# Class Schedule - Spring 2009

## Physics

Physics
Head of Department: Dale Van Harlingen
Department Office: 209 Loomis Laboratory of Physics, 1110 West Green, Urbana
Phone: 333-3761
www.physics.uiuc.edu

**PHYS 100  Thinking About Physics**  credit: 1 hours.
Designed for students who want to prepare for PHYS 211 by improving their conceptual and problem solving skills. Shows how to analyze physical situations, describe them mathematically, and understand the meaning of the solutions. Examples will be drawn from material that will be covered in PHYS 211. PHYS 100 and PHYS 211 may be taken concurrently. Approval of the department is required to register. Prerequisite: Credit or concurrent registration in MATH 220 or MATH 221.

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**PHYS 101  College Physics: Mech & Heat**  credit: 5 hours.
Newton’s Laws, work and energy, rotational motion, fluids, thermodynamics, and waves. A noncalculus-based course for students in the life sciences, preprofessional health programs, agriculture, and veterinary medicine. Credit is not given for both PHYS 101 and either PHYS 211 or PHYS 213. Prerequisite: Trigonometry.
This course satisfies the General Education Criteria for a:
Quantitative Reasoning II
Nat Sci & Tech - Phys Sciences

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Physical Sciences, and Quant Reasoning II course.
PHYS 102  **College Physics: E&M & Modern**  credit: 5 hours.
Electric forces and fields, electric potential, electric circuits, magnetic forces and fields, geometrical optics, relativity, and modern physics. A noncalculus-based course for students in life sciences, preprofessional health programs, agriculture, and veterinary medicine. Credit is not given for both PHYS 102 and either PHYS 212 or PHYS 214. Prerequisite: PHYS 101.

This course satisfies the General Education Criteria for a:
Quantitative Reasoning II
Nat Sci & Tech - Phys Sciences

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**PHYS 123  Physics Made Easy  credit: 3 hours.**

Designed for students who are interested in explaining and teaching science to children at the elementary school level. A hands-on inquiry-based approach to learning is used. No math or physics background needed. Topics cover most of the National Science Education K-4 Content Standards. Students assemble and keep a science teaching tool-kit.

This course satisfies the General Education Criteria for a:
Nat Sci & Tech - Phys Sciences

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Physical Sciences course.
Register for the lecture (A) section and for one of the lab (L) sections. PHYS 123 lab sections carry a $50 materials fee.
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**PHYS 140  How Things Work  credit: 3 hours.**

Nonmathematical lecture-demonstration course for nonscience students, underscoring the generality and ubiquity of basic physical laws in understanding commonplace phenomena: musical instruments, photography, electric and electronic circuits, television, motors, engines, etc. Credit is not given to engineering majors.

This course satisfies the General Education Criteria for a:
Quantitative Reasoning II
Nat Sci & Tech - Phys Sciences
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**PHYS 141 Special Problems** credit: 1 hours.

Special problems in physics: discussions and independent study. Supplement to PHYS 140. Prerequisite: Credit or concurrent registration in PHYS 140.
To register for PHYS 141, use the PHYS 141 CRN (available from the departmental undergraduate records office) specific to the instructor with whom you have arranged to study. (You cannot register under the general CRN 10140.)

**PHYS 199  Undergraduate Open Seminar**  credit: 1 TO 5 hours.
Approved for both letter and S/U grading. May be repeated.

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Independent Study
Instructor Approval Required
INDEPENDENT STUDY. To register for independent study under PHYS 199, use the PHYS 199 CRN (available from the departmental undergraduate records office) specific to the instructor with whom you have arranged to work. (You cannot register under the general CRN 10145.)

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Credit Hours: 1 hours
Behavior of Complex Systems
Discovery course.
EXPLORING THE BEHAVIOR OF COMPLEX SYSTEMS: CHAOS, FRACTALS AND ARTIFICIAL LIFE, 1 hour. The behavior of complicated systems with many parts will be explored with hands-on computer simulations and lab experiments. Students will experiment with lightning, turbulence, explosions, and human rhythms and use simple computer models to imitate their irregular and symmetric patterns and dynamics and will develop an intuition as to why isolated complex systems prefer harmony and symmetry whereas competing complex systems prefer chaos. Applications in business, engineering, and social sciences will be discussed. First Year Discovery Program Course. Registration restricted to freshmen. Students should enroll in only one Discovery course.

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Credit Hours: 1 hours
Science and Pseudoscience
Discovery course.
SCIENCE AND PSEUDOSCIENCE, 1 hour. The world we live in continues to develop at an amazing rate, with much of that development fueled by science and technology. Despite the overwhelming impact that scientific advances have on our society, a large number of people continue to hold irrational, unsupported beliefs in things like extrasensory perception, alien abductions and psychic crime-solvers. This one hour course will take a critical look at some of these beliefs from the standpoint of scientific inquiry and exploration. We will discuss the scientific method, how science progresses and the types of argumentative fallacies that pervade the pseudoscientific community. In addition, we will discuss examples of good science, and show how the scientific method is self-correcting. Students will have an opportunity to research paranormal claims, as well as play "devil's advocate" during in-class debates. This course is aimed at nonscientists (although science majors could benefit from the course as well) with the specific goals of teaching students how to be thoughtful, skeptical consumers of information and the importance of the scientific method. First Year Discovery Program Course. Registration restricted to freshmen. Students should enroll in only one Discovery course.

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Credit Hours: 1 hours
Honors Mechanics
HONORS SEMINAR: TOPICS IN MECHANICS. PREREQUISITES: CONCURRENT REGISTRATION IN PHYS 211 AND CONSENT OF INSTRUCTOR. PHYS 199HM CAN BE USED TO SATISFY THE HONORS COMPONENT OF PHYS 211. PHYS 199HM is the honors supplement to PHYS 211 and is intended for those students intending to major in physics or who have a strong interest in the subject. Areas to be addressed include rotational and central force motion, non-inertial frames, non-linear systems and post-Newtonian mechanics. The use of simple visualization tools such as Mathematica and Excel will be encouraged.
Lecture-Discussion

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Credit Hours: 1 hours
Honors Electricity & Magnetism
HONORS SEMINAR: TOPICS IN ELECTRICITY AND MAGNETISM. PREREQUISITES: PHYS 211, CONCURRENT REGISTRATION IN PHYS 212, AND CONSENT OF INSTRUCTOR. PHYS 199HO CAN BE USED TO SATISFY THE HONORS COMPONENT OF PHYS 212. Students investigate special topics in electricity and magnetism. Through weekly meetings (similar in format to the discussion sections of Physics 211 and 212), students will derive for themselves some of the surprising features of our post-classical physical world. For example, the need for special relativity, the existence of magnetic fields, and the origin of electromagnetic radiation are consequences of simple observations such as the constancy of the speed of light. Other topics will include the nature of Gauss' law and Maxwell's equations, potentials and superposition, amplifiers, analog computers, and the role of quantum mechanics in electrodynamics. PHYS 199HO is intended for students who have been comfortable with the level of difficulty of PHYS 211, and whose math skills are fairly strong. It allows students to confront in greater depth some of the most interesting intellectual issues in classical electrodynamics. The course will use calculus as a problem-solving tool.

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Credit Hours: 1 hours
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Section M1 (or M2 or M3 or M4) is only for students taking Spring 2009 PHYS 211 who took Fall 2008 PHYS 100.

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Credit Hours: 1 hours
Enrichment Mechanics
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Credit Hours: 1 hours
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Section M3 (or M1 or M2 or M4) is only for students taking Spring 2009 PHYS 211 who took Fall 2008 PHYS 100.

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Credit Hours: 1 hours
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Section M4 (or M1 or M2 or M3) is only for students taking Spring 2009 PHYS 211 who took Fall 2008 PHYS 100.

PHYS 211 University Physics: Mechanics credit: 4 hours.
Newton's Laws, work and energy, static properties and fluids, oscillations, transverse waves, systems of particles, and rotations. Lectures with demonstrations, discussions and laboratory. For students in engineering, mathematics, physics and chemistry. Credit is not given for both PHYS 211 and PHYS 101. Prerequisite: Credit or concurrent registration in MATH 231.

This course satisfies the General Education Criteria for a:
Quantitative Reasoning II
Nat Sci & Tech - Phys Sciences

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PHYS 212  **University Physics: Elec & Mag**  credit: 4 hours.

Coulomb’s Law, electric fields, Gauss’ Law, electric potential, capacitance, circuits, magnetic forces and fields, Ampere’s law, induction, electromagnetic waves, polarization, and geometrical optics. Lectures with demonstrations, discussions, and laboratory. For students in engineering, mathematics, physics, and chemistry. Credit is not given for both PHYS 212 and PHYS 102. Prerequisite: PHYS 211; credit or concurrent registration in MATH 241.

This course satisfies the General Education Criteria for a:
Quantitative Reasoning II
Nat Sci & Tech - Phys Sciences

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PHYS 213  **Univ Physics: Thermal Physics**  credit: 2 hours.

Introduction to the first and second laws of thermodynamics including kinetic theory of gases, heat capacity, heat engines, introduction to entropy and statistical mechanics, and introduction to application of free energy and Boltzmann factor. Lectures with demonstrations, discussions, and laboratory. For students in engineering, mathematics, physics and chemistry. Credit is not given for both PHYS 213 and PHYS 101. Prerequisite: PHYS 211; credit or concurrent registration in MATH 241.

This course satisfies the General Education Criteria for a:
- Quantitative Reasoning II
- Nat Sci & Tech - Phys Sciences

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**Physical Sciences, and Quant Reasoning II course.**

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**PHYS 213  **Univ Physics: Thermal Physics**  credit: 2 hours.

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- Nat Sci & Tech - Phys Sciences

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**Physical Sciences, and Quant Reasoning II course.**

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Physical Sciences, and Quant Reasoning II course.
PHYS 214  Univ Physics: Quantum Physics  credit: 2 hours.
Interference and diffraction, photons and matter waves, the Bohr atom, uncertainty principle, and wave mechanics. Lectures with demonstrations, discussions, and laboratory. For students in engineering, mathematics, physics, and chemistry. Credit is not given for both PHYS 214 and PHYS 102. Prerequisite: PHYS 212 (includes MATH 241 and PHYS 211).
This course satisfies the General Education Criteria for a:
Quantitative Reasoning II
Nat Sci & Tech - Phys Sciences
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Students registering for discussion section DSS (38332) must register for lecture A1 (38329) (8:30-9:45).
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Students registering for lab section LSS (38431) must register for lecture A1 (38329) (8:30-9:45).

**PHYS 280  Nuclear Weapons & Arms Control**  credit: 3 hours.
Beginner's-level introduction to the physics of nuclear weapons, nuclear weapon effects, delivery systems, and defenses against nuclear attack; includes presentation of current issues. Nontechnical, but about technology. Designed to assist in making informed judgments about nuclear armaments and arms control. Same as GLBL 280.

This course satisfies the General Education Criteria for a:
Advanced Composition
Advanced Composition course. Not intended for students with Freshman class standing. Minimum of sophomore standing required. Register for the lecture (A) section and for one of the writing lab (L) sections.

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Advanced Composition course.

**PHYS 325  Mechanics and Relativity I**  credit: 3 hours.

Examines kinematics and dynamics. Special relativity, Newtonian kinematics and dynamics in three dimensions, behavior of systems of particles, oscillations, transient response of oscillators, nonlinear oscillators, motion in rotating frames of reference, and rigid body dynamics. Vector analysis is developed as needed. Credit is not given for both PHYS 325 and PHYS 219. Prerequisite: Credit or concurrent registration in MATH 285 and PHYS 212.

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PHYS 326  **Mechanics and Relativity II**  credit: 3 hours.
Continuation of PHYS 325. Lagrangian techniques and the calculus of variations, central force motion, scattering, coupled oscillations, the wave equation in one dimension, generalized coordinates and the Hamiltonian formulation, relativistic dynamics, Euler angles and tops, non-linear and fluid dynamics. Prerequisite: PHYS 325; credit or concurrent registration in MATH 241 or MATH 380.

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PHYS 401  **Classical Physics Lab**  credit: 3 hours.
Experiments and techniques in classical mechanics and electromagnetism. Dynamics of electrical and mechanical oscillators in the linear domain. Fourier analysis of system response. Measurements of electrostatic fields, transmission lines, waves, and radiation. Investigation of electromagnetic phenomena in dielectrics, conductors, and magnetic materials. Instruction in data analysis and report writing. Graduate credit is not given to physics graduate program majors. Prerequisite: PHYS 325.

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PHYS 402  **Light**  credit: 0 TO 4 hours.

Wave kinematics; geometrical optics: basic concepts, ray-tracing and matrix formalism, Gaussian imaging by thick lenses, stops, apertures, and intensity relations; interference; interference spectroscopy and coherence; diffraction: Fresnel-Kirchhoff formulation, Fraunhofer case, Fresnel case, and holography; polarized light. Lectures, laboratory, and problems. 4 undergraduate hours. 3 or 4 graduate hours (3 hours without lab). Prerequisite: MATH 285; PHYS 102 (includes PHYS 101) or PHYS 214 (includes PHYS 211 and PHYS 212).

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Credit Hours: 3 hours
Restricted to Graduate - Urbana-Champaign.
Graduate students (only) may enroll in the AA lecture (and no laboratory) for 3 hours credit.

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Credit Hours: 4 hours
Undergraduate and graduate students may enroll in the BB lecture and in one of the laboratory (BL) sections for 4 hours credit.

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<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>36714</td>
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<td>F</td>
<td>6106 - Engineering Sciences Building</td>
<td>Rajaram, S</td>
</tr>
</tbody>
</table>

PHYS 403  **Modern Experimental Physics**  credit: 2 TO 5 hours.

Techniques and experiments in the physics of atoms, atomic nuclei, molecules, the solid state, and other areas of modern physical research. 3 to 5 undergraduate hours, or 2 to 4 graduate hours. First time registration must be for 5 undergraduate hours or 4 graduate hours. May be repeated for variable credit of 3 to 5 undergraduate hours or 2 to 4 graduate hours. Prerequisite: PHYS 401; concurrent registration in PHYS 486.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
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</thead>
<tbody>
<tr>
<td>46820</td>
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<td>A</td>
<td>01:00 PM - 04:50 PM</td>
<td>TR</td>
<td>5105 - Engineering Sciences Building</td>
<td>Colla, E Hertzog, D</td>
</tr>
</tbody>
</table>
PHYS 404  **Electronic Circuits I**  credit: 0 TO 5 hours.

The physics of semiconductor devices; theory and application of discrete and integrated devices in linear circuits; use of operational amplifiers and feedback; regulation, oscillators, and modulation; emphasizes practical experience. Lectures, problems, and laboratory. Same as CHEM 423. 5 undergraduate hours. 4 graduate hours. Offered Spring term only. Prerequisite: PHYS 401 and PHYS 435.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>38598</td>
<td>Lecture</td>
<td>AC</td>
<td>04:00 PM - 05:50 PM</td>
<td>MW</td>
<td>136 - Loomis Laboratory</td>
<td>Giannetta, R</td>
</tr>
</tbody>
</table>

Credit Hours: 5 hours
Restricted to Undergrad - Urbana-Champaign.
Undergraduates register for lecture AC (38598) and for one of the laboratory (L) sections.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
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<td>38600</td>
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<td>AG</td>
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<td>MW</td>
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<td>Giannetta, R</td>
</tr>
</tbody>
</table>

Credit Hours: 4 hours
Restricted to Graduate - Urbana-Champaign.
Graduate students register for lecture AG (38600) and for one of the laboratory (L) sections.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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<th>Days</th>
<th>Location</th>
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<tr>
<td>38605</td>
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<thead>
<tr>
<th>CRN</th>
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<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>38601</td>
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<td>09:00 AM - 11:50 AM</td>
<td>WF</td>
<td>5106 - Engineering Sciences Building</td>
<td>Zhao, X</td>
</tr>
</tbody>
</table>

PHYS 419  **Space, Time, and Matter-ACP**  credit: 3 OR 4 hours.

Identical to PHYS 420 except for the additional writing component including a final term paper. Same as PHIL 419. 3 undergraduate hours. 4 graduate hours. Credit is not given for both PHYS 419 and PHYS 420. Junior standing is required. Prerequisite: One physical science course; one of PHYS 214, PHIL 101, PHIL 270, PHIL 317.

This course satisfies the General Education Criteria for a:
Advanced Composition

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
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<th>Location</th>
<th>Instructor</th>
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<tr>
<td>38575</td>
<td>Lecture</td>
<td>A</td>
<td>01:00 PM - 02:20 PM</td>
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<td>144 - Loomis Laboratory</td>
<td>Weissman, M</td>
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</tbody>
</table>

Credit Hours: 3 hours
Advanced Composition course.
Restricted to Undergrad - Urbana-Champaign.
Undergraduates enroll in section A (38575). (To enroll in this course without the Advanced Composition component and for reduced credit, see PHYS 420.)

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
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<th>Location</th>
<th>Instructor</th>
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<tr>
<td>38576</td>
<td>Lecture</td>
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<td>Weissman, M</td>
</tr>
</tbody>
</table>

Credit Hours: 4 hours
Advanced Composition course.
Restricted to Graduate - Urbana-Champaign.
Graduate students enroll in section G (38576).

**PHYS 420  Space, Time, and Matter  credit: 2 hours.**
Philosophical examination of some fundamental concepts and theories of the physical world, such as time, matter, space, and geometry; interpretation of quantum theory. Graduate students write an additional paper. Same as PHIL 420. Credit is not given for both PHYS 420 and PHYS 419. Junior standing is required. Prerequisite: One physical science course; one of PHYS 214, PHIL 101, PHIL 270, PHIL 317.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
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<th>Days</th>
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<th>Instructor</th>
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<tr>
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<td>Weissman, M</td>
</tr>
</tbody>
</table>

Meets with and is the same as PHYS 419 except for carrying only 2 hours credit, requiring no final term paper and not satisfying the Advanced Composition requirement.

**PHYS 427  Thermal & Statistical Physics  credit: 4 hours.**
Equilibrium thermodynamics, statistical mechanics, and kinetic theory of gases. A unified treatment is used in that the principles of heat and thermodynamics are discussed along with statistical postulates and the microscopic approach of introductory quantum mechanics. Designed primarily for advanced undergraduates. Credit is not given for both PHYS 427 and any of ME 404, CHEM 442, CHEM 444, MSE 500. Prerequisite: Two 400-level courses in physics.

<table>
<thead>
<tr>
<th>CRN</th>
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<th>Days</th>
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<td>Greene, L</td>
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</table>

**PHYS 435  Electromagnetic Fields I  credit: 3 hours.**
Static electric and magnetic fields, their interactions with electric charge and current, and their transformation properties; the effect of special relativity is incorporated. Macroscopic fields in material media are described. Prerequisite: MATH 285; PHYS 325; credit or concurrent registration in MATH 241 or MATH 380.

<table>
<thead>
<tr>
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<table>
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<tbody>
<tr>
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<table>
<thead>
<tr>
<th>CRN</th>
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<th>Instructor</th>
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<tbody>
<tr>
<td>38591</td>
<td>Discussion/Recitation</td>
<td>D2</td>
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<td>32 - Loomis Laboratory</td>
<td>Morales, J</td>
</tr>
</tbody>
</table>

**PHYS 436  Electromagnetic Fields II  credit: 3 hours.**
Concentrates on time-dependent fields. Electromagnetic induction, Maxwell's equations, electromagnetic wave propagation in various media and structures, and electromagnetic radiation from charge and current distributions are treated. The relativistic covariance of Maxwell's equations is discussed. Prerequisite: PHYS 326 and PHYS 435.
<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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<th>Time</th>
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</tbody>
</table>

**PHYS 466  Atomic Scale Simulations** credit: 3 OR 4 hours.
Same as CSE 485 and MSE 485. See MSE 485.

<table>
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Credit Hours: 3 hours
Restricted to Undergrad - Urbana-Champaign.
This section is for Undergraduate Students only.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
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<tr>
<td>44679</td>
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<td>WF</td>
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<td>Ceperley, D</td>
</tr>
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</table>

Restricted to Graduate - Urbana-Champaign.
This section is for Graduate Students only, you may choose either 3 or 4 credit hours.

**PHYS 470  Subatomic Physics** credit: 4 hours.
The nature and properties of nuclei and elementary particles, symmetries, interactions, nuclear models, tools and techniques of experimental subatomic physics, and applications to power generation, astrophysics, chemistry, medicine, and biology. Lecture-problem format. Offered Spring term only. Prerequisite: PHYS 485 or PHYS 486.

<table>
<thead>
<tr>
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<th>Type</th>
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</table>

**PHYS 479  Plasma and Fusion Science** credit: 3 hours.
Same as ECE 421 and NPRE 421. See NPRE 421.

<table>
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<th>Location</th>
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<tr>
<td>34722</td>
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<td>L</td>
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</tr>
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</table>
PHYS 486  **Quantum Physics I**  credit: 4 hours.
Atomic phenomena integrated with an introduction to quantum theory; evidence for the atomic nature of matter and the properties of the Schrödinger equation, single particle solutions in one dimension, the hydrogen atom, perturbation theory, external fields, and atomic spectroscopy of outer electrons. Prerequisite: MATH 285; PHYS 214; credit or concurrent registration in MATH 415.

<table>
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<tr>
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<th>Type</th>
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<td>143 - Loomis Laboratory</td>
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<tr>
<td>36748</td>
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<td>D2</td>
<td>08:00 PM - 08:50 PM</td>
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<td>139 - Loomis Laboratory</td>
<td>Link, W</td>
</tr>
</tbody>
</table>

PHYS 487  **Quantum Physics II**  credit: 4 hours.
Continuation of PHYS 486. Identical particles, spectral hyperfine structure, magnetic properties of matter, atomic spectroscopy of inner electrons, high-energy photon effects, molecular binding and spectra, emission and absorption of light, and symmetry principles. Prerequisite: PHYS 486.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
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<tbody>
<tr>
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</table>

Register for the lecture and for one of the discussion sections.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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<th>Time</th>
<th>Days</th>
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<th>Instructor</th>
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<tr>
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</tr>
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<td>36762</td>
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<td>W</td>
<td>139 - Loomis Laboratory</td>
<td>Link, W</td>
</tr>
</tbody>
</table>

PHYS 496  **Intro to Physics Research**  credit: 3 hours.
Presents current research topics through extensive reading, writing, and oral-presentation activities. Designed for second-semester juniors interested in pursuing physics research careers and advanced physics training. Students generally become involved in a research group at this time, leading to a full-time summer research experience. 3 undergraduate hours.

This course satisfies the General Education Criteria for a: Advanced Composition

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>43749</td>
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<td>A</td>
<td>02:00 PM - 04:50 PM</td>
<td>F</td>
<td>322 - Loomis Laboratory</td>
<td>Cooper, S</td>
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</table>
Advanced Composition course.

**PHYS 497  Individual Study**  credit: 1 TO 4 hours.
Individual study at an advanced level in a subject not covered by course offerings. May be repeated. Prerequisite: Consent of instructor.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
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<tbody>
<tr>
<td>10147</td>
<td>Independent Study</td>
<td></td>
<td>ARRANGED -</td>
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</table>

To register for PHYS 497, use the PHYS 497 CRN (available from the departmental undergraduate records office) specific to the instructor with whom you have arranged to study. (You cannot register under the general CRN 10147.)

**PHYS 498  Special Topics in Physics**  credit: 1 TO 4 hours.
Subject offerings of new and developing areas of knowledge in physics intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. May be repeated in the same or separate terms if topics vary.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
</tr>
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<tbody>
<tr>
<td>36765</td>
<td>Lecture</td>
<td>BIO</td>
<td>10:30 AM - 11:50 AM</td>
<td>MW</td>
<td>158 - Loomis Laboratory</td>
<td>Aksimentiev, O</td>
</tr>
</tbody>
</table>

Credit Hours: 3 hours
Intro to Biological Physics
INTRODUCTION TO BIOLOGICAL PHYSICS. We will apply simple yet powerful ideas of physics to gain some understanding of biology. (What is the inertia of a bacteria and how does this affect its behavior?) We will begin with atoms, move to molecules, then macromolecules, then cells, and finally whole systems. For example, how do we see? The answer: photons cause the release of chemicals that create electricity. How do we move? The answer: tiny biomolecular motors break chemical bonds, using the energy to create force and motion with efficiencies that put man-made machines to shame. These motors, and indeed, much of biology at the molecular level, operate at the nanometer (one-billionth of a meter) and picoNewton (1 trillionth of a pound) scales. How can we measure such tiny things? Come find out! Prerequisite: PHYCS 211-212-213 sequence or consent of instructor. No prior biology knowledge or prerequisites, since the course includes a molecular biology primer.

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
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<tr>
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<td>Aksimentiev, O</td>
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</table>

Credit Hours: 4 hours
Intro to Biological Physics
Restricted to Graduate - Urbana-Champaign.
Meets with PHYS 498BIO (36765). Graduate students only, for 4 hours credit. (Undergraduates should enroll in 36765 for 3 hours credit.)

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
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<th>Location</th>
<th>Instructor</th>
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</thead>
<tbody>
<tr>
<td>40425</td>
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<td>PM1</td>
<td>11:00 AM - 01:50 PM</td>
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<td>6105 - Engineering Sciences Building</td>
<td>Errede, S</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
<th>Location</th>
<th>Instructor</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Laboratory-Discussion</td>
<td>PM1</td>
<td>01:00 PM - 02:20 PM</td>
<td>TR</td>
<td>6105 - Engineering Sciences Building</td>
<td>Errede, S</td>
</tr>
</tbody>
</table>

Credit Hours: 4 hours
Physics of Musical Instruments
PHYSICS OF MUSIC AND MUSICAL INSTRUMENTS. (Also available as PHYS 498 section PM2.) This course will investigate the physics of all kinds of music and musical instruments, the generation and propagation of sound waves in various media, and acoustics in general. Topics covered will include: Sound waves & propagation of sound waves, complex vibrations and resonance
phenomena, perception of sound, tone quality, frequency & pitch, musical intervals, scales, tuning & temperament, all kinds of
musical instruments, all kinds of music, auditorium and room acoustics, sound transducers, microphones, loudspeakers and
loudspeaker enclosure design. Prerequisites: PHYCS 211, 212 and 214; or consent of instructor.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
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<th>Instructor</th>
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<tr>
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<td></td>
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<td>02:00 PM - 04:50 PM</td>
<td>F</td>
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</table>

Credit Hours: 4 hours

Physics of Musical Instruments

PHYSICS OF MUSIC AND MUSICAL INSTRUMENTS. (Also available as PHYS 498 section PM1. See PM1 for a course description.)

PHYS 504  **Statistical Physics**  credit: 4 hours.

Single-particle distribution functions; classical and quantum mechanical systems, Boltzmann equation, virial theorem, and equations
of state for gases; formal theory: ensembles, identical particles, thermodynamics of simple systems, and distribution functions;
onequilibrium problems; conservation laws and hydrodynamic equations, sound waves, and transport coefficients; plasmas, normal
Fermi fluid, superfluids, and systems with internal degrees of freedom. Prerequisite: PHYS 427 and PHYS 486.

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<tr>
<th>CRN</th>
<th>Type</th>
<th>Section</th>
<th>Time</th>
<th>Days</th>
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<th>Instructor</th>
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<td>36782</td>
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<td>02:30 PM - 03:50 PM</td>
<td>TR</td>
<td>136 - Loomis Laboratory</td>
<td>Goldenfeld, N</td>
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</table>

PHYS 505  **Classical Electromagnetism**  credit: 4 hours.

Review of Maxwell's equations followed by a relativistic formulation of the electromagnetic field and the motion of charged particles;
plane and guided waves; retarded potentials; radiation from simple antennas; radiation from accelerated charged particles; synchrotron
radiation, bremsstrahlung, scattering, and further topics. Prerequisite: PHYS 436.

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<th>Time</th>
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<td>158 - Loomis Laboratory</td>
<td>Eckstein, J</td>
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</tbody>
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PHYS 509  **Mathematical Physics II**  credit: 4 hours.

Continuation of PHYS 508. Further core techniques of mathematical physics widely used in the physical sciences. Complex
variables; group theory in classical and quantum systems; tensors in physics; differential forms and their applications in mechanics;
electromagnetism. Topics are illustrated with realistic physics problems; a broad range of illustrative examples are explored;
applications are emphasized. Prerequisite: PHYS 508.

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PHYS 541  **Physics of Compact Objects**  credit: 4 hours.

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<td>Shapiro, S</td>
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</table>

PHYS 550  **Biomolecular Physics**  credit: 4 hours.
Physical concepts governing the structure and function of biological macromolecules: general properties, spatial structure, energy levels, dynamics and functions, and relation to other complex physical systems such as glasses; recent research in biomolecular physics; physical techniques and concepts from theoretical physics emphasized. Designed for students without appreciable background in biology and chemistry. Same as BIOP 550 and MCB 550. Prerequisite: CHEM 104; PHYS 485 or PHYS 487.

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PHYS 560  **Condensed Matter Physics I**  credit: 4 hours.
Crystalline perfection, free-electron gas, screening, plasma oscillations, and dielectric response; Bloch electrons, Brillouin zones, and band structure; semiconductors, intrinsic and extrinsic, with applications; phonons, elasticity, and anharmonicity; ferromagnetism and second-order phase transitions; superconductivity. Prerequisite: PHYS 427 and PHYS 580.

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<td>MW</td>
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<td>Chiang, T</td>
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</table>

PHYS 575  **Particle Physics I**  credit: 4 hours.
Basic calculations in elementary particle theory. Quantum electrodynamics, quantum chromodynamics, and the Glashow-Weinberg-Salam theory of weak and electromagnetic interactions as applied to the phenomenology of particle decays and high energy reactions. Prerequisite: PHYS 570 (in exceptional circumstances, PHYS 570 may be taken concurrently with departmental approval). Recommended (strongly): credit or concurrent registration in PHYS 582.

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<td>MW</td>
<td>322 - Loomis Laboratory</td>
<td>El-Khadra, A</td>
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</tbody>
</table>

PHYS 581  **Quantum Mechanics II**  credit: 4 hours.
Spin and identical particles, simple many-particle systems and elements of second-quantization theory; time-dependent processes, radiative transitions, and quantization of the electromagnetic field; scattering of particles with spin; polarization; introduction to the Klein-Gordon and Dirac equations, and properties of simple relativistic systems. Prerequisite: PHYS 580.
PHYS 583  **Advanced Field Theory**  credit: 4 hours.
Quantization and Feynman path integral; gauge theories and renormalization; renormalization group with applications to particle physics and critical phenomena; approximation methods and recent developments. Prerequisite: PHYS 582.

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PHYS 597  **Individual Study**  credit: 1 TO 16 hours.
Individual study in a subject not covered in course offerings may be arranged for credit by registration under this number. 2 to 16 hours for full term; 1 to 8 hours for half-term. May be repeated. Prerequisite: Consent of instructor.

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To register for PHYS 597, use the PHYS 597 CRN (available from the departmental graduate records office) specific to the instructor with whom you have arranged to study. (You cannot register under the general CRN 10150.)

PHYS 598  **Special Topics in Physics**  credit: 1 TO 4 hours.
Subject offerings of new and developing areas of knowledge in physics intended to augment the existing curriculum. See Class Schedule or departmental course information for topics and prerequisites. May be repeated in the same or separate terms if topics vary.

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<tr>
<th>CRN</th>
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Credit Hours: 4 hours
Geom of Field Thry & Strings 2
Restricted to Graduate - Urbana-Champaign.
GEOMETRY OF FIELD THEORY AND STRINGS, PART 2. Continuation from Fall 2008 of a self-contained treatment of the mathematics underlying quantum field theory and string theory, designed to prepare students for research in these fields. Prerequisite: Fall 2008 PHYS 598GFT or consent of instructor.

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<tr>
<td>51225</td>
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<td>IC</td>
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<td>TR</td>
<td>141 - Altgeld Hall</td>
<td>Di Francesco, P</td>
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</table>

Credit Hours: 4 hours
Integrable Combinatorics
INTEGRABLE COMBINATORICS. Meets with MATH 595 IC. Classical combinatorics is the art of counting, guessing and proving. It is the simplest way into many sophisticated physics and mathematics problems. In this course, we address various counting problems arising in theoretical physics, mostly statistical physics and field theory, and unravel their very rich mathematical structures, inherited from either classical or quantum integrability. We target an audience of both mathematicians and physicists. We will develop various technical tools, such as: matrix integrals, orthogonal polynomials, tree bijections, lattice paths and associated determinants, transfer matrices, (quantum) R-matrices, divided difference equations such as the quantum Knizhnik-Zamolodchikov...
(qKZ) equation and their multiple contour integral solutions. While we always put a special emphasis on the combinatorial aspects, each technique will be applied within its original physical context. However, each of the problems addressed will be put into a simple combinatorial form that does not require any prior knowledge. Conversely, all techniques will be self-contained and only basic mathematical knowledge is required. Applications range from quantum gravity to algebraic geometry, always in relation to simple two-dimensional lattice models. The scope of this course is to expose the extent and depth of various connections between mathematics and physics, as both inspirational tools and fields of application.

**PHYS 599  Thesis Research**  credit: 0 TO 16 hours.
Approved for S/U grading only. May be repeated.

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To register for PHYS 599, use the PHYS 599 CRN (available from the departmental graduate records office) specific to the instructor with whom you have arranged to study. (You cannot register under the general CRN 10154.)