PHYSICS (PHYS)

PHYS105 Science of Sustainability
What is sustainability? It most certainly is not switching light bulbs or "buying organic," although perhaps those activities contribute to sustainability. The task for our course will be to undertake a scientific inquiry into the conditions for an enduring human presence on Earth. To do so, we must begin with physical principles, examining both what humans require and demand from the world and what the world is capable of providing. Our inquiry will broaden to include chemical and ecological principles, ultimately asking what the social sciences can do to illuminate the problem without violating the physical constraints nature imposes.

Students should have a familiarity with quantitative and algebraic concepts and, above all, a desire to incorporate quantitative thinking into verbal discourse. Writing is also a core element of the course with frequent writing assignments in various formats.
Offering: **Host**
Grading: **OPT**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Identical With: **ENVS235**
Prereq: **None**

PHYS107 Life in the Cell from a Molecule's Perspective
What does DNA look like when it is not condensed into chromosomes? How do partners in molecular processes find each other? If a molecular motor "walks," how does it take a step? We will explore these major topics in molecular biophysics by discussing primary scientific literature. Emphasis will be placed on revealing the ways in which our understanding of biological processes can be improved by understanding the underlying physics. Students should have a broad high school science background, familiarity with quantitative and algebraic concepts, and a desire to incorporate quantitative thinking into verbal discourse. Writing is a core element of the course.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **MB&B117**
Prereq: **None**

PHYS111 Introductory Physics I
This course, along with PHYS 112 in the spring semester, is an introduction to the fundamental principles of physics. Employing trigonometry, algebra, and basic calculus, the goal is to provide tools for the quantitative understanding of a wide variety of phenomena, with many examples taken from the life sciences. The lab PHYS121 is recommended.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Prereq: **None**

PHYS112 Introductory Physics II
This is the second of two non-calculus courses covering fundamental principles of physics. The emphasis is on developing a conceptual understanding of the physical processes that govern our universe. Proficiency in elementary algebra, vector algebra, trigonometry, and arithmetic is required. The lab PHYS122 is recommended.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Prereq: **PHYS111**

PHYS113 General Physics I
This course is the first term of a general physics course with calculus, recommended for students interested in majoring in the sciences. With the focus on Newtonian dynamics, PHYS 113 seeks to develop both conceptual understanding and the ability to use this knowledge to obtain quantitative predictions of how the universe works. Through a collaborative and interactive classroom experience, students develop problem-solving skills and a mathematical description of mechanics. The associated lab, PHYS123, is highly recommended.

PHYS113 and PHYS116 are part of a sequence of courses that lead into the physics major. PHYS113 is a pre-requisite for PHYS116; therefore, students must take them in sequence.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Prereq: **None**

PHYS115 Newtonian Mechanics
This course in classical mechanics assumes a level of familiarity with general physics and comfort with vectors and calculus that is not assumed in PHYS113. This course will study classical mechanics at a level that is rigorous and mathematically sophisticated, employing contemporary instructional techniques. It will also teach elementary programming and data analysis skills essential to physical science. The course may be ideal for students who have previously taken a general physics course but not at the level required as preparation for PHYS324, Electricity and Magnetism.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Prereq: **None**

PHYS116 General Physics II
This course is the second term of a general physics course with calculus, recommended for students interested in majoring in the sciences. The focus is on the physics of charged particles, including an introduction to the concepts of electric and magnetic fields. Students will develop both conceptual understanding of how charged particles give rise to both electricity and magnetism and the ability to use this knowledge to quantitatively describe the behavior of these particles in a variety of contexts, including electrical devices. Through a collaborative and interactive classroom experience, students develop problem-solving skills and a mathematical description of electricity and magnetism. The associated lab PHYS124 is highly recommended; any student wishing to major in physics should enroll in PHYS124, since it is a requirement for the major.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Prereq: **PHYS113**

PHYS121 Physics Laboratory I
This laboratory course provides experience with phenomena discussed in PHYS111 lectures. While this course is not required by the Physics Department, students planning to enter the health professions should be aware that a year of physics WITH LABORATORY is usually required for admission. Consult your major advisor if you are in doubt about similar requirements in your field. Each laboratory is limited to 16.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.50**

Gen Ed Area: **NSM-PHYS**
Prereq: **None**

PHYS122 Physics Laboratory II
This course provides laboratory experiences for students taking PHYS112.

This laboratory course teaches students how to obtain, process, and evaluate data and compare these data with quantitative models of how our world works.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Prereq: **None**

PHYS123 General Physics Laboratory I
This laboratory course provides experience with phenomena discussed in PHYS113 lecture, integrating calculus with the experiments.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Prereq: **None**

PHYS124 General Physics Laboratory II
This laboratory course is designed to be taken in conjunction with PHYS116. Students will get hands-on experience with physical systems that demonstrate the principles being studied in PHYS116. Hands-on experience helps in developing physical intuition, a deeper understanding of the course material, and the world around us. The emphasis in this course is on experimental technique and the proper identification, appreciation, and handling of experimental error.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Prereq: **PHYS113 OR PHYS123**

PHYS162 It's About Time
The course will explore ideas and tools that help us to conceptualize and quantify time. Measurement of time has been accomplished by careful observation of celestial objects, counting growth rings in trees, or determining the abundance of radioactive decay products, and with devices as varied as the hour glass and the atomic clock. A thorough investigation of these and other methods and tools will illuminate old and new views of time and will allow us to venture into various fields of physics such as classical mechanics, the theory of relativity, atomic and nuclear physics, electricity, and optics. Along the way, we will discuss concepts including, but not limited to: the origin of time, its smoothness, time dilation, the relativity of simultaneity, and the direction of time's arrow.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Prereq: **None**

PHYS170 Introduction to Design and Engineering
This course will provide a hands-on introduction to design and engineering. Students will engage in individual and team projects in a studio environment where we seek to develop a shared practice and understanding of the engineering design process. We will study biological organisms to find inspiration for design of hoppers, swimmers, and climbers. Students will build skills using computer-aided design (CAD) software and using tools for fabrication and prototyping including laser cutting and 3D printing. We will also hone skills in identifying which scientific and engineering principles need to be understood to achieve design goals.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **1.00**
Gen Ed Area: **NSM-CIS**
Identical With: **IDEA170, CIS170**
Prereq: **None**

PHYS207 Introduction to Biophysics
This course will introduce students to major topics in biophysics with an emphasis on the statistical physics of biological systems at the microscopic or molecular level. Topics covered will include molecular motors, self-assembly, and single-molecule manipulation. Students will learn how physical arguments and reasoning can provide significant insight into the design and function of biological systems. While this course is geared toward students who have had a full year of calculus-based physics, relevant concepts in biology and chemistry will be introduced as needed. No detailed knowledge of biology or chemistry beyond the high-school level is required for this course.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **PHYS116**

PHYS213 Waves and Oscillations
The properties of periodic motion recur in many areas of physics, including mechanics, quantum physics, and electricity and magnetism. We will explore the physical principles and fundamental mathematics related to periodic motions. Topics will include damped and forced harmonic motion, normal modes, the wave equation, Fourier series and integrals, and complex analysis. Principles and techniques developed in this course are central to many subsequent courses, particularly Quantum Mechanics (PHYS214, PHYS315), Classical Dynamics (PHYS313), and Electricity and Magnetism (PHYS324). An important component of this course is to develop the ability to use mathematical software packages to graph expressions, solve equations, and obtain numerical solutions to differential equations.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Prereq: **PHYS116**

PHYS214 Quantum Mechanics I
This course provides an introduction to wave and matrix mechanics, including wave-particle duality, probability amplitudes and state vectors, eigenvalue problems, and the operator formulation of quantum mechanics.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Prereq: **PHYS213**

PHYS215 Special Relativity
This calculus-based half-credit, half-semester introduction to Einstein's theory of special relativity promotes both a qualitative understanding of the subject and a quantitative problem-solving approach.
Offering: **Host**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Prereq: **None**

PHYS217 Nonlinear Dynamics and Chaos
The techniques of nonlinear dynamics and chaos have been proven useful for a variety of disciplines, ranging from astrophysics to population dynamics. This course provides an introduction with applications.
Offering: **Host**
Grading: **A-F**

Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Prereq: **PHYS113, PHYS116, AND PHYS213**

PHYS219 Introduction to Contemporary Physics
This course examines the foundations of modern physics, including special relativity, the building blocks of matter, the fundamental interactions and gravity, and recent views of the universe such as entanglement, supersymmetry, strings, and dark matter and dark energy.
Offering: **Host**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Prereq: **(PHYS113 AND PHYS116)**

PHYS221 Modeling and Data Analysis: From Molecules to Markets
The development of models to describe physical or social phenomena has a long history in several disciplines, including physics, chemistry, economics, and sociology. With the emergence of ubiquitous computing resources, model building is becoming increasingly important across all disciplines. This course will examine how to apply modeling and computational thinking skills to a range of problems. Using examples drawn from physics, biology, economics, and social networks, we will discuss how to create models for complex systems that are both descriptive and predictive. The course will include significant computational work. No previous programming experience is required, but a willingness to learn simple programming methods is essential.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **QAC221, CIS231**
Prereq: **None**

PHYS313 Classical Dynamics
This is a course in classical mechanics at the intermediate level that utilizes problem solving instruction and learning. It approaches Newtonian mechanics from a more advanced point of view and introduces Lagrangian and Hamiltonian dynamics.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS513**
Prereq: **(PHYS213 AND MATH221 AND MATH222 AND MATH122)**

PHYS315 Quantum Mechanics II
This course will expand the formalism of quantum mechanics to include spin and angular momentum in three dimensions. The quantum theory of identical particles will be developed and applied to multi-electron atoms. The remainder of the course will explore approximation methods for applying quantum mechanics to more complex systems.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS515**
Prereq: **(PHYS214 AND MATH223) OR (PHYS214 AND MATH221)**

PHYS316 Thermal and Statistical Physics
Thermodynamics and statistical mechanics are pillars of physics. Thermodynamics provides a framework through which we can understand the rules for the conversion of energy and matter from one form to another. As we will learn, every transfer of energy results in the conversion of some energy into an unusable form. Using the tools of thermodynamics, we can establish limits for the amount of useful work that can be extracted from any process. These limits have important implications for the quest to achieve sustainability in our use of energy and materials. As we learn about thermodynamics, we will spend some time exploring this real-world application of the material covered.

Likewise, statistical mechanics provides us with a set of tools for understanding how the behavior of individual atoms and molecules impacts the properties and behavior of materials that can be observed in our daily lives. Our approach to this material differs from many previous physics courses and requires a mixture of statistical and counting skills, coupled with physical intuition for the nature of matter. In addition to explaining phase transitions, critical phenomena, and the statistical nature of fermions and bosons, the tools of statistical mechanics are essential for understanding phenomena like evaporative cooling and the greenhouse effect. We will explore the conditions that lead to these phenomena and discuss the role they may play in a comprehensive approach to sustainability.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS516**
Prereq: **PHYS214**

PHYS317 Molecular Biophysics Journal Club I
This course includes presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from journals including but not limited to the Biophysical Journal, Biopolymers, Current Opinion iIn Structural Biology, Journal of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-CHEM**
Identical With: **MB&B507, MB&B307, CHEM507, CHEM307, PHYS517**
Prereq: **None**

PHYS318 Molecular Biophysics Journal Club II
Presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from the Biophysical Journal, Biopolymers, Current Opinion in Structural Biology, Journal of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-CHEM**
Identical With: **MB&B508, MB&B308, CHEM508, PHYS518, CHEM308**
Prereq: **None**

PHYS324 Electricity and Magnetism
This course covers the classical field theory of electricity and magnetism. The core of the course covers electrostatics and magnetostatics with emphasis on both physical insight and the partial differential equations that describe these fields. We then cover electrodynamics to complete Maxwell's equations and to derive the elementary properties of electromagnetic radiation.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS524**
Prereq: **PHYS116 AND PHYS124 AND PHYS213 AND MATH222**

PHYS339 Molecular and Cellular Biophysics
This course is an integrated consideration of the biophysics and biophysical chemistry of biological systems from molecules to cells. The objective is to develop a critical sense of the quantitative data currently being obtained from

microscopy to spectroscopy, considering both ensemble and single-molecule experiments, and to gain familiarity and facility with interpretation using mathematical and computational models. Biological systems are inherently complex, and some form of modeling is always involved in developing an explanation of how they work. However, these models typically involve only a few basic constructs (simple harmonic motion, ideal fluids, two-state Ising models, random walks, electrostatic interactions, classical dynamics, rate equations, QM energy levels, distribution functions, and network analysis) and only elementary aspects of linear algebra, calculus, differential equations, and statistics. This course deals with how these constructs are integrated in the framework of Boltzmann statistical mechanics to formulate mathematical models of biological phenomena, how these models are validated and refined, and how they are used to form explanations and make testable predictions. Model systems to be considered include the nucleosome, the ribosome, membrane dynamics and ion channels, molecular devices and motors, prototype signal transduction systems, and regulatory processes. This course is suitable for physics and chemistry students who wish to learn about biological applications and for molecular and cellular biology students to develop skills with quantitative physicochemical modes of inquiry applied to the life sciences.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Identical With: **CHEM309, MB&B309, CHEM509, MB&B509, PHYS539**
Prereq: **(CHEM251 AND CHEM252)**

PHYS340 Computational Physics
This course introduces students to numerical techniques used in modern computational physics. Using the UNIX operating system and its support software as our programming environment, we will write code using the c programming language to implement the basic numerical techniques necessary for solving the majority of physics problems that do not have an analytical solution. Previous experience with UNIX/c is useful but not required.
Offering: **Host**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Prereq: **(MATH221 AND PHYS213) OR (MATH223 AND PHYS213)**

PHYS342 Experimental Optics
This is an experimental course in optics, including lenses, lens combinations, interference and diffraction, interferometry, and spectrometry.
Offering: **Host**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS542**
Prereq: **(PHYS116 AND PHYS213)**

PHYS345 Electronics Lab
This laboratory course covers the fundamentals of analog and digital electronics: passive DC and AC circuits, linear transistor and integrated circuits, and digital integrated circuits.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS545**
Prereq: **(PHYS116 AND PHYS213)**

PHYS358 Condensed Matter
This course is an introduction to condensed-matter physics with emphasis on fundamental properties of solids. We will explore crystal structure, phonons, and electrons in solids as a basis for understanding the thermal, electronic, and magnetic properties of materials. In addition to lectures and problem sets, there will be several numerical experiments in which computer simulation and visualization tools will be used to explore microscopic properties of materials.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS558**
Prereq: **[PHYS315 or PHYS515] AND [PHYS324 or PHYS524]**

PHYS377 Chemistry of Materials and Nanomaterials
This course will provide an introduction to materials chemistry, with a special emphasis on nanomaterials. Topics covered will include colloidal metal nanomaterials; semiconductors and quantum dots; carbon nanotubes, fullerenes, and graphene; metal-organic frameworks; self-assembly and metamaterials; electron and scanning probe microscopies; and lithography. The course will also discuss applications of these materials and techniques in areas such as plasmonics and sensing, catalysis, energy generation, and medicine.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Identical With: **CHEM377**
Prereq: **CHEM251**

PHYS395 Structural Biology Laboratory
One of the major catalysts of the revolution in biology that is now under way is our current ability to determine the physical properties and three-dimensional structures of biological molecules by x-ray diffraction, nuclear magnetic resonance (NMR) spectroscopy, and other spectroscopic methods. This course is designed to familiarize students with current research techniques in biochemistry and molecular biophysics. Students will perform spectroscopic investigations on a protein that they have isolated and characterized using typical biochemical techniques, such as electrophoresis, enzyme extraction, and column chromatography. The course will provide hands-on experience with spectroscopic methods such as NMR, fluorescence, UV-Vis absorption, and Raman as well as bioinformatic computational methods. All of these methods will be applied to the study of biomolecular structure and energetics. This course provides a broad knowledge of laboratory techniques valuable for independent research at the undergraduate level and beyond.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-MBB**
Identical With: **MB&B395, CHEM395**
Prereq: **([MB&B208 or BIOL208] AND CHEM141 AND CHEM142) OR ([MB&B208 or BIOL208] AND CHEM143 AND CHEM144)**

PHYS401 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS402 Individual Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS407 Senior Tutorial (downgraded thesis)
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.
Offering: **Host**
Grading: **A-F**

PHYS408 Senior Tutorial (downgraded thesis)
Downgraded Senior Thesis Tutorial - Project to be arranged in consultation with the tutor. Only enrolled in through the Honors Coordinator.
Offering: **Host**
Grading: **A-F**

PHYS409 Senior Thesis Tutorial
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS410 Senior Thesis Tutorial
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS411 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS412 Group Tutorial, Undergraduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS419 Student Forum
Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.
Offering: **Host**
Grading: **Cr/U**

PHYS420 Student Forum
Student-run group tutorial, sponsored by a faculty member and approved by the chair of a department or program.
Offering: **Host**
Grading: **Cr/U**

PHYS421 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.
Offering: **Host**
Grading: **OPT**

PHYS422 Undergraduate Research, Science
Individual research projects for undergraduate students supervised by faculty members.
Offering: **Host**
Grading: **OPT**

PHYS423 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS424 Advanced Research Seminar, Undergraduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS491 Teaching Apprentice Tutorial
The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.
Offering: **Host**
Grading: **OPT**

PHYS492 Teaching Apprentice Tutorial
The teaching apprentice program offers undergraduate students the opportunity to assist in teaching a faculty member's course for academic credit.
Offering: **Host**
Grading: **OPT**

PHYS500 Graduate Pedagogy
The elements of good teaching will be discussed and demonstrated through lectures, practice teaching sessions, and discussions of problems encountered in the actual teaching environment. The staff consists of faculty and experienced graduate students. An integral part of the course is a required one-day workshop BEFORE the first day of formal classes.

Training in pedagogy in the first semester of attendance is required for all incoming Wesleyan MA and PhD students who have not already fulfilled this requirement at Wesleyan. BA/MA students are not required to get training in pedagogy but may choose to do so.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **None**
Identical With: **E&ES500, CHEM500, BIOL500, ASTR500, MB&B500, MUSC500, PSYC500, MATH500**
Prereq: **None**

PHYS501 Individual Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS502 Individual Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS504 Selected Topics, Graduate Sciences
Topic to be arranged in consultation with the tutor. A seminar primarily concerned with papers taken from current research publications designed for, and required of, graduate students.
Offering: **Host**
Grading: **A-F**

PHYS505 Condensed Matter Physics Seminar I
Presentations and discussions of material at the forefront of the discipline, emphasizing emerging, novel physics topics.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

PHYS506 Condensed Matter Physics Seminar II
Presentation and discussion of material at the forefront of the discipline, emphasizing emerging, novel physics topics.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

PHYS507 Atomic and Molecular Physics Seminar I
Presentations and discussions of material at the forefront of the discipline, emphasizing current research at Wesleyan.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **PHYS214**

PHYS508 Atomic and Molecular Physics Seminar II
Presentations and discussions of material at the forefront of the discipline, emphasizing current research at Wesleyan.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

PHYS509 Theoretical Physics Seminar I
Presentations and discussions of material at the forefront of the discipline, emphasizing emerging, novel physics topics.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **([PHYS313 or PHYS513] AND PHYS214 AND [PHYS315 or PHYS515] AND [PHYS316 or PHYS516])**

PHYS510 Theoretical Physics Seminar II
Presentations and discussions of material at the forefront of the discipline, emphasizing emerging, novel physics topics.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **([PHYS315 or PHYS515] AND [PHYS324 or PHYS524] AND [PHYS316 or PHYS516])**

PHYS511 Group Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS512 Group Tutorial, Graduate
Topic to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS513 Classical Dynamics
This is a course in classical mechanics at the intermediate level that utilizes problem solving instruction and learning. It approaches Newtonian mechanics from a more advanced point of view and introduces Lagrangian and Hamiltonian dynamics.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS313**
Prereq: **(PHYS213 AND MATH221 AND MATH222 AND MATH122)**

PHYS515 Quantum Mechanics II
This course will expand the formalism of quantum mechanics to include spin and angular momentum in three dimensions. The quantum theory of identical particles will be developed and applied to multi-electron atoms. The remainder of the course will explore approximation methods for applying quantum mechanics to more complex systems.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS315**
Prereq: **(PHYS214 AND MATH223) OR (PHYS214 AND MATH221)**

PHYS516 Thermal and Statistical Physics
Thermodynamics and statistical mechanics are pillars of physics. Thermodynamics provides a framework through which we can understand the rules for the conversion of energy and matter from one form to another. As we will learn, every transfer of energy results in the conversion of some energy into an unusable form. Using the tools of thermodynamics, we can establish limits for the amount of useful work that can be extracted from any process. These limits have important implications for the quest to achieve sustainability in our use of energy and materials. As we learn about thermodynamics, we will spend some time exploring this real-world application of the material covered.

Likewise, statistical mechanics provides us with a set of tools for understanding how the behavior of individual atoms and molecules impacts the properties and behavior of materials that can be observed in our daily lives. Our approach to this material differs from many previous physics courses and requires a mixture of statistical and counting skills, coupled with physical intuition for the nature of matter. In addition to explaining phase transitions, critical phenomena, and the statistical nature of fermions and bosons, the tools of statistical mechanics are essential for understanding phenomena like evaporative cooling and the greenhouse effect. We will explore the conditions that lead to these phenomena and discuss the role they may play in a comprehensive approach to sustainability.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS316**
Prereq: **PHYS214**

PHYS517 Molecular Biophysics Journal Club I
This course includes presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from journals including but not limited to the Biophysical Journal, Biopolymers, Current Opinion iIn Structural Biology, Journal of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-CHEM**
Identical With: **MB&B507, MB&B307, CHEM507, CHEM307, PHYS317**
Prereq: **None**

PHYS518 Molecular Biophysics Journal Club II
Presentation and active discussion of a series of current research articles in the field of molecular biophysics and biophysical chemistry from the Biophysical Journal, Biopolymers, Current Opinion in Structural Biology, Journal of Biomolecular Structure and Dynamics, and the Annual Review of Molecular Biophysics and Biomolecular Structure.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-CHEM**
Identical With: **MB&B508, MB&B308, CHEM508, PHYS318, CHEM308**
Prereq: **None**

PHYS521 Physics Colloquium I
Presentations by outside experts and discussion of material at the forefront of the discipline, emphasizing emerging, novel physics topics.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

PHYS522 Physics Colloquium II
Presentations by outside experts and discussion of material at the forefront of the discipline, emphasizing emerging, novel physics topics.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **([PHYS315 or PHYS515] AND [PHYS313 or PHYS513])**

PHYS524 Electricity and Magnetism
This course covers the classical field theory of electricity and magnetism. The core of the course covers electrostatics and magnetostatics with emphasis on both physical insight and the partial differential equations that describe these fields. We then cover electrodynamics to complete Maxwell's equations and to derive the elementary properties of electromagnetic radiation.
Offering: **Crosslisting**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS324**
Prereq: **PHYS116 AND PHYS124 AND PHYS213 AND MATH222**

PHYS539 Molecular and Cellular Biophysics
This course is an integrated consideration of the biophysics and biophysical chemistry of biological systems from molecules to cells. The objective is to develop a critical sense of the quantitative data currently being obtained from microscopy to spectroscopy, considering both ensemble and single-molecule experiments, and to gain familiarity and facility with interpretation using mathematical and computational models. Biological systems are inherently complex, and some form of modeling is always involved in developing an explanation of how they work. However, these models typically involve only a few basic constructs (simple harmonic motion, ideal fluids, two-state Ising models, random walks, electrostatic interactions, classical dynamics, rate equations, QM energy levels, distribution functions, and network analysis) and only elementary aspects of linear algebra, calculus, differential equations, and statistics. This course deals with how these constructs are integrated in the framework of Boltzmann statistical mechanics to formulate mathematical models of biological phenomena, how these models are validated and refined, and how they are used to form explanations and make testable predictions. Model systems to be considered include the nucleosome, the ribosome, membrane dynamics and ion channels, molecular devices and motors, prototype signal transduction systems, and regulatory processes. This course is suitable for physics and chemistry students who wish to learn about biological applications and for molecular and cellular biology students to develop skills with quantitative physicochemical modes of inquiry applied to the life sciences.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **NSM-CHEM**
Identical With: **CHEM309, MB&B309, CHEM509, MB&B509, PHYS339**
Prereq: **(CHEM251 AND CHEM252)**

PHYS542 Experimental Optics
This is an experimental course in optics, including lenses, lens combinations, interference and diffraction, interferometry, and spectrometry.
Offering: **Crosslisting**
Grading: **A-F**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS342**
Prereq: **(PHYS116 AND PHYS213)**

PHYS545 Electronics Lab
This laboratory course covers the fundamentals of analog and digital electronics: passive DC and AC circuits, linear transistor and integrated circuits, and digital integrated circuits.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS345**
Prereq: **(PHYS116 AND PHYS213)**

PHYS549 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS550 Advanced Research Seminar, Graduate
Advanced research tutorial; project to be arranged in consultation with the tutor.
Offering: **Host**
Grading: **OPT**

PHYS558 Condensed Matter
This course is an introduction to condensed-matter physics with emphasis on fundamental properties of solids. We will explore crystal structure, phonons, and electrons in solids as a basis for understanding the thermal, electronic, and magnetic properties of materials. In addition to lectures and problem sets, there will be several numerical experiments in which computer simulation and visualization tools will be used to explore microscopic properties of materials.
Offering: **Crosslisting**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **NSM-PHYS**
Identical With: **PHYS358**
Prereq: **[PHYS315 or PHYS515] AND [PHYS324 or PHYS524]**

PHYS563 Analytical Mechanics
Advanced classical mechanics: multidimensional motion, rigid bodies and rotational dynamics, chaotic dynamics, and applications.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **(PHYS213 AND PHYS217 AND PHYS313) OR (PHYS213 AND PHYS217 AND PHYS513)**

PHYS565 Mathematical Physics
Historically, physics and mathematics are closely related. Physics uses powerful tools developed by mathematicians, while physicists, investigating the actually existing universe, provide mathematicians with new concepts and ideas to explore. This way, many mathematical techniques, and even entire areas of mathematics, developed from the need to solve certain real-life problems posed by physical reality. The purpose of this course is to give students an overview of the powerful array of mathematical tools available for the solution of physical problems. Starting with the presentation of tools of complex analysis, we will apply them to the solution of ordinary and partial differential equations. We will encounter Fourier and Laplace transforms and will study the Green's function method for the solution of bound and scattering problems. We will also look into the elements of Group Theory and apply it to angular momentum in quantum many-body systems.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **MATH222 AND MATH223 AND PHYS313 AND PHYS315 AND PHYS324**

PHYS566 Electrodynamics
This course covers boundary value problems, Green's functions, multipoles, fields in dielectric and magnetic media, electromagnetic radiation, and wave guides.
Offering: **Host**
Grading: **OPT**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **None**

PHYS567 Statistical Mechanics
This course will develop important concepts in statistical physics by examining several applications in detail. The areas covered will include the classical and quantum gases, critical behavior and phase transitions, and elementary transport phenomena.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **[PHYS316 or PHYS516]**

PHYS568 Quantum Mechanics
This course will develop advanced aspects of theory and application of quantum mechanics.
Offering: **Host**
Grading: **A-F**
Credits: **1.00**
Gen Ed Area: **None**
Prereq: **[PHYS315 or PHYS515]**

PHYS571 Advanced Topics in Atomic and Molecular Physics
This course will introduce classical and quantum collision theory, with special consideration of atomic and molecular collisions.
Offering: **Host**
Grading: **OPT**
Credits: **0.50**
Gen Ed Area: **None**
Prereq: **PHYS315**

PHYS572 Advanced Topics in Atomic and Molecular Physics
In this round of Advanced Topics (PHYS 572), fundamentals and applications of low temperature plasmas will be considered. We will investigate theoretical and experimental aspects related to the production and diagnostic of such plasmas. Discussion of a several usages of plasmas--for example, in chemical analysis, material processing, environmental monitoring, or medical applications--will conclude the semester.
Offering: **Host**
Grading: **OPT**
Credits: **0.50**
Gen Ed Area: **None**
Prereq: **PHYS515**

PHYS573 Advanced Topics in Condensed Matter
The course will cover advanced topics in condensed-matter physics, with emphasis on current research problems within the department.
Offering: **Host**
Grading: **OPT**
Credits: **0.50**
Gen Ed Area: **None**
Prereq: **([PHYS358 or PHYS558] AND [PHYS315 or PHYS515])**

PHYS574 Advanced Topics in Condensed Matter: Fluid Mechanics
This course will be an introduction to fluid mechanics, with emphasis on current research problems within the department. Topics will include Navier-Stokes equations, boundary layers, instabilities and turbulence.
Offering: **Host**
Grading: **OPT**
Credits: **0.50**
Gen Ed Area: **None**
Prereq: **None**

PHYS575 Advanced Topics in Theoretical Physics
This graduate course presents advanced topics in theory of relevance for current research in the department. The specific material varies each time the course is taught.
Offering: **Host**
Grading: **OPT**
Credits: **0.50**
Gen Ed Area: **None**
Prereq: **PHYS213 AND PHYS214 AND PHYS324**

PHYS576 Advanced Topics in Theory
This graduate course will present advanced topics in theory of relevance for current research in the department.
Offering: **Host**
Grading: **OPT**
Credits: **0.50**
Gen Ed Area: **NSM-PHYS**
Prereq: **None**

PHYS577 Lab Pedagogy
This course is taken by graduate students teaching PHYS121 or PHYS123.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Prereq: **None**

PHYS578 Lab Pedagogy
This course is taken by graduate students teaching PHYS122.
Offering: **Host**
Grading: **OPT**
Credits: **0.50**
Gen Ed Area: **None**
Prereq: **None**

PHYS587 Seminar in Chemical Physics
Weekly seminars presented jointly with the Department of Physics under the auspices of the Chemical Physics Program. These informal seminars will be presented by students, faculty, and outside visitors on current research and other topics of interest.
Offering: **Crosslisting**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Identical With: **CHEM547**
Prereq: **None**

PHYS588 Seminar in Chemical Physics
Weekly seminars presented jointly with the Chemistry Department under the auspices of the Chemical Physics Program. These informal seminars will be presented by students, faculty, and outside visitors on current research and other topics of interest.
Offering: **Host**
Grading: **Cr/U**
Credits: **0.25**
Gen Ed Area: **None**
Identical With: **CHEM548**
Prereq: **None**