Physics and Astronomy

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Physics is the study of the basic interactions that govern the behavior of the universe as we know it. As such, a knowledge of physics is necessary for the proper understanding of any science, and, of course, it is an exciting field of study in its own right.

The department offers comprehensive training in physics that can lead to a teaching position in grades 7-12; industrial, institutional, and government work; and graduate study. The major includes lecture courses, laboratory courses, and a chance for qualified students to participate in research with faculty members.

General Education Requirement (GER) ASTRO 107 (together with ASTRO 100 or equivalent), PHYS 101, 110, 111, 120, 121, 151, 152, and 153 may be used to fulfill Broad Exposure/Stage 2, Group E.

Distribution Requirement See Appendix A for the Distribution Requirement, which was replaced by the General Education Requirement in fall 2001 and which may be binding on students who matriculated prior to fall 2001.

Graduate Study The Department of Physics and Astronomy offers a number of advanced courses, listed in the Graduate Catalog, which give credit toward the degree of master of arts. Qualified undergraduate students may be admitted to these courses with the approval of the department chair.

Accelerated BA/MA Program in Physics This special program for a limited number of well-qualified students leads to a bachelor of arts and a master of arts degree. Students are offered the opportunity quickly to reach a level where they can stand in competition for admission into any doctoral program in physics. The program requires 124-126 credits (including the 30 credits required for a physics major BA degree and 30 credits from the graduate curriculum). Because this program requires a large number of physics courses, many of which have other physics courses as prerequisites, students in this program should begin taking physics courses in their first or second semester. Students should consult the department chair, undergraduate advisor, or graduate advisor for details as early as possible.

Physics for Non-Physics Majors A minimum of one year of physics is recommended for all majors in sciences and health sciences. Medical and dental schools also require one year of physics.

Students requiring one year of physics may take either the PHYS 110-120 sequence (9 cr) or the PHYS 111-121 sequence (11 cr). Although both sequences cover the same topics, PHYS 111-121 utilizes elementary calculus and meets for one additional lecture hour each week. It is recommended for science students and those premed students who satisfy the mathematics pre- or corequisite. PHYS 101 (4 cr) should be taken only by those who want a one-semester terminal course in physics; it does not satisfy preprofessional requirements.

Students should take no more than one first-semester course (PHYS 101, 110, 111) and no more than one second-semester course (PHYS 120, 121) since they may receive credit for no more than one course from each group.

Major The major consists of 8 credits of introductory physics courses and a 22-credit concentration in physics courses at the 200 level and higher. Additionally, 15-24 credits of allied courses (mathematics and chemistry) are also required. Together, the introductory physics and the Option 1 concentration (30 cr total) satisfy the major requirement for certification as a teacher of physics in grades 7-12. Option 1, together with the MA (see the Accelerated BA/MA Program in Physics), is recommended for students planning to continue for a PhD degree in physics. Option 2 is recommended for those interested in a career in the telecommunications industry, as it includes a foundation in lasers and fiber optics.

Eight (8) credits of introductory physics are required, with PHYS 111-121 recommended. PHYS 110-120 or PHYS 130-133 may be taken instead. No more than 8 credits toward the major can be obtained from these courses. It is recommended that PHYS 190 be taken if the PHYS 111-112 sequence is not taken and either PHYS 110-120 or PHYS 130-133 are taken.

Concentration in Physics Four intermediate-level lecture courses (16 cr), PHYS 221, 330, 334, and 335, must be taken in addition to the lab course PHYS 222 (2 cr). Also, one of two options below is necessary.

Option 1 For students in the BA/MA program, students intending to teach grades 7-12, and students intending to enter the medical profession. Two physics laboratory courses (4 cr), PHYS 230 and 235, are required.

Option 2 (**Laser and Fiber Optics Concentration)** All four courses of the sequence PHYS 231, 232, 233, and 234 are required. No more than 4 credits of the sequence PHYS 231-234 may be used toward the major.

MATH 150, 155, 250, and 254 (15 cr) are required of all physics majors in addtion to one year of high school chemistry or college chemistry.

Minor 12 credits in biological sciences, chemistry, computer science, geology, mathematics, or another approved field selected after conference with the major advisor. For students planning to become physics teachers at the secondary level the 21-credit sequence in secondary education constitutes an appropriate minor.

Preparation for Teaching The major in physics satisfies the requirements for NY State Certification of at least 30 credits for teachers in adolescence education: physics (grades 7-12).

Students preparing to teach physics are advised to include the following courses or their equivalents in their undergraduate program: MATH 254; CHEM 102, 103, 104, 105; ASTRO 100; GEOL 101; and BIOL 100. See the School of Education section of this catalog for additional requirements and consult with an advisor in the School of Education.

Honors Work The opportunity for students to do individual research (experimental or theoretical) is offered in courses PHYS 453 and 454.

Pre-Engineering Program

The College offers courses that will prepare the student in the first two years of study to pursue a career in engineering. Students planning to go into engineering should consult the pre-engineering advisor during preadmission conference days and also at least once each semester.

This program is directed toward the degree of bachelor of science in engineering. The courses offered are chosen so that students will have satisfied their first two years' requirement if they transfer to another college for their final two years.

Those students planning to go to an engineering school other than City College should see the pre-engineering advisor to work out a program suitable to their needs.

If, by the end of the fourth semester, students decide not to continue their engineering degree and to remain at Hunter College, they become subject to the same requirements as other Hunter College students. Many of the courses taken in the pre-engineering program may be used to satisfy these requirements.

The following courses comprise the pre-engineering curriculum:

	Credits to be taken to prepare for:			
COURSES	Chemical Engineering	Civil Engineering	Electrical Engineering	Mechanical Engineering
SCIENCE COURSES				
Mathematics				
MATH 150, 155, 250, 254	15	15	15	15
MATH 211	—	—	3	—
Chemistry				
CHEM 102, 103	4.5*	4.5*	4.5**	4.5*
CHEM 104, 105	4.5*	4.5*	—	4.5*
Computer Science				
CSCI 130	4	4	4	4
Geology				
GEOL 101	—	4	—	—
Physics				
PHYS 111, 121	11	11	11	11
PHYS 330 or 360	4	4	4	4
PHYS 335 or 365	4	—	4	—
Technical Drawing				
ARTCR 261	3	3	—	3
OTHER COURSES				
English				
ENGL 120	3	3	3	3
Humanities & Social Sciences				
3-4 courses***	9-12	9-12	9-12	9-12
Economics				
ECO 200 or 201	3	3	3	3

*CHEM 102 and 104 can be replaced by CHEM 111, 112, 113 (3 semesters).

**CHEM 102 can be replaced by CHEM 111, 112 (2 semesters) for 4 cr.

***Skills courses will not be credited. For example, accounting, statistics, photography, drawing, musical instruments technique, non-literature courses, etc., are regarded as skills courses.

Articulation Agreement for Queensborough AAS Degree in Laser Technology A QCC student completes 64 credits to receive the AAS degree in laser technology. Hunter College accepts 57 credits. In particular, the physics department at Hunter grants 36 credits.

Queensborough courses QCC EN 101, 102 (6 credits) transfer as Hunter ENGL 120, 220 (6); QCC MA 440, 441 (8 credits) transfer as Hunter MATH 121 and 150 (6); QCC Soc Sci, History and Humanities (9 credits) transfer as Hunter distribution (9); QCC Physics, QCC Electronics (41 credits) transfer as Hunter Physics Department credits (36). In particular, the 11 QCC electronic credits transfer to become Hunter 6 credits in electronics (4 for lecture PHYS 221 and 2 for lab PHYS 222). The 30 QCC physics/laser credits transfer to Hunter as 30 physics credits.**

Hunter courses Physics: bridge course from algebra-based technology physics to calculus physics (1); Physics: mechanics, atomic/nuclear, E&M I, E&M II (15); Math: MA 155-Cal II, MA250-Cal III, MA 254-differential equations (11); Chemistry: Chemistry with labs I and II (9); Literature: distribution (6); Social Sciences: distribution (6); Humanities/Arts: distribution (6); Foreign language: distribution (9 or 6); Total: 63 cr (1 year of high school foreign language is assumed); 60 credits (2 years of high school foreign language is assumed).

Note 1: Thirteen of the Hunter credits for graduation could be taken at QCC in addition to the laser degree. Hunter allows a maximum transfer of 90 cr from other colleges with a 70 cr limit from community colleges. Consult the laser program advisor at QCC for details.

Note 2: The chemistry 9- cr requirement could be replaced with other courses if the student already took 1-year chemistry in high school. Consult the physics department at Hunter about more transfer cr for QCC laser courses (3 cr) and Hunter replacement courses (6 cr).

Note 3: The General Education Requirement must be chosen carefully to meet the Hunter Pluralism and Diversity Requirement. Consult the physics department advisor at Hunter for details.

COURSE LISTINGS

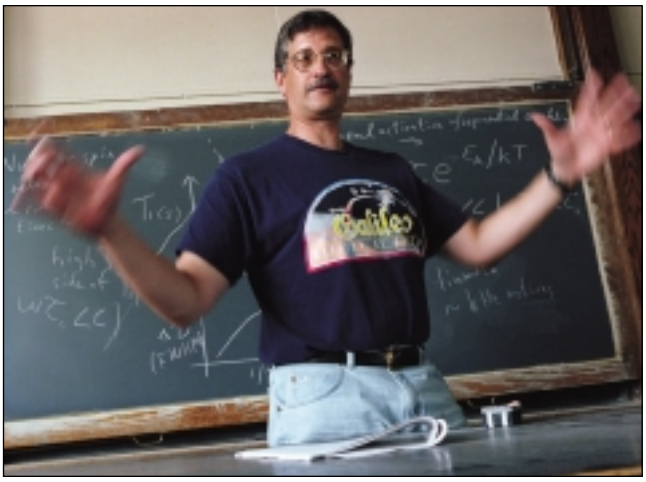
***ASTRO 100 Basic Concepts in Astronomy** 3 hrs, 3 cr; GER/2/E; core credit awarded only if ASTRO 100 and ASTRO 107 are completed. Introductory 1-sem astronomy course designed for non-science majors.

***ASTRO 101 Concepts and Laboratory Exercises in Astronomy** 5 hrs, 4 cr. Along with the existing lectures on the basic concepts of contemporary astronomy, particularly current issues in cosmology, the origin and fate of the universe, which emphasize how we use evidence to conclude things about the universe, students may undertake corresponding laboratory exercises in astronomy, establish familiarity with the major features of the night sky, demonstrate the physical principles of astronomical instrumentation, and give examples of the use of indirect evidence.

ASTRO 107 Laboratory Exercises in Astronomy 2 hrs, 1 cr. Prereq: or coreq: ASTRO 100; GER/2/E; core credit awarded only if ASTRO 100 or equivalent and ASTRO 107 are completed. Laboratory exercises in astronomy to observe the major features of the night sky, demonstrate the physical basis of astronomical instruments, and experiment with astronomical phenomena.

*This course fulfills the General Education Requirement for a science course with a lab.

**Pending Hunter College Senate approval



***PHYS 101 Study of Selected Phenomena and Basic Concepts of Physics** (1-sem course) 6 hrs (3 lec, 3 lab), 4 cr; GER/2/E. Introductory physics course designed for non-science majors and others requiring a 1-sem terminal course.

***PHYS 110 General Physics: Introductory Course in Mechanics, Heat, and Sound** 7 hrs (3 lec, 3 lab, 1 rec), 4.5 cr; GER/2/E. Prereq: MATH 125 or MATH 120/121 or equiv by mathematics dept. exam. First semester of 2-sem introductory physics course using algebra.

***PHYS 111 General Physics: Introductory Course in Mechanics, Heat, and Sound** 8 hrs (4 lec, 3 lab, 1 rec), 5.5 cr. Prereq (or coreq with perm): MATH 150; GER/2/E. First semester of a 2-sem introductory physics course using calculus. For physics and other science majors.

***PHYS 120 General Physics: Introductory Course in Electricity and Magnetism, Light, and Atomic Physics** 7 hrs (3 lec, 3 lab, 1 rec), 4.5 cr. Prereq: PHYS 110 or 111; GER/2/E. Second semester of PHYS 110, a 2-sem introductory physics course using algebra.

***PHYS 121 General Physics: Introductory Course in Electricity and Magnetism, Light, and Atomic Physics** 8 hrs (4 lec, 3 lab, 1 rec), 5.5 cr. Prereq: PHYS 110 or 111. Prereq (or coreq with perm): MATH 155; GER/2/E. Second semester of PHYS 111, a 2-sem introductory physics course using calculus.

***PHYS 130 Preprofessional Science: Core 1** 2 hrs, 1.5 cr. Prereq: MATH 050 or placement by CAPT. Coreq: CHEM 130, MATH 130, and PHYSC 130 Lab. The physics component of the first semester of a four-semester, fully integrated course in general chemistry, general physics, and mathematical functions and graphs. Topics include properties of linear functions and their graphs, mechanics, introductory thermodynamics, and stoichiometry.

***PHYS 131 Preprofessional Science: Core 2** 2 hrs, 1.5 cr. Prereq: MATH 130, PHYS 130, CHEM 130 and PHYSC 130 Lab. Coreq: CHEM 131, MATH 131 and PHYSC 131 Lab. The physics component of the second semester of a four-semester, fully integrated course in general chemistry, general physics, and mathematical functions and graphs. Topics include properties of polynomial, rational, exponential, and logarithmic functions and their graphs, chemical equilibrium, electrochemistry and further topics in thermodynamics. Completion of PHYS 130 and 131 is equivalent to completion of PHYS 110.

***PHYS 132 Preprofessional Science: Core 3** 2 hrs, 1.5 cr. Prereq: MATH 131, PHYS 131, CHEM 131 and PHYSC 131 Lab. Coreq: CHEM 132, MATH 132, and PHYSC 132 Lab. The physics component of the third semester of a four-semester, fully integrated course in general chemistry, general physics, and mathematical functions and graphs. Topics include trigonometric functions, topics in analytic geometry, waves, the structure of the atom, and chemical bonding.

***PHYS 133 Preprofessional Science: Core 4** 2 hrs, 1.5 cr. Prereq: MATH 132, PHYS 132, CHEM 132 and PHYSC 132 Lab. Coreq: CHEM 133, MATH 133 and PHYSC 133 Lab. The physics component of the fourth semester of a four-semester, fully integrated course in general chemistry, general physics, and mathematical functions and graphs. Topics include trigonometric identities, applications of trigonometry, chemical kinetics, electricity and magnetism, optics, and nuclear physics. Completion of PHYS 132 and 133 is equivalent to completion of PHYS 120.

PHYS 190 Tutorial in Mathematical Physics 3 hrs (2 lec, 1 rec), 2 cr. Prereq: MATH 155 and either PHYS 120 or PHYS 133. Applications of differential and integral calculus to selected topics chosen from the major subfields of physics. Completion of this course and its prerequisites is equivalent to completion of the calculus-based general physics sequence, PHYS 111 and 121.

PHYS 221 Electronics 4 hrs, 4 cr. Prereq: PHYS 120 or PHYS 121 or PHYS 133. Circuit theory of passive devices (resistors, capacitors, and inductors). Semi-conductor principles and transistor amplifier design. Integrated circuit applications and digital computer logic circuit principles.

PHYS 222 Electronics Laboratory 4 hrs, 2 cr. Coreq: PHYS 221. Experiments are performed with passive devices (capacitors, inductors, resistors) and active devices (diodes, transistors). A variety of transistor amplifier and oscillator circuits are studied as well as integrated circuit applications.

PHYS 230 Classical Physics Laboratory 4 hrs, 2 cr. Prereq: PHYS 120 or 121. Selected experiments of mechanics, electricity/magnetism, and thermodynamics. Experiments may include driven oscillator resonance, coupled oscillators, liquid nitrogen heat of vaporization, Fourier analysis/filtering, ferromagnetic hysteresis, and the nonlinear pendulum period. Elementary error analysis techniques and computer software for data analysis/graphing.

***PHYS 231 Fundamentals of Laser and Fiber Optics** 5 hrs, 4 cr. Prereq: PHYS 120 or PHYS 121 or equivalent and MATH 125 and MATH 126 or equivalent. Topics in optics related to lasers and optical fiber and devices for modulating and directing signals from such devices. Geometrical optics with emphasis on ray tracing. Matrix methods in optics. Lenses thick and thin, mirrors, prisms and other passive optical elements and systems. Propagation of light in materials. Dispersion and its effects. Special topics in geometric and wave optics. Laboratory complements classwork.

***PHYS 232 Laser and Electro-Optics Technology** 7 hrs, 5 cr. Prereq: PHYS 231. Wave optics, interference, coherence, polarization, birefrigence, diffraction, gratings in two and three dimensions, power and energy measurements, basics of laser safety, ultra-fast pulse technology measurements, basics of laser safety, ultra-fast pulse technologies, electro-optics and acousto-optics switches, optical materials, non-linear optics. Laboratory complements classwork.

***PHYS 233 Laser Electro-Optics Devices** 6 hrs, 4 cr. Prereq: PHYS 231. Laser as a device, principle of operation, cavity modes and their control (tuning elements, Q switching, mode-locking) and detection, laser design, types of lasers, includes discussion of laser types for medical, ranging and tracking, material processing, pollution monitoring, and optical memory applications, semiconductor laser. Laboratory complements class work.

***PHYS 234 Fiber Optics Devices, Measurements, and Applications** 6 hrs, 4 cr. Prereq: PHYS 231. Propagation of light in optical fiber, including analysis of the behavior of different modes. Dispersion and distortion. Specialized light sources and their characterization. Fiber optic sensors. All-optical fiber amplifiers. Optical switches and logic gates. Optical isolators. Techniques for joining fibers. Instruments for characterizing fiber and fiber links. Optical communications systems and protocols. Wavelength division multiplexing. Medical applications including fiber optics-diagnostic and surgical. Optical data processing and optical memories. Laboratory complements classwork.

PHYS 235 Modern Physics Laboratory 4 hrs, 2 cr. Prereq: PHYS 120 or 121. Selected experiments of quantum physics and optics. Experiments may include nuclear half-life, microwave diffraction, Bragg scattering of x-rays, nuclear multichannel scintillation, Franck-Hertz quantum levels, Millikan oil drop. Error analysis techniques including Gauss and Poisson distributions and correlation of data. Programming for data analysis.

PHYS 301 Theoretical Physics 4 hrs, 4 cr. Prereq: MATH 254. Analysis of mathematical techniques for solving partial differential equations occurring in physics. Cross-listed as MATH 301.

PHYS 330 Atomic and Nuclear Physics 4 hrs, 4 cr. Prereq: PHYS 120 or 121. Prereq or coreq: MATH 250. Examines experimental evidence and develops modern view of structure of atom and nucleus.

*This course fulfills the General Education Requirement for a science course with a lab.

PHYS 334 Intermediate Electricity and Magnetism 4 hrs, 4 cr. Prereq: PHYS 120 or 121. Prereq or coreq: MATH 250. Electrostatics, currents, magnetism, and introduction to electromagnetic theory of light.

PHYS 335 Intermediate Mechanics 4 hrs, 4 cr. Prereq: PHYS 120 or 121; prereq or coreq: MATH 250. Study of laws of motion and coordinate systems; introduction to powerful analytical techniques.

PHYS 336 Thermodynamics and Statistical Mechanics 4 hrs, 4 cr. Prereq: PHYS 120 or 121; MATH 250. Study of fundamental ideas of heat, reversibility, and entropy. Introduction to statistical nature of some physical laws.

PHYS 342 Optics 3 hrs, 3 cr. Prereq: PHYS 120 or 121; MATH 250. Study of lenses, mirrors, interference, diffraction, and polarization, as well as lasers, holography, and Fourier optics.

PHYS 385 Numerical Methods I 3 hrs, 3 cr. Prereq: MATH 254. Accuracy and precision, convergence, iterative and direct methods. Topics selected from: solution of polynomial equations and linear systems of equations, curve fitting and function approximation, interpolation, differentiation and integration, differential equations. *Note:* This course is cross-listed as MATH 385 and CSCI 385 so that students in the mathematics and computer science departments can use the course toward the completion of their major requirements.

PHYS 411 Theoretical Mechanics 3 hrs, 3 cr. Prereq: PHYS 335. Prereq or coreq: MATH 254. Classical mechanics of particles and rigid bodies; special relativity; Hamilton's formulation; Liouville's theorem.

PHYS 415 Electromagnetic Theory 3 hrs, 3 cr. Prereq: PHYS 334. Prereq or coreq: MATH 254. Electrostatics; electromagnetics; Maxwell's equation with application to waves; waves in guides; radiation.

PHYS 424 Plasma Physics 3 hrs, 3 cr. Prereq: PHYS 334. Motion of charged particles in external magnetic and electrical field; fusion using tokamaks, mirrors, and lasers.

PHYS 425 Quantum Theory 3 hrs, 3 cr. Prereq: PHYS 330. Prereq or coreq: MATH 254. From Bohr model and DeBroglie waves to Schrodinger wave equation; solutions for simple cases; transformations.

PHYS 427 Intermediate Physics Laboratory 4 hrs, 2 cr. Prereq: PHYS 235. Study of modern experimental techniques in variety of fields.

PHYS 445 Solid State Physics 3 hrs, 3 cr. Prereq: PHYS 330. Energy levels in atoms, molecules, and solids; crystal structure; properties of solids; semiconducting devices.

PHYS 453 Introduction to Research 1 to 3 cr. Prereq: PHYS 330, 334, 335, and 427 or perm chair. Independent theoretical or experimental research or independent study of approved topic.

PHYS 454 Introduction to Research 1 to 3 cr. Prereq: PHYS 453 or perm chair. Independent theoretical or experimental research or independent study of approved topic.

PHYS 485 Numerical Methods II 3 hrs, 3 cr. Prereq: PHYS 385. Topics in numerical methods selected from solutions of linear equations, interpolating functions, root finding methods, nonlinear equations, Fourier series and the fast Fourier transform, partial differential equations. A major term project will be assigned. *Note:* This course is cross-listed as MATH 485 and CSCI 485 so that students in the mathematics and computer science departments can use the course toward the completion of their major requirements.

Courses not offered during 2002-2004:

ASTRO 181 Astronomy of the Solar System
ASTRO 182 Stellar Astronomy

PHYS 145 Physics of Computers
PHYS 186 Acoustics of Music
PHYS 240 Physics of Biological Systems
PHYS 245 Computer Applications in Physical Sciences
PHYS 280 Astrophysics
PHYS 360 Atomic and Nuclear Physics for Engineers
PHYS 364 Electricity and Magnetism for Engineers
PHYS 365 Analytical Mechanics
PHYS 403 Topics in Modern Physics

Political Science

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Assistant Professor Dwyer
Advisor Charles Tien, 1702 West Building; 772-5494

Web Site http://maxweber.hunter.edu/polsc

Political science deals with the various political, social, and cultural arrangements through which people govern their lives. It attempts to interpret the past and explain the present and often dares to draw images of the future. As a field of study, it reaches to many levels, from the evolution of political philosophy and the character of contemporary political concepts to the problems of development in emerging nations, from the crisis of urban government in America to the interaction of peoples and states in the international arena. In short, its centers of interest are broad and diverse.

Many people think of politics in terms of political parties and voting. Political science is interested in both of these subjects, but it is also interested in many other areas. Students will find courses on the ideas of great thinkers from Plato to the present, the problems of cities, war and peace, democracy and utopia, democratic and authoritarian political systems, international political economy, human rights, women and politics, American politics, the domestic and foreign policies of the United States and countries in Latin America, Europe, Asia, Africa, and other regions.

A large number of political science majors choose some branch of public service upon completing their bachelor's degrees. Some go into teaching. Others enter business. Some work in journalism. Still others enter politics or go on to law school or graduate training. Political science, therefore, prepares students for a variety of career opportunities as well as for a lifetime of active citizenship.

Writing Corequisites and Prerequisites Intermediate and advanced political science courses require significant expository writing. To assure that students are ready for these courses, they should be enrolled in ENGL 120 (or its equivalent) or have successfully completed the course. For all 200-level courses, ENGL 120 (or its equivalent) is a prerequisite or corequisite; for all 300-level and 400-level courses, ENGL 120 (or its equivalent) is a prerequisite.

General Education Requirement (GER) POLSC 110(W) may be used to fulfill Academic Foundations/Stage 1, Group C. POLSC 110(W), 111, 112(W), 115, and 117(W) may be used to fulfill Broad Exposure/Stage 2, Group B. POLSC 201(W), 202(W), 203(W), 206(W), 209(W), 211(W), 212(W), 214(W), 215(W), 218(W), 219(W), 230(W), 235(W), 244(W), 253(W), 254(W), 262(W), 267(W), 271(W), 274(W), 281(W), 282(W), 301(W), 309(W), 311(W), 315(W), 316(W), 321(W), 341(W), 348(W), 352(W), 376(W), 377(W), 378(W), and 380(W) may be used to fulfill Focused Exposure/Stage 3, Group B.

Distribution Requirement See Appendix A for the Distribution Requirement, which was replaced by the General Education Requirement in fall 2001 and which may be binding on students who matriculated prior to fall 2001.