# Course Schedule—Fall 2006

## Physics & Astronomy

### PHYSICS AND ASTRONOMY

*Note: Text highlighted in red indicates that a change has been made to the course listing. The red text indicates the current, updated information.*

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Instructor</th>
<th>Credits</th>
<th>Prerequisites</th>
<th>Corequisites</th>
<th>Course Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>171.101</td>
<td>GENERAL PHYSICS FOR PHYSICAL SCIENCE MAJORS I (4)</td>
<td>Ford</td>
<td>4</td>
<td>Coreq: 173.111-112; 110.108-109</td>
<td>One-year course in general physics covering mechanics, heat, sound, electricity and magnetism, optics, and atomic physics.</td>
<td>Lec. Sec. 01-14 ThF 10:30-12</td>
</tr>
</tbody>
</table>

Sec. 14 added 8/01/06

| 171.102     | GENERAL PHYSICS FOR PHYSICAL SCIENCE MAJORS II (4) | Barnett | 4       | Prereq: C- or better in 171.101 | Coreq: 173.112; 110.109 | One-year course in general physics covering mechanics, heat, sound, electricity and magnetism, optics, and atomic physics. | Lec. Sec. 01-04 MTW 11 |

| 171.103     | GENERAL PHYSICS I FOR BIOLOGICAL SCIENCE MAJORS (4) | Feldman | 4       | Coreq: 173.111-112; 110.108-109 or 110.106-107 | Standard calculus based physics tailored to students majoring in one of the biological sciences. Topics in modern physics and in fluid dynamics will be covered in this course. | Lec. Sec. 01-09 MTW 9 |

| 171.105     | CLASSICAL MECHANICS I (4) | Tchernyshyov | 4       | Coreq: 173.115-116 and 110.108-109 | Recommended for students who plan to major or minor in Physics. Students enrolled in this course should enroll in the Classical Mechanics Lab only. Classical electricity and magnetism with fewer topics than 171.101-102 and 171.103-104 but in greater depth, and is for students who intend to take 171.201-202. | Lec. Sec. 01 MTW 11 |

| 173.111     | GENERAL PHYSICS LAB I (1) | Swartz | 1       | Coreq: 173.115-116 and 110.108-109 | Experiments are chosen from both physical and biological sciences and are designed to give students background in experimental techniques as well as to reinforce physical principles. | Sec. 01 M 1-4 |

02 M 1-4

03 M 1-4

04 T 1-4

05 T 1-4

06 T 1-4

07 W 1-4

08 W 1-4

09 W 1-4

10 Th 1-4

11 Th 1-4

12 Th 1-4

13 Th 9-12am
**GENERAL PHYSICS LAB II (1)** Swartz

- Prereq: 173.111
- Coreq: 171.102; 171.104; 173.115
- Experiments are chosen from both physical and biological sciences and are designed to give students background in experimental techniques as well as to reinforce physical principles.

**SUBATOMIC WORLD (3)** Blumenfeld

- Introduction to concepts of physics of the subatomic world: Symmetries, relativity, quanta, neutrinos, particles, and fields. Emphasis on ideas of modern physics, not on the mathematics.

**INTRODUCTION TO FRONTIER PHYSICS (1)** Henry

- Explores modern experimental methods and theoretical ideas in physics.

**PHYSICS OF THE EVERYDAY WORLD (3)** Krolik

- Introduction to concepts of physics and their consequences for everyday experience. Using numbers to describe the natural world. Intended for non-scientists.

**CLASSICAL MECHANICS LABORATORY (1)** Swartz

- Experiments chosen to complement the lecture course Classical Mechanics I, II 171.105-106 and introduce students to experimental techniques and statistical analysis.

**SPECIAL RELATIVITY AND WAVES (4)** Leheny

- Prereq: 171.105-106 (preferred) or 171.101-102 or 171.103-104; Calculus 110.202 or 110.211-212
- Course continues introductory physics sequence (begins with 171.105-106). Special theory of relativity, mathematics of waves, harmonic oscillation, forced and damped oscillators, electromagnetic waves, diffraction, interference.

**CONTEMPORARY PHYSICS SEMINAR (1)** Henry

- Prereq: 171.101-102, 171.103-104, or 171.105-106
- This seminar exposes physics majors to a broad variety of contemporary experimental and theoretical issues in the field. Students read and discuss reviews from the current literature, and are expected to make an oral or written presentation.

**SPECIAL RELATIVITY (1)** Leheny

- Three-week introduction to special relativity for students physics majors who elect to take 171.209 in place of 171.201. Prereq: 171.105-106 (preferred) or 171.101-102 or 171.103-104; Calculus 110.108-109. Coreq: Calculus 110.202 or 110.211-212

**WAVE PHENOMENA WITH BIOPHYSICAL APPLICATIONS (4)** Reich

- Prereq: 171.101-102
Selection of topics in applied mathematics most frequently used by physicists. First term focuses on analytic white dwarfs, neutron stars, pulsars, black holes, binary stars, accretion disks, protostars, and extrasolar planetary astrophysics. Topics include stellar atmospheres, stellar interiors, nucleosynthesis, stellar evolution, supernovae, systems.

INTERSTELLAR MEDIUM AND ASTROPHYSICAL FLUID DYNAMICS
Neufeld Norman

ADVANCED LABORATORY
and emission of radiation, identical particles, second quantization, density matrix, perturbation theory (time-independent and time-dependent), transition probabilities and selection rules, atomic structure, scattering theory.

QUANTUM MECHANICS

ELECTROMAGNETIC THEORY
Kaplan
Prereq: 171.101-102 or 171.105-106; 110.201-202; Coreq: 110.302 or 110.416 Static electric and magnetic fields in free space and matter; boundary value problems; electromagnetic induction; Maxwell's equations; and an introduction to electrodynamics.

QUANTUM MECHANICS I
Broholm
Prereq: 171.202, 171.204, 110.113 Fundamental aspects of quantum mechanics. Uncertainty relations, Schrodinger equation in one and three dimensions, tunneling, harmonic oscillator, angular momentum, hydrogen atom, spin, Pauli principle, perturbation theory (time-independent and time-dependent), transition probabilities and selection rules, atomic structure, scattering theory.

ADVANCED PHYSICS LAB
Armitage
A broad exposure to modern laboratory procedures such as holography, chaos, and atomic, molecular, and particle physics.

STATISTICAL PHYSICS AND THERMODYNAMICS
Markovic
An undergraduate course that develops the laws and general theorems of thermodynamics from a statistical framework.

INTRODUCTION TO STELLAR PHYSICS
Wyse
Prereq: 110.108-109, 110.204 Survey of stellar astrophysics. Topics include stellar atmospheres, stellar interiors, nucleosynthesis, stellar evolution, supernovae, white dwarfs, neutron stars, pulsars, black holes, binary stars, accretion disks, protostars, and extrasolar planetary systems.

CONDENSED MATTER PHYSICS
Chien, C.L.
Prereq: 171.304, 110.201-202 Undergraduate course covering basic concepts of condensed matter physics: crystal structure, diffraction and reciprocal lattices, electronic and optical properties, band structure, phonons, superconductivity and magnetism.

MATHEMATICAL METHODS FOR PHYSICISTS
Kovesi-Domokos
Prereq: 110.201-202 Selection of topics in applied mathematics most frequently used by physicists. First term focuses on analytic methods: functions of complex variables, series and perturbation methods for solving differential equations, Sturm-Liouville theory and special functions, Fourier series and transforms.

INTRODUCTION TO MATHEMATICAL BIOLOGY
Morava
Prereq: 110.107, 110.302 Cross-listed with Mathematics

INDEPENDENT RESEARCH: UNDERGRADUATES
Students may register for independent research with a faculty member in the Department of Physics and Astronomy. A research plan should be sent to the Director of Undergraduate Study before the add/drop date that includes project details, the number of hours of effort each week and the number of credits. The course may not be used for one of the two electives required for a BA, but one semester of research may be used as one of four focused electives in a BS program.

SENIOR THESIS
Preparation of a substantial thesis based upon independent student research, supervised by at least one faculty member in Physics and Astronomy. This course may only be taken for credit during one semester. However, students are expected to have engaged in their research project during previous semesters through 171.501-502, summer research, etc. This course may not be used as one of the two electives required for a BA, but can be used as one of the four focused electives in a BS program.

ELECTROMAGNETIC THEORY
Domokos
Prereq: 110.101-106 Theory of the Maxwell equations, with static and dynamic applications, boundary-value problems, guided and free waves, diffraction, scattering, special relativity, electron theory.

QUANTUM MECHANICS
Tesanovic
Review of wave mechanics and the Schrodinger equation, Hilbert space, harmonic oscillator, the WKB approximation, central forces and angular momentum, scattering, electron spin, density matrix, perturbation theory (time-independent and time-dependent), quantized radiation field, absorption and emission of radiation, identical particles, second quantization, Dirac equation.

ADVANCED LABORATORY
Armitage
Covers a thorough survey of analog and digital electronics with a strong emphasis on integrated-circuit technology.

INTERSTELLAR MEDIUM AND ASTROPHYSICAL FLUID DYNAMICS
Neufeld Norman
Physical
states of interstellar gas; diagnostics: commonly encountered emission and absorption lines, continuum processes, refraction, dispersion, and scintillation; ionization equilibrium; heating and cooling, multi-phase systems and thermal instabilities; dust physics: optical properties, temperature and ionization; basic equations of fluid mechanics: mass continuity, Navier-Stokes and equations of state; hydrostatic equilibrium and the Jeans mass; fluid instabilities; shock waves and similarity solutions for blast waves; MHD equations and magnetized equilibria.

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<tr>
<th>Course Code</th>
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<th>Description</th>
<th>Section</th>
<th>Days and Time</th>
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<tr>
<td>171.613</td>
<td>RADIATIVE ASTROPHYSICS / QUANTUM PHYSICS</td>
<td>Bennett</td>
<td>A one-term survey of the processes that generate radiation of astrophysical importance. Topics include: radiative transfer, the theory of radiation fields, polarization and Stokes parameters, radiation from accelerating charges, bremsstrahlung, synchrotron radiation, thermal dust emission, Compton scattering, properties of plasmas, atomic and molecular quantum transitions, and applications to astrophysical observations.</td>
<td>Sec. 01</td>
<td>MW 2-3:20</td>
</tr>
<tr>
<td>171.616</td>
<td>THE UNIVERSE AT HIGH ENERGIES</td>
<td>Norman</td>
<td>Limit 18 Study of the Universe from the perspective of the most energetic phenomena. Topics covered will include: black holes, supernovae, pulsars, galaxies and quasars, clusters of galaxies and gamma ray bursts.</td>
<td>Sec. 01</td>
<td>MW 10:30-12</td>
</tr>
<tr>
<td>171.619</td>
<td>MOLECULAR ASTROPHYSICS</td>
<td>Neufeld</td>
<td>An advanced graduate level course that emphasizes the importance of molecules in astrophysical environments as diverse as interstellar clouds, circumstellar outflows, cometary comae, and active galactic nuclei.</td>
<td>Sec. 01</td>
<td>MW 10:30-12</td>
</tr>
<tr>
<td>171.621</td>
<td>CONDENSED MATTER PHYSICS</td>
<td>Chien, C.L.</td>
<td>This sequence is intended for graduate students in physics and related fields. Topics include: metals and insulators, diffraction and crystallography, phonons, electrons in a periodic potential, transport.</td>
<td>Sec. 01</td>
<td>M 4-5:30pm, W 3-4:30, MW 7-8, THF 10:30-12</td>
</tr>
<tr>
<td>171.634</td>
<td>TOPICS IN MAGNETISM</td>
<td>Chien, C.L.</td>
<td>Limit 15 Course added 8/28/06</td>
<td>Sec. 01</td>
<td>ThF 1-2:30</td>
</tr>
<tr>
<td>171.701</td>
<td>ADVANCED FIELD THEORY</td>
<td>Feldman</td>
<td>Limit 15 Course added 9/22/06</td>
<td>Sec. 01</td>
<td>M 3:30-5, T 9</td>
</tr>
<tr>
<td>171.703</td>
<td>ADVANCED STATISTICAL MECHANICS</td>
<td>Robbins</td>
<td>Prereq: 171.303-304, 171.312 or equivalents. Brief review of basic statistical mechanics and thermodynamics. Then hydrodynamic theory is derived from statistical mechanics and classical treatments of phase transitions, including Ginzburg-Landau theory.</td>
<td>Sec. 01</td>
<td>ThF 9-10:30</td>
</tr>
<tr>
<td>171.801</td>
<td>INDEPENDENT RESEARCH - GRADUATES</td>
<td>Staff</td>
<td></td>
<td>Sec. 01</td>
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Sec. 01 | Staff
Sec. 02 | Sundrum
Sec. 03 | Feldman
Sec. 04 | Chien, Chia-ling
Sec. 05 | Domokos
Sec. 06 | Reich
Sec. 07 | Chien, Chih-yung
Sec. 08 | Kroli
Sec. 09 | Barnett
Sec. 10 | Norman
Sec. 11 | Blumenfeld
Sec. 12 | Heckman
Sec. 13 | Moos
Sec. 14 | Szalay
Sec. 15 | Ford
Sec. 16 | Bagger
Sec. 17 | Wyse
Sec. 18 | Henry
Sec. 19 | Neufeld
Sec. 20 | Tesanovic
Sec. 21 | Blair
Sec. 22 | Robbins
Sec. 23 | Glazebrook
Sec. 24 | Broholm
Sec. 25 | Bianchi
Sec. 27 | Kaplan
Sec. 28 | Pinkenthal
Sec. 29 | Leheny
Sec. 30 | Markovic
Sec. 31 | Tchernyshyov
Sec. 32 | Bennett
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<th>Day(s)</th>
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<tr>
<td>172.631</td>
<td><strong>PHYSICS SEMINAR</strong> Broholm &lt;br&gt;First year graduate students only&lt;br&gt;Study of the methods and results of modern physics and other results of modern physics and other topics of interest. Each student will discuss some phase of the subject.</td>
<td></td>
<td>Sec. 01</td>
<td>M 12</td>
</tr>
<tr>
<td>172.633</td>
<td><strong>LANGUAGE OF ASTROPHYSICS</strong> Krolik&lt;br&gt;Course added 8/28/06</td>
<td></td>
<td>Sec. 01</td>
<td>W 12</td>
</tr>
<tr>
<td>172.711</td>
<td><strong>INTERMEDIATE SEMINAR</strong> Henry&lt;br&gt;Nonspecialized seminar in which second-year graduate students discuss subjects of general interest, supplementing the material of the standard courses and including recent advances in physics.</td>
<td></td>
<td>Sec. 01</td>
<td>T 12</td>
</tr>
<tr>
<td>172.722</td>
<td><strong>HOT TOPICS IN ASTROPHYSICS</strong> Norman</td>
<td></td>
<td>Sec. 01</td>
<td>M 4-6pm</td>
</tr>
<tr>
<td>172.731</td>
<td><strong>CAS RESEARCH SEMINAR</strong> Meurer</td>
<td></td>
<td>Sec. 01</td>
<td>T 3:30-5</td>
</tr>
<tr>
<td>172.735</td>
<td><strong>STARBURST JOURNAL CLUB SEMINAR</strong> Heckman</td>
<td></td>
<td>Sec. 01</td>
<td>F 12</td>
</tr>
<tr>
<td>172.751</td>
<td><strong>ELEMENTARY PARTICLE PHYSICS SEMINAR</strong> Staff</td>
<td></td>
<td>Sec. 01</td>
<td>W 12-1:30</td>
</tr>
<tr>
<td>172.753</td>
<td><strong>ADVANCED PARTICLE THEORY SEMINAR</strong> Kaplan</td>
<td></td>
<td>Sec. 01</td>
<td>F 2</td>
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<tr>
<td>172.763</td>
<td><strong>CONDENSED MATTER PHYSICS SEMINAR</strong> Markovic</td>
<td></td>
<td>Sec. 01</td>
<td>W 2-3:30</td>
</tr>
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