, this course surveys a wide range of physical geology topics. Our initial coverage of minerals and rocks, the basic building blocks of the world around us, includes discussions of the environments in which they form and the major processes operating in these environments. Hands-on exercises are designed to aid in the identification of these basic components of the Earth and to teach students how to recognize clues to their formation. Students will use this knowledge in a series of self-guided on-campus "field trips." Our coverage of plate tectonics includes discussions of the major evidence in support of this grand unifying theory of geology, including seismicity and earthquakes, volcanism and plutonic activity, orogenesis and structural geology, and geomagnetism and paleogeographic reconstruction. We will establish these ideas in a global context and apply them to the geologic history of the North American continent. Requirements include laboratory exercises, on-campus field trips, at least one off-campus field trip and small group projects. This course does not count toward the physics major. No prerequisite.

Origins

PHYS 109 CREDITS: 0.5

Around us we see a vast, expanding universe of galaxies. The galaxies are composed of stars, some of which planets orbit. At least one of these planets in the universe is inhabited by an astoundingly complex set of living things. Where did all this come from? This course presents an overview of the formation and evolution of the universe, the solar system, planet Earth, and life on our planet. Astronomical observations, computer simulations and laboratory experiments will supplement lectures and readings. This course does not count toward the physics major. No prerequisite.

General Physics I

PHYS 130 CREDITS: 0.5 QR

This course is the first course in a one-year introductory physics sequence. Topics include Newtonian mechanics, work and energy, fluids, and electric fields. When possible, examples will relate to life-science contexts. The course will be taught using a combination of lectures, in-class exercises, homework assignments and examinations. Knowledge of calculus is not required. This course does not count towards the physics major. Prerequisite: sophomore standing and concurrent enrollment in PHYS 131. Offered every fall.

Introduction to Experimental Physics I

PHYS 131 CREDITS: 0.25 QR

This laboratory course meets one afternoon each week and is organized around weekly experiments that explore the phenomena of classical mechanics and electromagnetism, including motion, forces, fluid mechanics and conservation of energy and momentum. Lectures cover the theory and instrumentation required to understand each experiment. Experimental techniques emphasize computerized acquisition and analysis of video images to study motion. Students are introduced to computer-assisted graphical and statistical analysis of data as well as the analysis of experimental uncertainty. This course does not count toward the physics major. Prerequisite: concurrent enrollment in PHYS 130 (or PHYS 140 for sophomores enrolled in PHYS 140). Offered every fall.

Except in rare circumstances, this...

General Physics II

PHYS 135 CREDITS: 0.5 QR

This course is the second course in a one-year introductory physics sequence.

~~This course focuses on a wide variety of physics topics relevant to students in the life sciences~~. Topics include wave phenomena, geometrical and physical optics, elementary quantum theory, atomic physics, X-rays, radioactivity, nuclear physics and thermodynamics. When possible, examples will relate to life-science contexts. The course will be taught using a combination of lectures, in-class exercises, homework assignments and examinations. This course does not count toward the physics major. Prerequisite: PHYS 130 and concurrent enrollment in PHYS 136. Offered every spring.

Knowledge of calculus is not required.

Introduction to Experimental Physics II

PHYS 136 CREDITS: 0.25

This laboratory course meets one afternoon each week and is organized around weekly experiments that explore the phenomena of wave~~, phenomena,~~ geometrical and physical optics, elementary quantum theory, atomic physics, X-rays, radioactivity, nuclear physics and thermodynamics. Lectures cover the theory and instrumentation required to understand each experiment. Students will continue to develop skills in computer-assisted graphical and statistical analysis of data as well as the analysis of experimental uncertainty. This course does not count toward the physics major. Prerequisite: Phys 131 and concurrent enrollment in PHYS 135. Offered every ~~fall.~~ Spring.

Classical Physics

PHYS 140 CREDITS: 0.5 QR

(Phys 140, 145, & 240)

This lecture course is the first in a three-semester, calculus-based introduction to physics. Topics include the kinematics and dynamics of particles and solid objects; work and energy; linear and angular momentum; and gravitational, electrostatic and magnetic forces. PHYS 140~~, 145 and 240 are~~ is

recommended for students who might major in physics and is also appropriate for students majoring in other sciences and mathematics, particularly those who are considering careers in engineering. The course will be taught using a combination of lectures, in-class exercises, homework assignments and examinations. This course is required for the physics major. Prerequisite: concurrent enrollment in or credit for MATH 111 ~~(if not previously taken)~~ and concurrent enrollment in PHYS 141 (first-year students) or PHYS 131 (sophomore students). Open only to first-year and sophomore students. Offered every fall.

First Year Seminar in Physics

PHYS 141 CREDITS: 0.25 QR

This seminar will explore a significant current topic in physics that will challenge first-year students. The topic varies from year to year. In the past, the seminar has explored such topics such nanoscience, astrophysics, particle physics, biological physics and gravitation. In addition to introducing the fundamental physics connected with these topics, the course will expose students to recent developments, as the topics are often closely related to the research area of faculty teaching the seminar. The seminar meets one evening a week for lectures, discussions, laboratory experiments and computer exercises. This course fulfills the concurrent laboratory requirement of PHYS 140 and serves as solid preparation for PHYS 146. This course is required for the physics major. Prerequisite: first-year students who are concurrently enrolled in or have placed out of PHYS 140. Offered every fall.

Modern Physics

PHYS 145 CREDITS: 0.5 QR

This lecture course is the second in a three-semester, ~~a continuation of the~~ calculus-based introduction to physics, ~~PHYS 140, and~~ focusing ~~focuses~~ on the physics of the 20th century. Topics include geometrical and wave optics, special relativity, photons, photon-electron interactions, elementary quantum theory (including wave-particle duality, the Heisenberg uncertainty principle, and the time-independent Schrödinger equation), atomic physics, solid-state physics, nuclear physics and elementary particles. PHYS 145 is recommended for students who might major in physics and is appropriate for students majoring in other sciences or mathematics, particularly those who are considering careers in engineering. The course will be taught using a combination of lectures, in-class exercises, homework assignments and examinations. Open only to first-year and sophomore students. This course is required for the physics major. Prerequisite: PHYS 140 and MATH 111 ~~or permission of instructor~~ or equivalent and concurrent enrollment in PHYS 146 and MATH 112 ~~or permission of department chair~~. Offered every spring.

Modern Physics Lab

PHYS 146 CREDITS: 0.25 QR

This laboratory course is a corequisite for all students enrolled in PHYS ~~135 or~~ 145. The course meets one afternoon each week and is organized around weekly experiments ~~demonstrating~~ exploring the phenomena of waves, optics, X-rays, and atomic and nuclear physics. Lectures cover the theory and instrumentation required to understand each experiment. Experimental techniques include the use of lasers, X-ray diffraction and fluorescence, optical spectroscopy, and nuclear counting and spectroscopy. Students are introduced to computer-assisted graphical and statistical analysis of data, as well as the analysis of experimental uncertainty. This course is required for the physics major. Prerequisite: PHYS 131 or 141 and concurrent enrollment in PHYS 145. Offered every spring.

Fields and Spacetime

PHYS 240 CREDITS: 0.5 QR

This lecture course is the third semester of the calculus-based introductory sequence in physics, which begins with PHYS 140 and PHYS 145. Topics include electric charge, electric and magnetic fields, electrostatic potentials, electromagnetic induction, Maxwell's equations in integral form, electromagnetic waves, the postulates of the special theory of relativity, relativistic kinematics and dynamics, and the connections between special relativity and electromagnetism. This course may be an appropriate first course for particularly strong students with advanced placement in physics and mathematics, such students must be interviewed by and obtain permission from the chair of the Physics Department. This course is required for the physics major. Prerequisite: PHYS 140 or equivalent and concurrent enrollment in PHYS 241 (upperclass students) or PHYS 141 (first-years) and MATH 213 or equivalent. Offered every fall.

Fields and Spacetime Laboratory

PHYS 241 CREDITS: 0.25 QR

This laboratory course is a corequisite for all upperclass students enrolled in PHYS 240. The course is organized around experiments demonstrating various phenomena associated with the special theory of relativity and electric and magnetic fields. Lectures cover the theory and instrumentation required to understand each experiment. Laboratory work emphasizes computerized acquisition and analysis of data, the use of a wide variety of modern instrumentation and the analysis of experimental uncertainty. This course is required for the physics major. Prerequisite: PHYS 146 and concurrent enrollment in PHYS 240. Offered every fall.

Oscillations and Waves

PHYS 245 CREDITS: 0.5 QR

The topics of oscillations and waves serve to unify many subfields of physics. This course begins with a discussion of damped and undamped, free and driven, and mechanical and electrical oscillations. Oscillations of coupled bodies and normal modes of oscillations are studied along with the techniques of Fourier analysis and synthesis. We then consider waves and wave equations in continuous and discontinuous media, both bounded and unbounded. The course may also treat properties of the special mathematical functions that are the solutions to wave equations in non-Cartesian coordinate systems. This course is required for the physics major. Prerequisite: PHYS 145 and 240. Offered every spring.

Introduction to Computational Physics

PHYS 270 CREDITS: 0.5 QR

As modern computers become more capable, a new mode of investigation is emerging in all science disciplines, using computers to model the natural world and ~~solving~~ to solve model equations numerically rather than analytically. Thus, computational physics is assuming co-equal status with theoretical and experimental physics as a way to explore physical systems. This course will introduce students to a variety of computational methods, which could include the methods of computational physics, numerical integration, numerical solutions of differential equations, Monte Carlo techniques and discrete Fourier transforms. Students will learn to implement these techniques in the computer language C, a widely used high-level programming language in computational physics, and for some techniques students may also learn implementations in the computer language Python. In addition, the course will expand students' capabilities in using a symbolic algebra program (Mathematica) to aid in theoretical analysis and in scientific visualization. This course is required for the physics major. Prerequisite: PHYS 240 and MATH 112 or permission of instructor. Offered every spring. (period)

Classical Mechanics

PHYS 340 CREDITS: 0.5 QR

This course begins by revisiting most of the Newtonian mechanics learned in introductory physics courses but with added mathematical sophistication. A major part of the course will be spent understanding an alternate description to that of the Newtonian picture: the Lagrange-Hamilton formulation. The course will also cover the topics of motion in a central field, classical scattering theory, motion in non-inertial reference frames and dynamics of rigid body rotations. This counts toward the theoretical elective for the major. Prerequisite: PHYS 245 and MATH 213. Offered every other year, fall semester.

Astrophysics and Particles

PHYS 345 CREDITS: 0.5 QR

From particle accelerators to galaxies and stars to the big bang, high-energy particle physics and astrophysics address the sciences' most fundamental questions. This course will cover topics of contemporary relevance from the combined fields of cosmology, astrophysics, phenomenological particle physics, relativity and field theory. Topics may include the big bang, cosmic inflation, the standard model of particle physics, an introduction to general relativity, and the structure and evolution of stars and galaxies' stellar structure and galactic evolution. This counts toward the theoretical elective for the major. Prerequisite: PHYS 350 or permission of instructor. Offered every other year, spring semester.

Electricity and Magnetism

PHYS 350 CREDITS: 0.5 QR

In this course we develop further the basic concepts of electricity and magnetism previously discussed in PHYS 240 and introduce mathematical techniques for analyzing and calculating static fields from source distributions. These techniques include vector calculus, Laplace's equation, the method of images, separation of variables and multipole expansions. We will revisit Maxwell's equations and consider the physics of time-dependent fields and the origin of electromagnetic radiation. Other topics include the electric and magnetic properties of matter. This course provides a solid introduction to electrodynamics and is a must for students who plan to study physics in graduate school. This counts toward the theoretical elective for the major. Prerequisite: PHYS 245 and MATH 213. Offered every other year, fall semester.

Optics

PHYS 355 CREDITS: 0.5 QR

The course begins with a discussion of the wave nature of light. The remainder of the course is concerned with the study of electromagnetic waves and their interactions with lenses, apertures of various configurations and matter. Topics include the properties of waves, reflection, refraction, interference, and Fraunhofer and Fresnel diffraction, along with Fourier optics and coherence theory. This counts toward the theoretical elective for the major. Prerequisite: PHYS 350 or permission of instructor. Offered every other year, spring semester.

Quantum Mechanics

PHYS 360 CREDITS: 0.5 QR

This course presents an introduction to theoretical quantum mechanics. Topics include wave mechanics, the Schrödinger equation, angular momentum, the hydrogen atom and spin. This counts toward the theoretical elective for the major. Prerequisite: PHYS 245 and MATH 213. Offered every other year, fall semester.

Quantum Mechanics II

PHYS 365 CREDITS: 0.5 QR

This course extends the formalism of quantum mechanics and applies it to a variety of physical systems. Topics covered may include atomic and molecular spectra, nuclear structure and reactions, NMR, scattering, perturbation theory, quantum optics, open system dynamics and quantum entanglement. This counts toward the theoretical elective for the major. Prerequisite: PHYS 360. Offered every other year, spring semester.

Thermodynamics and Statistical Mechanics

PHYS 370 CREDITS: 0.5 QR

This introduction to thermodynamics and statistical mechanics focuses on how microscopic physical processes give rise to macroscopic phenomena; that is, how, when averaged, the dynamics of atoms and molecules can explain the large-scale behavior of solids, liquids and gases. We extend the concept of conservation of energy to include thermal energy, or heat, and develop the concept of entropy for use in determining equilibrium states. We then apply these concepts to a wide variety of physical systems, from steam engines to superfluids. This counts toward the theoretical elective for the major. Prerequisite: PHYS 245 and MATH 213. Offered every other year, fall semester.

Condensed Matter Physics

PHYS 375 CREDITS: 0.5 QR

Modern field theories may find their inspiration in the quest for understanding the most fundamental forces of the universe, but they find crucial tests and fruitful applications when used to describe the properties of the materials that make up our everyday world. In fact, these theories have made great strides in allowing scientists to create new materials with properties that have revolutionized technology and our daily lives. This course will include crystal structure as the fundamental building block of most solid materials; how crystal lattice periodicity creates electronic band structure; the electron-hole pair as the fundamental excitation of the "sea" of electrons; and Bose-Einstein condensation as a model for superfluidity and superconductivity. Additional topics will be selected from the renormalization group theory of continuous phase transitions, the interaction of light with matter, magnetic materials and nanostructures. There will be a limited number of labs on topics such as crystal

growth, X-ray diffraction as a probe of crystal structure, specific heat of metals at low temperature and spectroscopic ellipsometry. This counts toward the theoretical elective for the major. Prerequisite: PHYS 360. Offered every other year, spring semester.

Introduction to Electronics

PHYS 380 CREDITS: 0.25 QR

This course will build upon the foundation developed in PHYS 240 and 241 for measuring and analyzing electrical signals in DC and AC circuits, introducing students to many of the tools and techniques of modern electronics. Familiarity with this array of practical tools will prepare students for engaging in undergraduate research opportunities as well as laboratory work in graduate school or industry settings. Students will learn to use oscilloscopes, meters, LabVIEW and various other tools to design and characterize simple analog and digital electronic circuits. The project-based approach used in this and associated courses (PHYS 381 and 382) fosters independence and creativity. The hands-on nature of the labs and projects will help students build practical experimental skills including schematic and data sheet reading, soldering, interfacing circuits with measurement or control instruments and troubleshooting problems with components, wiring and measurement devices. In each electronics course, students will practice documenting work thoroughly, by tracking work in lab notebooks with written records, diagrams, schematics, data tables, graphs and program listings. Students will also engage in directed analysis of the theoretical operation of components and circuits through lab notebook explanations, worksheets and occasional problem sets. Students may be asked to research and present to the class a related application of the principles learned during investigations. This course is required as part of the one (1) unit of upper-level experimental physics coursework to complete the major in physics. Prerequisite: PHYS 240. Offered every ~~year and~~ fall runs the first half of the semester only.

Projects in Electronics 1

PHYS 381 CREDITS: 0.25 QR

In this course, students will explore circuit design and analysis for active and passive analog circuit elements, from the physics of the components (semiconductor diodes, transistors) to the behavior of multi-stage circuits. Experiments will explore transistors, amplifiers, amplifier design and frequency-sensitive feedback networks. This counts toward the experimental elective for the major. Prerequisite: PHYS 380 (may be taken in the same semester). Offered ~~in~~ alternate years ~~and~~ in fall semester runs the second half of the semester only.

Projects in Electronics 2

PHYS 382 CREDITS: 0.25 QR

In this course, students will explore applications of integrated circuits (ICs), the fundamental building blocks of electronic devices such as personal computers, smart phones and virtually every other electronic device in use today. Taking a two-pronged approach, the course will include experimentation with basic ICs such as logic gates and timers as well as with multipurpose ICs such as microcontrollers that can be programmed to mimic the function of many basic ICs. This counts toward the experimental elective for the major. Prerequisite: PHYS 380 (may be taken in the same semester). Offered ~~in~~ alternate years ~~and~~ runs in the second half of the semester only.

in fall semester

Advanced Experimental Physics 1

PHYS 385 CREDITS: 0.25 QR

This course is an introduction to upper-level experimental physics that will prepare students for work in original research in physics and for work in industry applications of physics. Students will acquire skills in experimental design, observation, material preparation and handling, and equipment calibration and operation. Experiments will be selected to introduce students to concepts, techniques and equipment useful in understanding physical phenomena across a wide range of physics subdisciplines, with the twofold goal of providing a broad overview of several branches of experimental physics and preparing students to undertake any experiments in PHYS 386 and 387. This course is required as part of the one (1) unit of upper-level experimental physics coursework to complete the major in physics. Prerequisite: PHYS 241 and 245. Offered every ~~year and~~ runs the first half of the semester only.

spring

Advanced Experimental Physics 2

PHYS 386 CREDITS: 0.25 QR

In this course students will explore fundamental physical interactions between light and matter, such as Compton scattering, Rayleigh and Mie scattering, and matter-antimatter annihilation, while also learning to use common nuclear and optical detection and analysis techniques. This counts toward the experimental elective for the major. Prerequisite: PHYS 385 (may be taken in the same semester). Offered ~~in~~ alternate years ~~and~~ runs the second half of the semester only.

in spring semester

Advanced Experimental Physics 3

PHYS 387 CREDITS: 0.25 QR

In this course students will probe the structure of solids using X-ray crystallography and atomic force microscopy, study the physical properties of semiconductors, and use the manipulation of magnetic fields to examine the resonant absorption of energy in atoms and nuclei. This counts toward the experimental elective for the major. Prerequisite: PHYS 385 (may be taken in the same semester). Offered ~~in~~ alternate years ~~and~~ runs the second half of the semester only.

in spring semester;

Research in Physics

PHYS 390 CREDITS: 0.25 - 0.5

Section 01 (0.25 units): In this course students will conduct research, synthesize and share experiences, attend professional presentations in the department, and present their research with oral and written presentations. Students will complete a minimum of three hours of independent research under the supervision of a faculty member as well as participate in ~~discussion sections~~ and other commitments as designed by the instructor. This course does not count toward any major requirement. Permission of instructor required. Offered every semester.

three to four hours

per week

Section 02 (0.5 units): This section carries the same requirements as Section 01, except that the time commitment is six to eight hours of individual research under the supervision of a faculty member. This section represents a significant commitment to a research project. Enrollment in this section requires consultation with the department chair. This course does not count toward any major requirement. Permission of instructor required. Offered every semester.

per week

in addition to participation in other commitments as designed by the instructor.

Individual Study

PHYS 493 CREDITS: 0.25 - 0.5

Individual studies may involve various types of inquiry: reading, problem solving, experimentation, computation, etc. To enroll in individual study, a student must identify a physics faculty member willing to guide the course and work with that professor to develop a description. The description should include topics and content areas, learning goals, prior coursework qualifying the student to pursue the study, resources to be used (e.g., specific texts, instrumentation), a list of assignments and the weight of each in the final grade, and a detailed schedule of meetings and assignments. The student must submit this description to the Physics Department chair. In the case of a small-group individual study, a single description may be submitted, and all students must follow that plan. The amount of work in an individual study should approximate the work typically required in other physics courses of similar types at similar levels, adjusted for the amount of credit to be awarded. An individual study course in physics is designed for .25 unit of credit. Individual study courses should supplement, not replace, courses regularly offered by the department. Because students must enroll for individual studies by the end of the seventh class day of each semester, they should begin discussion of the proposed individual study

typically

for approval

preferably the semester before, so that there is time to devise the proposal and seek departmental approval before the established deadline. Individual studies do not count towards the QR (quantitative reasoning) requirement. If a student wishes to satisfy the QR requirement through an individual study in physics, they must receive approval through the college petition process.

Senior Honors

PHYS 497Y CREDITS: 0.5

This course offers guided experimental or theoretical research for senior honors candidates. Students enrolled in this course will be automatically added to PHYS 498Y for the spring semester. Permission of instructor and department chair required. Cumulative GPA above college-mandated minimum required.

Senior Honors

PHYS 498Y CREDITS: 0.5

This course offers guided experimental or theoretical research for senior honors candidates. Permission of instructor and department chair required. Cumulative GPA above college-mandated minimum required.