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2009–10 ACADEMIC CALENDAR AND HOLIDAY SCHEDULE

September 1 Tuesday

Move-in day for Residence Hall

September 1–3 Tuesday–Thursday

New student orientation

September 7 Monday

Labor Day (Staff Holiday)

September 8 Tuesday

Fall semester classes begin

NOTE: TUESDAY CLASSES MEET

September 18 Friday

There will be a \$25 fee for dropping classes after this date

September 22 Tuesday

Fall Festival

November 26–29 Thursday–Sunday

Thanksgiving (Staff Holiday)

December 1–7 Tuesday–Monday

Registration for Spring 2010 classes

December 22 Tuesday

NOTE: MODIFIED SCHEDULE; THURSDAY CLASSES MEET

December 23 Wednesday

NOTE: MODIFIED SCHEDULE; FRIDAY CLASSES MEET

December 23 Wednesday

Fall semester classes and exams end (Final examinations will be given during the last week of the semester as announced by the schools)

December 24–January 18 Thursday–Monday

Winter recess; all schools

December 24–January 4 Thursday–Monday

Staff Holiday

January 5 Tuesday

Administrative Offices reopen.

All grades are due in the Office of Admissions and Records before Noon

January 18 Monday

Martin Luther King Jr.'s birthday (Staff Holiday)

January 19 Tuesday

Spring semester classes begin.

NOTE: MODIFIED SCHEDULE; MONDAY CLASSES MEET

January 29 Friday

There will be a \$25 fee for dropping classes after this date

February 12–15 Friday–Monday

Founder's Day/President's Day (Staff Holiday)

March 13–21 Saturday–Sunday

Spring recess (administrative offices remain open)

April 13–16 Tuesday–Friday

Registration for Fall 2010 classes

May 5–12 Wednesday–Wednesday

Last week of spring semester classes

May 12 Wednesday

Spring semester classes and exams end

NOTE: MODIFIED SCHEDULE; FRIDAY CLASSES MEET

(Final examinations will be given during the last week of the semester as announced by the schools)

May 13 Thursday

Senior grades due in the Office of Admissions and Records before 4 pm

May 17 Monday

All non-senior grades are due in the Office of Admissions and Records before 4 pm

May 24 Monday

Commencement rehearsal; annual student exhibition opens

May 25 Tuesday

Commencement

May 31 Monday

Memorial Day (Staff Holiday)

July 5 Monday

Independence Day (Celebrated—Staff Holiday)

THE COOPER UNION FOR THE ADVANCEMENT OF SCIENCE & ART

MISSION STATEMENT

Through outstanding academic programs in architecture, art and engineering, The Cooper Union for the Advancement of Science and Art prepares talented students to make enlightened contributions to society.

The college admits undergraduates solely on merit and awards full scholarships to all enrolled students. The institution provides close contact with a distinguished, creative faculty and fosters rigorous, humanistic learning that is enhanced by the process of design and augmented by the urban setting.

Founded in 1859 by Peter Cooper, industrialist and philanthropist, The Cooper Union offers public programs for the civic, cultural and practicable enrichment of New York City.

A BRIEF HISTORY

The Cooper Union for the Advancement of Science and Art, established in 1859, is among the nation's oldest and most distinguished institutions of higher education.

Located in New York City's East Village, The Cooper Union is an all honors college that provides full-tuition scholarships to all undergraduates accepted. Dedicated exclusively to preparing students for the professions of architecture, art and engineering, The Cooper Union has an enrollment of approximately 1,000 undergraduate students, all accepted on merit alone, and was the first college to forbid discrimination based on race, ethnicity or gender. Under the leadership of President George Campbell Jr., the rigor of its three professional schools—The Irwin S. Chanin School of Architecture, the School of Art and the Albert Nerken School of Engineering—has made The Cooper Union one of the most selective colleges in the nation.

Peter Cooper was a workingman's son who had less than a year of formal schooling. Yet he went on to become an industrialist and an inventor; it was Peter Cooper who designed and built America's first steam railroad engine. Cooper made his fortune with a glue factory and an iron foundry. Later, he turned his entrepreneurial skills to successful ventures in real estate, insurance, railroads and telegraphy. Once, he even ran for president.

In the late 1850s, when Cooper was a principal investor and first president of the New York, Newfoundland & London Telegraph Co., the firm undertook one of the 19th century's monumental technical enterprises—laying the first Atlantic cable. Cooper also invented Jello—with help from his wife, Sarah, who added fruit to his clarified gelatin.

If Cooper sounds like a real-life Horatio Alger, perhaps it is no surprise that three of Alger's tales tell of young men passing Cooper Union's stately Foundation Building and, duly inspired, deciding immediately to lead productive and moral lives.

As a boy, Peter Cooper learned carpentry, beer brewing and hat and coach making. But he was acutely aware of his lack of "even a common education," a deficiency that bothered him throughout his life. Though he later became one of America's richest men, he could not spell. So, in 1800, as a nine-year-old apprentice carriage-maker in New York City, he sought a place where he could learn scientific techniques and theory to supplement his innate inventiveness and manual skill. He found no such place.

As he grew up and became one of the most successful businessmen of America's Gilded Age, Cooper never forgot his beginnings or his lack of education. He thought children of immigrants and the working class deserved access to education. Believing

that education should be "as free as water or air" and inspired by a polytechnic school in Paris, he spent the last 30 years of his life creating and nurturing a school for the "boys and girls of this city, who had no better opportunity than I."

As one of the first colleges to offer a full-scholarship education both to men and women of working-class families, The Cooper Union was a pioneer long before access to education became public policy. Cooper's example motivated the founders of other prestigious colleges, such as Andrew Carnegie, Ezra Cornell and Matthew Vassar.

At first, The Cooper Union provided night classes for men and women in the applied sciences and architectural drawing. In addition, the college's Women's Art School, open during the day, offered free art classes and training in the new occupations of photography, telegraphy, "type-writing" and shorthand.

Those classes—a landmark in American history and the prototype for what is now called continuing education—have evolved into three distinguished schools that make up The Cooper Union for the Advancement of Science and Art: The Irwin S. Chanin School of Architecture, the School of Art and the Albert Nerken School of Engineering.

Cooper, however, founded more than a college. From the beginning, The Cooper Union also provided a public reading room and library, and a meeting place for artists and inventors. In the historic 900-seat Great Hall, the public heard social and political reformers as well as free lectures on science and government. Before they were elected, Presidents Lincoln, Grant, Cleveland, Taft, Theodore Roosevelt and Barack Obama spoke in the celebrated auditorium. Abraham Lincoln gave his "Right Makes Might" speech from the Great Hall podium, earning him the nomination for the presidency. Woodrow Wilson and Bill Clinton as sitting presidents also spoke there. Today, the Great Hall continues as a home for public forums, cultural events and community activities.

The Cooper Union is also the place where Thomas Edison and Felix Frankfurter were students, where the Red Cross and NAACP were organized, where suffragist Susan B. Anthony had her offices and where researchers developed the prototype of the microchip.

Peter Cooper's dream was to give talented young people the one privilege he lacked—a good education. He also wanted to make possible the development of talent that otherwise would have gone undiscovered. His dream—providing an education "equal to the best"—has come true. Since 1859, The Cooper Union has educated thousands of artists, architects and engineers, many of them leaders in their fields. Today, his dream is still our mission.

PROGRAMS

The following programs at The Cooper Union have been registered by the New York State Education Department.

Program	Hegis Code	Degree
Architecture	0202	B.Arch.
Engineering	0901	B.S.
Chemical Engineering	0906	B.E.
Civil Engineering	0908	B.E.
Electrical Engineering	0909	B.E.
Interdisciplinary Engineering	0901	B.E.
Mechanical Engineering	0910	B.E.
Fine Arts	1001	B.F.A.
Fine Arts	5012	Certificate
Master of Engineering	0901	M.E.
Master of Architecture	0202	M.Arch. II

Accreditation The Cooper Union is accredited by the Middle States Association of Colleges and Schools; all of the degree programs are registered with the New York State Education Department. In addition, the program leading to the degree bachelor of architecture is accredited by the National Architectural Accrediting Board, the program leading to the degree bachelor of fine arts is accredited by the National Association of Schools of Art and Design and the four programs (chemical, civil, electrical and mechanical engineering) leading to the degree bachelor of engineering are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology, 111 Market Place, Baltimore, MD 21202.

The National Architectural Accrediting Board mandates that the following statement be included in catalogs: In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes three types of degrees: the bachelor of architecture, the master of architecture and the doctor of architecture. A program may be granted a six-year, three-year or two-year term of accreditation, depending on the extent of its conformance with established educational standards. Master's degree programs may consist of a preprofessional undergraduate degree and a professional graduate degree that, when earned sequentially, constitute an accredited professional education. However, the preprofessional degree is not, by itself, recognized as an accredited degree.

FACILITIES AND RESOURCES

The Cooper Union comprises five buildings at Manhattan's Cooper Square, between Sixth and Ninth Streets and Third and Fourth Avenues.

The Foundation Building At the center of this educational complex is the Foundation Building, the college's original structure, which was built under Peter Cooper's supervision. Housed in the building are the Great Hall, The Cooper Union's historic auditorium; The Irwin S. Chanin School of Architecture; much of the School of Art, the library; The Arthur A. Houghton Jr. Gallery, and the Office of the President. The building also includes the Architecture Archive, classrooms, shops and studios.

The building is open during the fall and spring semesters from 8 am to 2 am, Monday through Thursday; 8 am to midnight, Friday and Saturday; and noon to 2 am on Sunday. Hours may be extended during high-use periods such as the last two weeks of the semester. The School of Art office is open from 8:30 am, to 6 pm during the academic year. Shops, special labs, the computer studio and other facilities that require supervision are open on a more restricted basis; each facility posts its own hours. A detailed schedule is available from the School of Art office. The Chanin School office is open Monday–Friday, 9 am–5 pm

During the summer months, the Foundation Building is open from 8 am to 6 pm Monday through Thursday; the administrative offices are open from 9 am to 5:15 pm Monday through Thursday; and all of the educational facilities are closed except to high school students who participate in the Saturday/Outreach Program and participants in the Summer Residency Program.

41 Cooper Square In September 2009, The Cooper Union opened 41 Cooper Square, its newest facility. The building was designed by Pritzker Prize-winning architect Thom Mayne, and features state-of-the-art laboratories, classrooms and studios along with conference rooms, lounges, 41 Cooper Gallery and the Frederick P. Rose Auditorium. It houses the Albert Nerken School of Engineering, the Faculty of Humanities and Social Sciences, the Louis and Jeanette Brooks Computer Center, The Herb Lubalin Study Center, The Saturday Outreach Program and provides student and teaching studios. In addition, 41 Cooper Square aspires to LEED Platinum certification and incorporates an array of green features to reduce energy cost and enhance the physical environment.

The building is open from 8 am through 2 am Monday through Thursday, 8 am through 12 am Friday and Saturday, and 12 pm through 2 am on Sundays. The Albert Nerken School of Engineering Office and the Faculty of Humanities and Social Sciences Office,

are both open from 9 am to 5 pm Monday through Friday, and 9 am to 5:15 pm Monday through Thursday during the summer. The Brooks Computer Center is open from 9 am to 12 am Monday through Friday, and 12 pm through 8 pm on Saturday and Sunday.

30 Cooper Square The Business Office, Center for Design & Typography, Office Services (mail, photocopies, supplies), and the Offices of Admissions and Records, Registrar, Student Services (financial aid, career counseling, health, recreation and safety) and External Affairs (Alumni Relations, Annual Fund, Alumni Association, Development, Public Affairs, The Saturday Outreach Program and Continuing Education and Public Programs) are housed at 30 Cooper Square. The building is open for public service from 9 am to 5 pm, Monday through Friday. Summer hours are Monday through Thursday, 9 am to 5:15 pm.

Student Residence Located on Stuyvesant Street and Third Avenue, the Student Residence opened in 1992 and provides housing for 178 students. Three, four or five students share each two- or three-bedroom unit. Each unit contains a bathroom and kitchenette. The building contains a laundry room, the residence hall office on the third floor, a study room, the Menschel Common Room and Peter Torocco Alumni Space.

The Student Residence is staffed by the resident manager, assistant manager, 24-hour security guards, resident assistants and maintenance staff. The building has sprinkler, security camera and alarm systems. Access for residents is controlled by a palm scanner.

The privilege of residing in the building is generally extended only to students in their first year of study. New students receive an application at the time they are admitted to The Cooper Union. Continuing students who have a special need (i.e. medical or financial problems) will be considered for housing on a space available basis and should inform the resident manager of their special circumstances at the time of re-application in April.

Social programming for the building occurs in the Menschel Room with its spacious terrace, a generous gift from the Horace W. Goldsmith Foundation.

Refund Policy for Student Residence A refund of housing charges resulting from an approved request to cancel the housing agreement will be made in accordance with the following schedule: 100 percent of the total housing charges for the semester if the cancelation request is made prior to August 1 for the subsequent fall semester and December 1 for the subsequent spring semester; 65 percent if made by September 30 for the fall semester and January 31 for the spring; and 35 percent if made by October 31 for the fall and February 28(29) for the spring. No refunds will be made after these dates.

Students who are evicted from the Student Residence or whose Housing Agreements are terminated for violations of the terms of the Housing Agreement are not eligible for refunds.

21 Stuyvesant Street The historic townhouse at 21 Stuyvesant Street, which is known as the Hamilton Fish House, was given to the college as a gift in the late 1990s. Renovated by Cooper Union alumna Toshiko Mori, it serves as the President's Residence.

Hecht Viewing Gardens Located in front of the student residence are the George Hecht Viewing Gardens, made possible by a gift from Hecht, a 1930 electrical engineering alumnus.

The Cooper Union Library The Library's specialized collections provide support for the academic programs at the institution's three degree-granting schools of Art, Architecture and Engineering, as well as courses in the Humanities and Social Sciences.

Located on the main floor of the Foundation Building, the Library houses over 100,000 volumes of books and periodicals, subscribes to several hundred current periodicals in print and online, as well as a substantial number of databases, and maintains collections that include electronic, visual and historic materials. The McGraw Electronic Resources Center provides additional access to an array of specialized databases and the Internet while serving as a focal point for instruction in electronic and traditional research techniques. The Library's Web resources are accessible from any computer on campus, and to authorized users off campus.

The Visual Resources Collection is comprised of more than 65,000 digital images and slides of art and architectural works, as well as substantial picture files, films, videos, DVDs, maps and blueprints. The Cooper Archives preserve manuscripts, papers, photographs and memorabilia relating to the history of The Cooper Union, its founder Peter Cooper, and the Cooper and Hewitt families.

Professional librarians are always available during library hours to assist students, faculty and staff with their information needs. Librarians also perform specialized searches and provide class instruction.

The Cooper Union Library is a member of a consortium of academic libraries that includes New York University's Bobst Library and the libraries of The New School. Under this agreement, the libraries share a combined online catalog, and students and faculty of The Cooper Union have access and borrowing privileges at the consortium libraries. A separate agreement provides access to the library of the Cardozo School of Law.

When classes are in session, Library hours are as follows:

Monday through Thursday 8:45 am–9 pm, Friday 8:45 am–6 pm, Saturday 11 am–5 pm and Sunday 12 noon–5 pm.

The Cooper Archives (by appointment) and the Visual Resources Collection are open Monday through Friday 9 am– 5 pm. When classes are not in session, the Library is open Monday through Friday, from 9 am–5 pm. Summer hours are Monday through Thursday 9 am–5 pm. The Library is closed on holidays observed by the college.

Continuing Education Continuing Education offers to the general public and the Cooper Union community a wide range of lectures, symposia, readings, performances and evening courses. These public programs comprise an effort to extend the creative and intellectual life of the college into the larger community, as well as to complement Cooper's undergraduate offerings. Many of the programs, including courses, are free to Cooper Union students, faculty and staff.

The Great Hall The Great Hall of The Cooper Union has stood for over a century and a half as a bastion of free speech and a witness to the flow of American history and ideas. When the hall opened in 1858, more than a year in advance of the completion of the institution, it quickly became a mecca for all interested in serious discussion and debate of the vital issues of the day. It has continued in that role ever since.

Student Life With fewer than 1,000 students, The Cooper Union is a small community of professionals-in-training within the larger community of New York City. The intellectual ferment of New York City provides the background for students' rigorous studies in architecture, art or engineering, and students enjoy the abundance of cafés, galleries, theaters, movie houses, restaurants, shops and clubs within walking distance. The local stations of two major subway lines provide easy access to midtown Manhattan and the outer boroughs.

The dean of students and the staff of the Office of Student Services oversee many aspects of student life outside the classroom, including student clubs and the student government, career counseling, financial aid, student health insurance, athletics and recreation and the production of the Campus Security Safety Report.

Life on campus is shaped by the current interests of students. The Joint Student Council has representatives from all class years in all three schools and allocates funding to student clubs through the Joint Activities Committee (JAC). Under the rules of the JAC Constitution, clubs are readily formed and as a result, new clubs emerge every year. Up to 80 clubs have flourished annually, including multiple professional organizations, a drama society, several musical groups, dance clubs, the student newspaper, a variety of ethnic and cultural groups and recreational groups. The clubs have sponsored lectures, exhibits, field trips,

conferences, poetry readings, films, dinners, publications, performances, ice cream socials, international food fairs and community service work. Each year, the clubs jointly sponsor the Fall Festival where members recruit new students to join the clubs and give information about upcoming activities. Professional societies compete in national design competitions and have a stellar record of bringing home prizes.

Students at The Cooper Union also participate in an extensive program of athletic and recreational activities supervised by the associate dean. There are varsity women's and men's volleyball teams, basketball, cross-country women's and men's tennis teams, soccer and ping pong teams, as well as classes in fencing, yoga, aerobics and tae kwan do. Varsity teams have won Hudson Valley Athletic Conference championships in several different sports in recent years and individual players have been voted player of the week. Cooper Union students have access to two athletic facilities very close to the school where they can enjoy these activities. Each year, several hundred students, alumni and friends go on the annual ski trips to Mont Sutton, Quebec, during the winter breaks in January and February.

New Student Orientation New students are invited to an orientation prior to the beginning of the fall semester. This three-day program provides an opportunity for first-year students to meet each other and to get acquainted with continuing students and administrators. Sessions on campus are designed to familiarize students with the academic program and culture at The Cooper Union. Mandatory sessions on academic integrity help students to understand how to prepare papers for college courses.

Services for Disabled Students The Cooper Union is an equal opportunity institution that admits students without regard to disabling conditions. The Cooper Union makes reasonable accommodations to meet the needs of disabled students on campus. A variety of supplemental services can be arranged. These can include, but are not limited to, providing note takers, readers and interpreters.

Disabled students should contact the dean of students for assistance at least six weeks before the beginning of the semester.

Career Development The Center for Career Development provides a wide range of programs, services and resources for students in the Schools of Architecture, Art and Engineering. The Center is dedicated to providing effective career tools that will help prepare and empower students to make a successful transition from studying with a distinguished and creative faculty to applying their knowledge and skills to a professional practice.

The Career Center strengthens The Cooper Union's historic commitment to science and art by advancing student inquiry into

relevant applications of the education they have received at the institution. In addition, the Career Center provides students with information about how to conduct career-related research, prepare competitive application materials, and present their accomplishments.

We encourage students to review career-preparation timelines, postings for internships and full-time positions, placement data, graduate-school timelines and related events, experiential-learning programs and grants, fellowships and scholarships at www.cooper.edu/career.

The Cooper Union Alumni Association The Alumni Association comprises all Cooper Union graduates and former students who were not graduated but who matriculated and attended at least one year, left The Cooper Union in good standing and whose classes have been graduated. The Association was organized in 1936 to foster the loyalty, interest and support of those who studied at this unique institution. Each year, all members of the Association receive ballots to select the members of the Alumni Council and the Executive Board, which are the leadership bodies of the Association. Members of the Alumni Council and Executive Board serve on committees to organize events commemorating Founder's Day, plan reunions, host young alumni events, coordinate class representatives and maintain an Alumni Association web site. The Association also supervises the annual fund, the primary source of contributions to the operating budget of The Cooper Union. Generous contributions to the annual fund by alumni, parents and others enable The Cooper Union to further Peter Cooper's mission of proving a full-tuition scholarship to all admitted students. Members of the alumni body provide mentoring and career insights through our CU@Lunch program, in conjunction with the Office of Career Services. The Association also recognizes outstanding seniors with the Service to School awards and presents four annual prestigious alumni awards: Alumnus of the Year, Gano Dunn, John Q. Hejduk and Augustus St. Gaudens. Through the Alumni Council, alumni are represented on various faculty committees and on the Board of Trustees. You can learn more about the Alumni Association and purchase Cooper Union merchandise by visiting our web site at www.cualumni.com or e-mail us at alumni@cooper.edu.

APPLICATION AND ADMISSION INFORMATION

The Process The admission process varies according to the school to which an applicant applies (architecture, art, engineering).

First-year applicants to **The Irwin S. Chanin School of Architecture** submit their applications no later than January 5 of the year they plan to attend. In late January or early February, each applicant is mailed a hometest with specific instructions. The hometest contains projects that must be completed and returned to the Office of Admissions and Records within approximately 30 days. Each hometest is then reviewed by the Architecture Admissions Committee. Admission is offered to approximately 25-30 students, based on the hometest and a review of the student's previous academic record.

First-year applicants to the **School of Art** submit their applications no later than January 8 of the year they plan to attend. In late January or early February, each applicant is mailed a hometest with specific instructions and a series of personal essay questions. The hometest contains projects that must be produced and returned to the Office of Admissions and Records, together with the essays and a portfolio of previous work, within approximately 30 days. Each complete record is then reviewed by a faculty committee. Final decisions are made by the Art School Admissions Committee based on all elements of the application, with substantial weight given to the hometest. Admission is offered to approximately 65 students.

First-year applicants to the **Albert Nerken School of Engineering** submit their applications no later than February 2 of the year they plan to attend. Once the initial application is filed, each applicant is mailed a series of questions to be answered in essay format. Academic components of an applicant's record—the high school average, SAT I (or ACT) scores, SAT II scores in mathematics (I or II) and physics or chemistry and strength of course selection—are used in evaluating a student for admission. Essays and teacher/counselor recommendations are also considered to ensure that the admission offers reflect an accurate match between applicant and institution. Admission is offered to approximately 170 students.

For information about the SAT I or II exams, please visit www.collegeboard.org. For information about the ACT, which can be taken in lieu of the SAT I exam only, please visit www.act.org. For further information about The Cooper Union, please visit our web site at www.cooper.edu.

Application Calendar for Architecture (Undergraduate)

Submit first-year application before:	January 5
Submit high school records before:	February 1
Apply to the College Board for SAT I at least one month before taking test.	
Recommended SAT I test date before:	February 1
Submit transfer application before:	January 5

Application Calendar for Architecture (Graduate)

Submit application and all materials before:	January 5
Apply to the College Board for GRE at least one month before taking test. ¹	
Recommended GRE test date before:	December 5

Application Calendar for Art

Submit first-year application before:	January 8
Submit high school records before:	February 1
Apply to the College Board for SAT I at least one month before taking test. ¹	
Recommended SAT I test date before:	February 1
Submit transfer application before:	January 8

Application Calendar for Engineering (Undergraduate)

Submit first-year application before:	February 2
Submit high school records before:	February 15
Apply to the College Board for SAT I at least one month before taking test. ¹	
Recommended SAT I test date before:	February 2
SAT results not acceptable if older than:	April 2007
Apply to the College Board for Math I or II and Physics or Chemistry SAT II Tests at least one month before taking tests. ¹	
Recommended SAT II Test date before:	February 2
Submit transfer application before:	March 12

Application Calendar for Engineering (Graduate)

Cooper Union students should submit graduate applications before:	March 1
Graduates from other colleges may submit graduate applications before:	March 1

The Cooper Union offers its full-tuition scholarship education to residents of the United States of America who qualify in the competition for admission, regardless of their race, religion, sex, color, age, national and ethnic origin or handicap. Graduation from an approved secondary school course covering at least 16 units or the equivalent is required of all candidates. Admission requirements and procedures are not the same for all curricula taught at The Cooper Union. (See the application calendar above, and subsequent pages for details.)

The application is available to be downloaded or transmitted online at www.cooper.edu. A \$65 non-refundable application fee is required when the application is filed. The admissions office is open for public service from 9 am to 4:30 pm, Monday through Friday. Information is readily available at www.cooper.edu.

¹ New York State residents should consult the Student Bulletin, New York State Edition (College Board), to confirm test dates.

General Application Procedure

Each candidate should:

1. Complete and return or electronically file an acceptable application and the \$65 application fee (no cash).²
2. Submit official high school and college records before the specified deadlines.³
3. Take all the required tests.³
4. Some students may be asked to appear for an interview, though this is not a general requirement for admission.

To be enrolled, each admitted candidate must:

1. Accept offer of admission and pay the appropriate fee.
2. Submit a final transcript before July 15.
3. File medical—including vaccination and immunization—records.
4. Document certification of citizenship status.
5. Register for courses.

The Cooper Union has agreed with many other colleges to use May 1 prior to the fall for which admission is sought as the deadline for students who are accepting our offers of admission. This is known as the candidate's reply date.

**First-Year Application Requirements—
Bachelor of Architecture Degree**

Applications for first-year admission must be submitted before January 5.

Applicants for first-year admission in architecture will be required to complete and submit a home test. Details will be mailed to applicants in late January or early February.

High school records must show graduation with a minimum of 16 units⁴ before July 15 of the year for which admission is sought, with required and elective subjects as follows:

Subject	Units Required for Architecture
English	4
History and Social Studies	2
Mathematics	3 ⁵
Science	2
Other Electives	6
Total Units Required	17

² A waiver of application fee may be granted if the student files a written request with the application and formal documentation of need (FAFSA or W2 form).

³ See the appropriate section below to discover which high school subjects, which college records and which tests are required for the curriculum you wish to enter at Cooper Union.

⁴ A unit represents a year's study in a subject, with classes meeting at least four times a week in a secondary school.

⁵ Including trigonometry and precalculus. Students who have not demonstrated an appropriate level of mathematics achievement will be required to enroll in a precalculus course in the summer prior to their enrollment, in preparation for MA 163-164 Calculus and Analytic Geometry, which is a first-year requirement.

Students who apply while attending high school will be expected to supply transcripts of subjects studied during the first three years of high school (Grades 9, 10 and 11). High school graduates must supply the full four-year record. High school transcripts should be sent during the fall and winter months, but no later than February 1 if supporting a freshman application. Each candidate should make certain that the high school subjects required for his/her major are completed prior to graduation since The Cooper Union will not be able to verify his/her senior program until final transcripts arrive in June or July. This is too late to make up a missing required subject or to make plans for admission to another college. All freshman candidates for degrees must submit acceptable scores on the College Board Scholastic Assessment Test (SAT I or ACT). Test scores should be sent to The Cooper Union (CEEB Code No. 2097). Testing later than February 1 of the year for which admission is sought is not acceptable; results must reach The Cooper Union before March 1. Students who have not demonstrated an appropriate level of mathematics achievement will be required to complete a precalculus course in the summer prior to their enrollment, in preparation for MA 163-164 Calculus and Analytic Geometry, a first-year requirement.

Recognizing that communication skills (both verbal and written) are integral to all curricula of The Cooper Union, all incoming students will be required to participate in a writing workshop conducted by the Faculty of Humanities and Social Sciences during the new student orientation program. An assessment based on the outcome of this workshop may indicate that student(s) will benefit from use of the resources of the Center for Writing and Language Arts (see page 117 for more information) in order to meet the expectations of the program as well as to develop the critical analytical and communication skills that provide the foundation for creative, academic and professional success.

Applicants whose first language is not English are encouraged to submit documentation of their English language proficiency. The Test of English as a Foreign Language will be taken into consideration in all admission deliberations (most admitted students score at least 250 [CBT], 100 [IBT] or 600 [paper test] on the TOEFL exam).

Admission decisions will be made available in early April; candidates are expected to reply before May 1, the candidate's reply date.

First-Year Application Requirements—Art Degree Applications for first-year admission must be submitted before January 8.

Applicants for freshman admission in art will be required to complete and submit the hometest and a portfolio of their (completed) works. Details will be mailed to applicants in February.

High school records must show graduation with a minimum of 16 units⁶ before July 15 of the year for which admission is sought, with required and elective subjects as follows:

Subject	Units Required for Art
English	4
History and Social Studies	2
Mathematics	1
Science	1
Other Electives	8
Total Units Required	16

Students who apply while attending high school will be expected to supply transcripts of subjects studied during the first three years of high school (Grades 9, 10 and 11). High school graduates must supply the full four-year record. High school transcripts should be sent during the fall and winter months, but no later than February 1 if supporting a freshman application. Each candidate should make certain that the high school subjects required for his/her major are completed prior to graduation since The Cooper Union will not be able to verify his/her senior program until final transcripts arrive in June or July. This is too late to make up a missing required subject or to make plans for admission to another college. All first-year candidates for degrees must submit acceptable scores on the College Board Scholastic Assessment Test (SAT I or ACT). Test scores should be sent to The Cooper Union (CEEB College Code No. 2097). Testing later than February 1 of the year for which admission is sought is not acceptable; results must reach The Cooper Union before March 1. Applicants whose first language is not English are encouraged to submit alternative documentation of their English language proficiency. The Test of English as a Foreign Language will be taken into consideration in all admission deliberations (most admitted students score at least 250 [CBT], 100 [IBT] or 600 [paper test] on the TOEFL exam). Admission decisions will be made available in early April; candidates are expected to reply before May 1, the candidate's reply date.

⁶ A unit represents a year's study in a subject, with classes meeting at least four times a week in a secondary school.

First-Year Application Requirements—Engineering

(Undergraduate) Candidates should file their applications before February 2 of the year for which admission is sought and their official high school transcripts before February 15.

High school records must show the following:⁷

Subject	Units Required for Engineering
English	4
History and Social Studies	2
Mathematics	4
Physics	1
Chemistry	1
Electives	5–7
Total Units Required	17 minimum 19 recommended

Students in high school will be expected to supply transcripts covering subjects taken during the first three years of high school (Grades 9, 10 and 11). High school graduates must supply the full four-year record. High school transcripts should be sent during the fall and winter months, but no later than February 15 if supporting a freshman application.

Each candidate should make certain that the high school subjects required for admission are completed prior to graduation since The Cooper Union will not be able to verify his/her senior program until final transcripts arrive in June or July. This is too late to make up a missing required subject or to make plans for admission to another college. In the area of mathematics, candidates may offer somewhat different patterns of preparation provided they will be ready for the intensive study of calculus at college. Preparation beyond the listed minimum in mathematics is highly recommended. College Board Advanced Placement Mathematics are suitable courses for such further preparation.

All engineering candidates must send to The Cooper Union (College Board Code No. 2097) results of the SAT I or ACT and of the SAT II in physics or chemistry and in either Level I or Level II mathematics. Applications for the SAT I and II should be filed with the College Board in Princeton, NJ, at least one month before the testing dates. Testing later than February 1 of the year for which admission is sought is not acceptable; results must reach The Cooper Union before March 1. Results of an SAT or ACT taken before April 2007 will not be accepted. Applicants whose first language is not English are encouraged to submit alternative documentation of their English language proficiency. The Test of English as a Foreign Language will be taken into consideration in all admission deliberations (most admitted students score at least

250 [CBT], 100 [IBT] or 600 [paper test] on the TOEFL exam) Admission decisions will be made in early April; candidates are expected to reply before May 1, the candidate's reply date.

First-Year Profile—Fall 2008 In 2008, The Cooper Union received 3,055 first-year applications; 283 students were admitted (9 percent) and 206 of those students accepted our offer (73 percent). The School of Architecture received 735 applications; 26 students were admitted (four percent) and 25 of those accepted our offer (96 percent). The School of Art received 1,393 applications; 69 students were admitted (five percent) and 63 of those students accepted our offer (91 percent). The School of Engineering received 927 applications; 188 students were admitted (20 percent) and 118 of those students accepted our offer (63 percent).

Geographically, 44 percent of the first-year architecture students lived in New York State; 40 percent of the first-year art students lived in New York State; and 60 percent of the first-year engineering students lived in New York State. In all, 52 percent of all Cooper Union first-year students came from New York State.

Twenty-five percent of all Cooper Union first-year students are Asian; 14 percent are African American, Caribbean or Latino; 2 percent are Native American; 12 percent are international students; and 42 percent are Caucasian, non-Latino. Thirty-five percent of all Cooper Union first-year students are women.

Please Note: SAT or ACT scores do not significantly enter the decision-making process of the School of Art but are important ingredients of the architecture and engineering admissions criteria.

The middle 50 percent of the architecture freshmen scored a high school average between 89 and 93 and SATs between 1210 and 1380. The middle 50 percent of the art freshmen scored a high school average between 85 and 94 and SATs between 1130 and 1350. The middle 50 percent of the engineering freshmen scored a high school average between 94 and 98 and SATs between 1370 and 1510.

Retention and Graduation Rate Eighty-two percent of the fall 2007 School of Architecture first-year students returned for fall 2008 and 82 percent of first-year students entering the School of Architecture in fall 2002 graduated within six years. Architecture students may expand their professional options with outside experience (foreign or domestic) for up to one year during their course of study at The Cooper Union. Ninety-five percent of the fall 2007 School of Art first-year students returned for the fall 2008 and 94 percent of first-year students entering the School of Art in fall 2003 graduated within five years. Ninety-three percent of the fall 2007

⁷ Including calculus.

School of Engineering first-year students returned for fall 2008 and 83 percent of first-year students entering the School of Engineering in fall 2003 graduated within five years.

Transfer Application Requirements—Bachelor of Architecture Degree Transfer applicants for the architecture program are those who will have completed elsewhere at least one year of an accredited architecture program by June of the year for which admission is sought.

Other individuals may be eligible to apply through the transfer application process if they can submit a portfolio of their creative work. This includes individuals who have or will have by June a bachelor's degree or the equivalent in a discipline other than architecture or those who have begun studies in a discipline related to architecture. Transfer applicants must apply before January 5 for September classes. Transfer applicants will be required to complete and submit a home test. Details will be mailed to applicants with the portfolio instructions. The admission decisions and the levels of entry for transfer students will be based upon a review of college record and of portfolio work. Special instructions concerning the content and form of transfer portfolios are mailed to applicants in late January or early February, to be returned to us by the posted date. All transfer applicants must submit official transcripts of previous educational experiences (high school and college and prior SAT or ACT scores).

If admitted, transfer students are offered admission into a specific year of the five-year design sequence. This decision is final and acceptance of the offer of admission represents agreement on the part of the admitted student with this decision. It will be necessary for the matriculating transfer student to successfully complete the design studio to which he/she is admitted, as well as all subsequent studios, as part of their degree requirements. The official academic transcript of a transfer student will be reviewed prior to the student's first registration. This review will determine what, if any, additional coursework may be eligible for transfer credit. (See page 35 for more information on transfer credit evaluation by the School of Architecture.)

Application Requirements—Master of Architecture II Degree

The post-professional Master of Architecture degree program is open to applicants who:

- hold the degree of bachelor of architecture (B.Arch.), the master of architecture I (M.Arch. I) or an equivalent degree from an international institution
- have completed a minimum of one year of work experience after obtaining their first professional degree.

All applicants must submit the following:

- A completed application form (available at http://archweb.cooper.edu/MarchApp_10.pdf)
- Application fee of \$65
- Official academic records (transcripts) from all colleges and universities from which you have received credit
- Recent GRE scores
- Recommendation letters (three are required)
- Resume/CV
- Written essay: The essay should succinctly explain your interest in the M.Arch. II program as well as the specified area of concentration
- Portfolio: Applicants must submit a portfolio that includes their most important and representative design and written work. The portfolio should consist of professional, academic and/or scholarly work. It should be bound into a brochure no larger than 9" x 12" (overall size). Applicant should not submit CDs, slides, loose sheets or original drawings. Simple packaging is preferred.
- Potential candidates will be required to be available and make necessary arrangements for a personal interview. Interview expenses will be the responsibility of the candidate.

Deferral of an Offer of Admission—Architecture Due to the small size of the programs, the deferral of an offer of admission to the B.Arch. (undergraduate) and/or M.Arch. II (graduate) program is not permitted.

Transfer Application Requirements—Art Transfer applicants for the art degree or certificate programs are those who will have completed between 18 and 60 credits of college studio art courses by the time they enroll at The Cooper Union.

All other applicants are freshman candidates. Transfer applicants must apply before January 8 for classes beginning in September. The admission decisions for transfer students will be based upon a review of prior college record and of portfolio work, including the hometest. Special instructions concerning content and form of transfer portfolios are mailed to applicants in late January or early February, to be returned to us by the posted date. Transfer applicants must not have completed more than 60 credits at another institution. (See also page 50.) All transfer applicants must submit official transcripts of previous educational experiences (high school and college and prior SAT or ACT scores). An accepted applicant who has previously earned a baccalaureate degree in a discipline other than art will be treated as a transfer student for purposes of evaluating completion of degree requirements and length of time allotted at The Cooper Union to complete the B.F.A.

Transfer Application Requirements—Engineering Transfer applications should be submitted before March 12 of the year for which admission is sought. It may be necessary to wait until late May, when the available space may be predicted accurately, before receiving notification of the admission decision. Transfer applicants must have completed all of The Cooper Union’s first-year program at another accredited college. If space is available, they are admitted on the basis of prior college records. All transfer applicants must submit official transcripts of previous educational experiences (high school and college and prior SAT or ACT scores).

Master of Engineering Application Requirements Students are accepted on an academically competitive basis subject to the availability of an adviser and of suitable facilities for the proposed thesis research. To be admitted to the program, a student should have completed an engineering baccalaureate program that is accredited by the Accreditation Board for Engineering and Technology (ABET). Current Cooper Union engineering students do not have to pay an application fee.

Cooper Union Undergraduates must have a minimum 3.0 grade point average in the major upon graduation. Consult the department chairman regarding specific departmental requirements. Generally, students entering Cooper Union undergraduate programs as freshmen require five years to complete the master of engineering.

Graduates from Other Colleges Depending on the availability of faculty and facilities, the engineering departments may be able to admit a few outstanding students into their master’s degree programs from outside The Cooper Union. To be considered for admission, a student should have completed an engineering baccalaureate program that is accredited by the Accreditation Board for Engineering and Technology (ABET). Applicants must submit official transcripts. Graduates of foreign institutions whose native language is not English are required to submit scores of the Test of English as a Foreign Language (TOEFL). Admitted students may be required to take advanced undergraduate courses to make up any deficiencies in their preparation. Specific admission requirements may be waived upon recommendation of the faculty in the area of the student’s major interest.

All application forms must be submitted to the Office of Admissions and Records by March 1. The application form is available to be downloaded at www.cooper.edu.

College Boards All candidates for first-year admission to The Cooper Union’s undergraduate degree programs and for the certificate program in art are required to take the Scholastic Assessment Test (SAT I) of the College Entrance Examination Board.⁸ College Board application forms and SAT descriptions may be obtained in most high schools or by writing to the CEEB, Box 592, Princeton, NJ 08541. College Board applications, with the required fee, should be returned to the College Board (not to Cooper Union) at least one month before the test date. The board tests are given at centers readily available around the world. Please visit www.collegeboard.com for more information. In addition, all candidates for freshman admission to the School of Engineering must take the SAT II in math (I or II) and physics or chemistry. (See Application Calendar on page 9). All College Board test results must be sent to Cooper Union (CEEB College Code No. 2097). SAT or ACT scores do not significantly enter the decision-making process of the School of Art, but are important ingredients of the architecture and engineering admission criteria.

English Proficiency Students with low verbal SAT I or ACT scores and records of poor achievement in English language study may be required to take a placement examination and, on the basis of that examination, to demonstrate increased proficiency in English before registering for HSS1. The Test of English as a Foreign Language (TOEFL) will be taken into consideration in all admission deliberations (most admitted students score at least 250 [CBT], 100 [IBT] or 600 [paper test] on the TOEFL exam).

Advanced Placement Credit and Credit by Examination The School of Engineering grants credit for high school work in Advanced Placement courses in mathematics, chemistry and physics, according to the following results on the Advanced Placement examinations:

AP Exam	Score	Course Waived	Credits
Calculus B.C.	4, 5	Ma 111	4
Chemistry	4, 5	Ch 110	3
Physics, Mechanics (c)	5 ⁹	Ph 112	4
Physics, Electro (c)	5 ⁹	Ph 213	4

No student is required to accept Advanced Placement credit from the School of Engineering. All students who score 5 on Advanced Placement examinations in English literature or European history may be eligible for three credits for each examination. In some cases, instead of receiving credit, students may be permitted to fulfill part of the humanities or social sciences requirement with an

⁸ ACT scores may be substituted for SAT I scores only. Please visit www.act.org for more information.

⁹ Students who earn a grade of 5 must take a Department of Physics examination in order to receive the 4 credits.

appropriate elective course. Those who wish to be considered either for AP credit or for advanced placement in an elective course should notify the Faculty of Humanities and Social Sciences before the first week of classes. The Cooper Union will consider granting credit for study in the Armed Forces, verified by U.S.A.F.I.

Early Decision (for Art Applicants) A select number of potential School of Art students seen at portfolio reviews are invited to complete their application and hometest for admission before the application deadline. In addition, if the School of Art is a first-year applicant's first choice, the applicant may choose the Early Decision option. All Early Decision applications will be reviewed and decisions will be rendered by the end of February, about one month before the normal notification date of April 1. Applicants who are admitted under the Early Decision option must make their commitment to the School of Art by April 1. Early Decision is an option for both first-year and transfer art applicants.

Deadlines for Early Decision—School of Art

November 30 Last day to take SAT or ACT

December 1 Application and academic records due for applicants choosing Early Decision option

Mid-December Hometest mailed to applicants choosing the Early Decision option

Mid-January Completed hometest submission date for applicants choosing Early Decision

Late-February Notification of admission decision for all Early Decision applicants

April 1 Early Decision candidate's reply date

Rolling Admission (for Art Applicants) Potential School of Art students who have received a preliminary review at National Portfolio Days, which occur after The Cooper Union's regular admission deadline (January 8), may be invited to apply after the regular admission deadline. All reasonable effort is made by the School of Art Admissions Committee to review these applications in a fair and timely fashion.

Early Decision (for Engineering Applicants) If the School of Engineering is the first choice of an applicant, the candidate may apply under the Early Decision plan. The Cooper Union will consider an application earlier than usual and give the applicant a decision in advance of the normal notification date. Application, test scores and high school record must be received by the Office of Admissions and Records by December 1. Applicants who are admitted

under the Early Decision option must agree to enroll in the School of Engineering at Cooper Union and withdraw all other college applications.

Deadlines for Early Decision—School of Engineering

December 1 Application, test scores and records must be received

December 21 Notification of admission decision

February 11 Candidate's reply date

Admission after Three Years of High School Candidates of exceptional merit may be considered for admission after completion of three years of high school. Engineering applicants must have excellent high school averages and test scores. Art and architecture applicants must have excellent high school records and exceptional ability. A recommendation from the high school principal, at least one recommendation from a teacher and an interview will be required. In accordance with the regulations of individual states, a student may or may not be eligible to receive an Equivalency Diploma after completion of a specific number of credits in appropriate subject areas at The Cooper Union. It is the responsibility of the applicant to investigate his/her state regulations in this regard.

Certificate in Art Requirements A Certificate in Art program is offered as an alternative to the B.F.A. program. Candidates for the certificate program must complete 60 credits in two years of full-time study (with a minimum of 30 credits per year) or in four years of part-time study (with a minimum of 15 credits per year). All foundation studio courses must be completed and students must follow prerequisite course requirements in selecting advanced studio. The Certificate in Art program consists of 30 credits in foundation studio, 21 credits in advanced studio and nine credits in art history. All admission requirements, academic standards and regulations of the School of Art apply to the certificate program. Students in the certificate program may apply through the Office of Admissions and Records for transfer to the B.F.A. program after 42 credits of work have been completed at The Cooper Union. Transfer certificate students may transfer a maximum of 12 credits from another institution toward their certificate.

International Students All applicants to The Cooper Union must live in the United States or its possessions or territories or apply from a domestic address. A minimum TOEFL score of 250 (CBT), 100 (IBT) or 600 (paper test) is required. Students on visas (those who are non-citizens or who are not permanent residents) who are accepted to The Cooper Union will be required to file a Certification of Finances with the Office of Admissions and Records prior to

receiving an I-20 and registration. The Certification of Finances must certify that students meet the minimum financial support requirements for resident students as indicated for each school (see Budget Guide, page 28). Students on visas (those who are non-citizens or who are not permanent residents with a “green card”) are assessed a fee of \$1800 per year.

Budget We provide full-tuition scholarships to all enrolled students and for those who apply, administer financial aid to help cover the additional costs of studying at The Cooper Union (i.e., books, supplies, housing, meals, etc.). However, it is important for all students to consider these expenses and try to budget accordingly. Please see pages 25–28 for more information about costs and financial aid.

GENERAL REGULATIONS

The Cooper Union reserves the right to change or amend its regulations, curricula, fees and admission procedures without prior notice.

Registration Unless permitted by the dean of Admissions and Records to do otherwise, all students must report on the scheduled dates to register and pay fees and laboratory deposits. Students who fail to meet all financial obligations to The Cooper Union will not be permitted to register. No student will be admitted to classes without evidence of completion of registration. Students who fail to register will be dropped from the rolls.

Attendance

School of Architecture and School of Art Classes are scheduled Monday through Friday between 9 am and 10 pm. Studio facilities usually are available to students on Saturdays and Sundays throughout the academic year.

Each student is required to be punctual and to attend each scheduled class. In the case of unavoidable absence, the student should, on his/her return, report to the instructor to explain the absence and inquire about making up the lost work. All architecture students are provided with studio space and are expected to work there during regular building hours.

School of Engineering Each student is expected to attend all classes and to satisfy other requirements in each course in such ways as the instructor may prescribe. If a student is absent an excessive number of times, he/she may, at the discretion of the instructor and with the approval of the dean, be asked to withdraw from the course.

After each absence, it is the student’s responsibility to consult with the instructor, without delay, to determine the nature of the makeup work required.

Faculty of Humanities and Social Sciences Each student is expected to attend all classes. No more than two unexcused absences will be permitted during any given semester. In the case of an unavoidable absence, the student should, on his/her return, report to the instructor to explain the absence and inquire about making up the lost work. Students who are absent three or more times may receive a reduction of the final grade or, at the discretion of the instructor, be asked to withdraw from the course.

Calendar Changes The academic year at The Cooper Union has fall and spring semesters and runs from September to May. In order to serve the student body most effectively during the academic year, The Cooper Union cannot modify its calendar or procedures to meet special demands of students.

Academic Standards and Regulations For specific academic standards and regulations of each school, consult the appropriate sections of this catalog.

Dismissal The Cooper Union reserves the right at any time to dismiss a student whose conduct, attendance or academic standing is, in its judgment, unsatisfactory and to grant or withhold credits, certificates, degrees or diplomas. Disciplinary authority is vested in the President's Office.

Health The Cooper Union requires a report of a physical examination from a licensed physician of the student's choice. The Cooper Union will provide its own medical form for this purpose and the form must be completed in its entirety. This report must include a record of vaccinations and immunizations. In addition, New York state law requires that students respond to a query concerning whether or not they have been immunized against meningitis.

The college reserves the right to exclude from attendance at any time any student whose physical or emotional condition is such that, in the opinion of a medical officer, attendance would endanger either the student's own welfare or that of other members of the community. Students whose attendance at The Cooper Union has been interrupted by a dismissal or extended leave of absence need to submit new medical records before they resume attendance. Likewise, students continuing on to the graduate program at The Cooper Union should submit new medical forms at the time of beginning graduate study.

Vaccination and Immunization New York State law requires that all undergraduate and graduate students be immunized against measles, mumps and rubella. The law applies to all students born on or after January 1, 1957.

Proof of immunity consists of:

- Measles: Two doses of live measles vaccine administered after 12 months of age, physician documentation of measles disease or a blood test showing immunity. **The exact date of these shots in month-day-year format must be written on the form and certified by the physician.**
- Mumps: One dose of live mumps vaccine administered after 12 months of age, physician documentation of mumps disease or a blood test showing immunity. The New York State Assembly is currently considering a proposal to require two mumps shots.
- Rubella: One dose of live rubella vaccine administered after 12 months of age or a blood test showing immunity.

Proof of immunity, including dates of immunizations, must be filed with the Office of Student Services **prior** to each student's initial

registration at The Cooper Union. **Students who claim a religious objection to being immunized must send a signed letter attesting to this fact to the dean of students by July 15.**

Students may not attend any events on campus, including classes and orientation programs, without having submitted these forms.

Meningitis Status New York State Public Health Law Section 2167 requires colleges to distribute information about meningococcal disease and vaccination to all enrolled students.

Meningitis is rare; however, cases of meningitis among young adults have more than doubled since 1991. When the disease strikes, its flu-like symptoms make diagnosis difficult. If not treated early, meningitis can lead to swelling of the fluid surrounding the brain and spinal seizures, limb amputation and even death.

The Cooper Union is required to maintain a record of the following for each student:

- A response to the receipt of meningococcal disease and vaccine information signed by the student or the student's parent or guardian, AND EITHER
- A record of meningococcal meningitis immunization within the past 10 years, OR
- An acknowledgement of meningococcal disease risks and refusal of meningococcal meningitis immunization signed by the student or the student's parent.

Students are asked to provide this information by July 15 of the year they enter The Cooper Union.

Health Insurance The Cooper Union requires all students to submit proof that they have health insurance prior to registration. Students who fail to supply the information requested on the Student Accident and Sickness Insurance Enrollment/Waiver Form before the beginning of the fall semester will be billed for the Cooper Union Student Accident and Sickness Insurance at a cost of \$1,466 for the 2009–10 academic year.

Obligations Students will be held accountable for all individual obligations, financial and other, entered into with The Cooper Union. Students who fail to meet all financial obligations to The Cooper Union will not be permitted to register. No student will be included in the graduating class unless all obligations have been accounted for prior to graduation. The Cooper Union will withhold transcripts and other information about a student who has not met financial obligations.

Transcripts Official transcripts of a student's scholastic record are issued directly to officials of other institutions or examining boards, upon request to the dean of Admissions and Records and Registrar. Each copy of a transcript will cost \$5 (there is no charge to currently enrolled students). Requests should include the name and complete address of the person who is to receive the transcript and must include the signature of the student or alumnus/a.

Transcripts are not issued for students during the period of time in which grades are being recorded. Transcripts of student grades are issued to inquiring employers and agencies if a student notifies the dean of Admissions and Records and Registrar in writing, authorizing the distribution of the transcript. *Official transcripts are not issued directly to students or to alumni.*

Current students have access to their transcript and registration information on SAIS, the Student Academic Information System, once they receive a password and a login at the Computer Center.

Student Records

Notification of FERPA Rights The Family Educational Rights and Privacy Act (FERPA) affords students certain rights with respect to their education records. These rights include: 1) The right to inspect and review the student's education records within 45 days of the day The Cooper Union receives a request for access. Students should submit to the Office of Admissions and Records written requests that identify the record(s) they wish to inspect. The Office of Admissions and Records official will make arrangements for access and notify the student of the time and place where the records may be inspected. If the records are not maintained by the Office of Admissions and Records, the office shall advise the student of the correct official to whom the request should be addressed. 2) The right to request the amendment of the student's education records that the student believes is inaccurate. Students may ask the Office of Admissions and Records to amend a record that they believe is inaccurate. They should write the Registrar and clearly identify the part of the record they want changed and specify why it is inaccurate. If the Registrar decides not to amend the record as requested by the student, the Registrar will notify the student of the decision and advise the student of his or her right to a hearing regarding the request for amendment. Additional information regarding the hearing procedures will be provided to the student when notified of the right to a hearing. 3) The right to consent to disclosure of personally identifiable information contained in the student's education records, except to the extent that FERPA authorizes disclosure without consent. One exception, which permits disclosure without consent, is disclosure to school officials with legitimate educational interests. A school

official is a person employed by The Cooper Union in an administrative, supervisory, academic, research or support staff position; a person or company with whom The Cooper Union contracted (such as attorney, auditor or collection agent); a person serving on the Board of Trustees or a student serving on an official committee (such as a disciplinary or grievance committee) or assisting another school official in performing his or her tasks. A school official has a legitimate educational interest if the official needs to review an education record in order to fulfill his or her professional responsibility. 4) The right to file a complaint with the U.S. Department of Education concerning alleged failures by The Cooper Union to comply with the requirements of FERPA. The name and address of the Office that administers FERPA is: Family Policy Compliance Office, U.S Department of Education; 400 Maryland Avenue, SW; Washington, DC 20202-5901.

Program Changes During the first several days of a semester, courses may be added to or dropped from a student's program without penalty or fee (program adjustment). Adding of courses after the posted date is not permitted. Students who wish to change their academic programs should consult with appropriate deans. All program changes must be reported by the student to the dean of admissions and records. A \$25 fee will be charged for dropping courses after the drop/add period.

Transfer of Academic Credit Every effort is made to provide admitted students with a preliminary evaluation of their transfer credit. School-wide policies dictate that a grade of B or better must be earned to be eligible for transfer of credit.

To seek credit or if there is a question about whether or not a class taken at a previous institution is eligible for transfer of credit please contact the department chairperson or respective dean of the school to which you are interested in obtaining credit.

Each department/school reserves the right to ask for additional information, i.e. coursework, syllabus, portfolio, etc. before granting transfer credit.

Currently enrolled students must always contact the appropriate department chairperson and dean of school at The Cooper Union prior to registering for classes at other colleges or universities should there be interest in obtaining transfer credit at The Cooper Union. Explicit permission must be granted by the department chairperson and dean of school before registering at another college or university to ensure that the course will be transferable.

Please see pages 35, 50, 70 and 116 for more detailed information about transfer credit.

Student Property The Cooper Union assumes no responsibility for loss of or damage to the work or property of students.

Policy on Copyrighted Material

Copyright Infringement The Cooper Union is obligated by federal law to inform its students of its policies and sanctions related to copyright infringement. Unauthorized distribution of copyrighted material, including unauthorized peer-to-peer file sharing (e.g., using BitTorrent to obtain/distribute music or movies) may subject students to civil and criminal liability, sanctions arising from a violation of The Cooper Union's Code of Fair Practice, and loss of internet services provided by the Cooper Union IT Department.

The basics of copyright law may be found at numerous websites, including those of many universities whose policies relating to copyright infringement generally and file sharing in particular are similar to The Cooper Union's policy:

<http://www.uspto.gov/web/offices/dcom/olia/copyright/copyrightrefresher.htm>

<http://www.copyright.umich.edu/file-sharing-faq.html>

http://deanofstudents.utexas.edu/lss/spot_illegalfilesharing.php

<http://www.copyright.gov/title17/>

Fair Use A limitation on copyright protection is known as "fair use." Permission of a copyright holder is not required (i.e., there is no copyright infringement) where the use is for *noncommercial* activities such as teaching (including multiple copies for classroom use), scholarship, research, studio work, criticism, comment, or news reporting. [Note that while "teaching" activities *may* qualify as fair use, the doctrine of fair use has a requirement relating to the "amount and substantiality" of the copyrighted work that does not permit, for example, the copying and distribution of an entire copyrighted textbook to a class.]

The routine use of file sharing programs to obtain music, movies and software does not constitute fair use. For more information on fair use see:

<http://www.copyright.gov/fls/fl102.html>

Code of Fair Practice In addition to the sanctions for copyright infringement provided by federal law, The Cooper Union's Code of Fair Practice explicitly prohibits:

- "illegally duplicating copyrighted or licensed software" (Category B offense)
- "any unauthorized use of network and/or computer hardware" (Category B offense)

A violation of copyright law might also be viewed as an act of academic dishonesty or fraud, which are Category A offenses and punishable by suspension or dismissal.

IT Department Responsibilities In order to receive a Cooper Union computer account, a student is required to sign a document provided by the IT Department in which they promise to respect the rights of copyright holders. While the IT Department does not monitor its networks for content, it may monitor the volume of use (bandwidth) for each computer on its networks. A student who is using excessive bandwidth may have his or her internet access reduced or terminated.

Students should be aware that representatives of copyright holders routinely search the internet for infringers, resulting in lawsuits being filed against students. Such lawsuits may be very expensive to settle. Copyright holders have frequently filed notices of copyright violations directly with The Cooper Union, which requires the school to take immediate action to eliminate infringement.

The IT Department advises against installing and/or leaving file sharing programs on any computer attached to a Cooper Union network. While there are legitimate reasons for using such programs (e.g., the distribution of non-copyrighted software), by operating "silently" they may put the owner of the computer in the position of distributing infringing files, and being liable for such distribution, even though he or she has no intent of doing so.

Policy on Religious Observances No student shall be refused admission to or be expelled from The Cooper Union solely because he/she is unable to participate in any examination, study or work requirement because of religious observances and practices. It is the intent of The Cooper Union to accommodate reasonably individual student and faculty religious obligations and practices without penalty, based on good faith effort and due notice to those relevantly concerned of the anticipated religious observance date. There is a mutual obligation of students and faculty to provide prior notice to each other of anticipated absences. Students absent because of religious observances and practices will be given the opportunity to make up any examination, study or work requirement missed without penalty.

Policy on Bicycles The Cooper Union encourages the use of the bicycle as a viable mode of transportation to and from campus. To ensure the safety of our faculty, students and staff, and taking into account the college's space constraints, the following bicycle policy will take effect September 1, 2009.

Bicycles that do not fold are not permitted in the Foundation Building, 41 Cooper Square, the Residence Hall or 30 Cooper

Square. Loose bicycle tires are not permitted as well. Folding bicycles, which must be covered prior to entering the building, may be stored in offices or lockers. Folding bicycles stored in lockers must fit within the locker such that locker doors remain closed. Bicycles found in public spaces such as studios, hallways, laboratories and lounges will be removed. Violators of this policy will be subject to disciplinary action and will be responsible for any assessed damages.

Bicycles may be parked only in those areas which have been specifically designated for this purpose. A bicycle parking area is indicated by the presence of bicycle racks.

Bicycles may not be parked in a way which would impede access to a building entrance or exit. No bicycle may be parked at any entrance, exit or access ramp to any Cooper Union owned building.

In the event that bicycles are stolen on campus, members of the Cooper Union community should report the incident to the Office of Buildings and Grounds. In addition members of the Cooper Union community are also encouraged to report the incident to the local Police Precinct (212-477-7811). The Cooper Union is not responsible for lost or stolen personal belongings, including bicycles.

Note: The Cooper Union has applied for installation of bike racks at 41 Cooper Square and an increase in the number of bike racks outside the Foundation Building through the City Racks program. Installation is expected sometime in the fall 2009. In addition, alternative bike storage options on campus are being explored by the administration.

Policy on Smoking In accordance with the New York City Clean Indoor Act, as amended, and New York State Public Health Law Article 13-E, the following Smoking Policy is effective at The Cooper Union September 1, 2009:

Smoking is prohibited at all times in all college owned buildings, including but not limited to auditoriums, classrooms, laboratories, offices and public areas and the Student Residence Hall. Furthermore, smoking is not permitted within 25 feet from a Cooper Union facility entrance.

This smoking policy is intended to keep the air clear of smoke for those within our facilities and for those entering and leaving Cooper Union owned buildings.

The Cooper Union requests and expects your cooperation and assistance in the implementation and enforcement of the smoking prohibition. Those who do not comply with this policy will be subject to disciplinary action up to and including fines and/or expulsion from the college, or termination of employment.

Conflicts related to smoking among employees should be brought to the attention of appropriate supervisory personnel and, if necessary, referred to the Equal Opportunity Officer. To report an incident concerning violation of this policy, please send a written report to the Director of Facilities Management.

Students alleged to be in violation of the policy are subject to disciplinary action through the appropriate student conduct jurisdiction.

In accordance with the law, any individual can voice objections to smoke that gathers in any smoke-free area without fear of retaliation.

Policy on Alcoholic Beverages and Illegal Drugs The Cooper Union strictly adheres to all local, state and federal laws relating to the use, possession or illegal manufacture of drugs and alcohol on its premises or at any official college-sponsored event. Violators may be subject to prosecution in accordance with federal, state or municipal law and are subject to The Cooper Union disciplinary proceedings as outlined in A Code of Fair Practice. On campus, students over the age of 21 may consume alcohol only in the context of official campus events where there is a security guard present to check IDs. Alcohol may not be carried from the room in which it is served. Student groups recognized by the Joint Activities Committee and approved for a budget line for serving alcohol must apply for an alcohol permit and follow The Cooper Union's procedures listed at the end of this section.

NEW YORK STATE LAW REGARDING ALCOHOL

Section 65 of the New York State Alcohol Beverage Control Law states:

“No person shall sell, deliver, give away or cause or permit to be sold, delivered or given away any alcoholic beverages to:

- Any person, actually or apparently, under the age of twenty-one (21) years;
- Any visibly intoxicated person;
- Any habitual drunk.”

In addition, legislation enacted in November 1991 specifies that a U.S. or Canadian driver's license or non-driver's identification card, a valid passport or an identification card issued by the United States Armed Forces must be used as written evidence of age for the purchase of alcoholic beverages. New York State law also prohibits the possession of alcoholic beverages with the intent to consume by a minor and penalizes the use of a fraudulent proof of age to procure alcohol. Social host liability may be imposed on any person who serves alcohol to a minor.

Procedures for Use in Serving Alcoholic Beverages at Student

Events/Exhibitions: Student groups recognized by the Joint Activities Committee must first apply for and be approved for a budget for their event. No later than two weeks before the approved event, two members of the student group must apply for an alcohol permit from the dean of students and complete arrangements to hire security guards. These student sponsors must sign an agreement to follow the rules listed below:

Serving Alcohol

1. The serving of hard liquor is not permitted.
2. The Cooper Union has a New York State Liquor Authority permit for the serving of wine and beer at student events. Such serving will be limited to those persons who can prove attainment of the minimum legal drinking age in New York State of 21 years. To facilitate quick identification of students of legal age at the point of service, a process of carding that requires the presentation of a Cooper Union ID will be carried out by a security guard available solely for that purpose and paid for by the student sponsors either through allocated JAC funds, or, in the case of student exhibitions, by the student exhibitors. There are no exceptions to this requirement.
3. Sponsors of events have the primary responsibility for ensuring that only those of legal drinking age are served alcohol. Sponsors must include at least two persons 21 years of age or older, and they must sign the required alcoholic beverage permit. Before authorization to hold an event can be given, all student sponsors must undergo an orientation with the dean of students or a designated representative of the Office of Student Services.
4. Such events must include the serving of food, in sufficient amount for the numbers attending, and the displaying of a variety of non-alcoholic beverages must be featured as prominently as alcoholic beverages and dispensed in the same area.
5. The promotion of alcohol in advertisements for events is not permitted. Other aspects of the event such as entertainment or food should be emphasized in the advertisements.
6. The serving of alcoholic beverages should be discontinued at approximately one hour before the end of the event.
7. Event sponsors must not only refuse to serve alcoholic beverages to anyone who appears intoxicated, but also must provide appropriate assistance to such persons. Assistance may include, but is not limited to, providing safe transportation arrangements for intoxicated guests and arranging for medical help.
8. State law requires that a U.S or Canadian driver's license or non-driver identification card, a valid passport or an ID issued by the U.S. Armed Forces must be used as written evidence of age for procuring alcoholic beverages.
9. The amount of alcohol permitted shall reflect the number of

students over 21 years of age expected at the event, as approved by the dean of students, and in no case shall exceed two kegs of beer.

Exhibitions

Students who wish to serve alcohol in connection with a student exhibition should consult the deans of the Schools of Art or Architecture for the appropriate procedure to follow, including ordering a guard.

Campus Security and Safety

"My earnest desire is to make this building and institution contribute in every way possible to unite all in one common effort to improve each and every human being, seeing that we are bound in one common destiny and by the laws of our being are made dependent for our happiness on the continued acts of kindness we receive from each other."

—Peter Cooper

It is in light of this statement that The Cooper Union establishes an attitude toward campus security and safety. The Cooper Union has been fortunate in maintaining an atmosphere where serious criminal activities have not occurred. Our goal remains to encourage the integrity, honesty and responsibility of each individual student to maintain an atmosphere of harmony and mutual respect.

Every incident of behavior that seems inconsistent with our philosophy and principles of safety and security should be reported to appropriate campus authorities. The guards in the lobby of each building should be notified immediately of any emergencies. Depending on the circumstances, it may also be appropriate to call the police at 911.

Students and staff should also file an incident report with either the office of the director of Facilities Management or with the Office of Student Services. Such reports help The Cooper Union respond to breaches in security. The director of Facilities Management maintains a daily log of such incidents. This log is available for inspection.

When appropriate, information about such incidents shall be disseminated to the community as a whole via fliers or memoranda.

The Campus Crime Awareness and Campus Security Act of 1990 requires colleges and universities to make available to all current students and employees and to all applicants for enrollment or employment statistics concerning the prevalence of certain types of crime on campus and in the neighborhood. These statistics are published annually in the Campus Security and Safety Report available on the Cooper Union web site and from the Office of Student Services, 30 Cooper Square, 6th floor, New York City, NY 10003. Crime statistics are available on line at <http://opc.ed.gov/security>.

A CODE OF FAIR PRACTICE

Preamble As an educational community, The Cooper Union affirms the rights of all its students to pursue freely their scholarly, artistic and intellectual interests. The Cooper Union has developed policies and procedures to safeguard this freedom and to maintain an environment conducive to academic endeavor. These rules are not intended to replace federal, state or municipal laws; all Cooper Union students are responsible for upholding such laws, and violation of the law may result in disciplinary action being taken by The Cooper Union.

In addition to the Standards of Conduct set forth below, students are bound by the rules regarding the use of individual facilities at The Cooper Union, including, but not limited to, the library, the Student Residence, the Computer Center, laboratories, shops, etc. Students are asked to assume positions of responsibility on the Cooper Union Student Judicial Board in order that they might contribute insights and develop skills in the resolution of disciplinary cases.

The Cooper Union reserves the right to amend this code at any time it deems necessary. Changes made to the Code must be approved by the Student Activities Committee before taking effect.

Part One: Student Rights

Students have certain rights established by federal, state or local statutes or institutional policy. Among these rights, but not limited to these alone, are:

The freedom to engage in free discussion, inquiry, and expression.

The freedom of access to public records.

The freedom of association.

Freedom from assault.

The right to express views on issues of institutional policy.

Freedom of the press.

Freedom from discrimination on the basis of age, race, religion, sex, color, sexual orientation, ethnicity, national origin, handicap or disability or any other legally protected characteristic.

Freedom from discriminatory sexual harassment.

The freedom from improper academic evaluation.

Part Two: Standards of Conduct for Students

Category A The Cooper Union finds the following categories of violations extremely serious:

1. Physical assaults resulting in injury, including sexual assaults.
2. Discrimination or bias related acts of assault or abuse.
3. Illegal drug sales and/or possession of illegal drugs.
4. False fire alarms or acts which undermine safety/security equipment systems.

5. Possessing or introducing dangerous weapons to the campus.
6. Violations of the campus alcohol policy which result in injury or damage to property or undermine the safety and security of the campus, including acts of hazing.
7. Acts of academic dishonesty including cheating, plagiarizing or submission of work which has not been prepared by the person claiming authorship.
8. Acts of fraud as defined in civil statutes. Some examples of these acts, but not limited to the following, are misrepresentation, falsifying records and/or documents, etc., or furnishing fraudulent information.
9. Acts of theft or vandalism against the property of another student, staff or faculty member or the school.

For these categories of the violations, the sanction will ordinarily be suspension or dismissal. In some cases, the Presidential Right of Summary Suspension may also be invoked.

Category B The purpose and ideals of The Cooper Union depend, for their full achievement, on respect, cooperation and integrity among members of the community. The Cooper Union has adopted the following rules of behavior in the interest of maintaining an orderly atmosphere:

1. At all reasonable times, a student shall comply with a request for identification from an employee of the College (guard, technician, professor, dean, etc.).
2. Students will respect the building hours and will leave the premises at the appropriate time.
3. Except for actions protected under the state, federal or institutional governances, a student may not willfully obstruct or disrupt any authorized activities on college premises or other Cooper Union activities, including its public service functions.
4. A student may not engage in activities commonly called libel and/or slander.
5. A student may not be involved in acts that cause physical or psychological harm.
6. A student may not consume, buy, sell, borrow, possess, lend or give as a gift any drug, narcotic or alcoholic beverage in such a way that would be in violation of any local, state or federal law.
7. When a student has a guest on campus, the student is responsible for the conduct of his or her guest.
8. The use of the computer and network facilities is for the purpose of supporting the educational experience at The Cooper Union. Unauthorized or inappropriate use of these facilities is prohibited. Misuse may include, but is not limited to, damaging or altering records or programs; invading the privacy of other users by using or

manipulating directories, files, programs or passwords; engaging in disruptive behavior; illegally duplicating copy righted or licensed software; using the facilities in support of a commercial concern or venture, or any unauthorized use of network and/or computer hardware, software, accounts or passwords.

9. A student may not gamble for money or other valuables while on the campus of The Cooper Union.
10. A student may not threaten members of the Student Judicial Committee or attempt to tamper with witnesses to the Student Judicial Committee.
11. A student may not smoke in a nonsmoking area.

Complaints about acts of academic dishonesty should be referred to the appropriate Academic Standards Committee for adjudication.

Complaints that a student has violated any of the standards described above should be referred to the dean of students, who shall meet with the student(s) complained against and shall try to resolve the matter with the agreement of all parties concerned. In the absence of a resolution by the Dean of Students the matter shall be referred to the Student Judicial Committee.

The Student Judicial Committee may also consider complaints that are not delineated under Category A or Category B above, provided the person against whom the complaint is filed is notified in writing as to whether the proceeding will follow the rules for Category A or Category B. A Judicial Panel formed under the rules of Category B retains the right to request that the case be heard again following Category A rules.

Complaints that a student group has violated any of the Standards of Conduct may be referred by the Student Judicial Committee to the Joint Activities Committee for resolution. Such action will not preclude the possibility of individual members of the group being subjected to charges as well.

Category C Sexual Harassment

1. Complaints About Other Students The harassment of any student is unacceptable and will not be tolerated at The Cooper Union. It is in the best interest of the entire Cooper Union community for students to report incidents of discrimination and harassment. Any student who believes he or she has been subjected to harassment by another student should submit a complaint, if possible in writing, to the Vice President for Business Affairs/Equal Opportunity Officer, the Dean of Students or his or her Academic Dean. The College will then designate the appropriate person to address the complaint. After a complaint is made, it will be investigated and an attempt will be made to resolve the matter as amicably and privately as possible. The penalties of expulsion, suspension, dismissal, warning, probation, or loss of privileges can be meted out to the offending student in the College's discretion

and as the College deems appropriate. The matter may be referred to the Student Judicial Committee.

2. Complaints About Faculty And Employees The Cooper Union has established separate procedures to handle student complaints about harassment and discrimination imposed on students by faculty or staff.

Sexual harassment, whether it imposes a requirement of sexual cooperation as a condition of academic achievement or not, is inimical to the College's academic environment. Harassment and discrimination on the basis of race, religion, national origin, sex, and/or sexual orientation and any other characteristic protected by law is also prohibited. Student complaints about harassment by staff or faculty should be filed with the Dean of Students, the Vice President for Business Affairs/ Equal Opportunity Officer, or the Academic Dean.

The Vice President for Business Affairs/Equal Opportunity Officer will investigate, or will appoint an investigator to investigate the matter and try to resolve the matter as amicably and privately as possible. If this effort is not successful and if the Vice President for Business Affairs or the President deems it appropriate under the circumstances, a Hearing Board may be appointed by the President to review the complaint, conduct any additional investigation deemed appropriate, and make recommendations to the President.

A Hearing Board is typically comprised of an Academic Dean, a faculty member, and an elected student representative, all from schools other than that of the complainant, although the College retains discretion to alter the composition of a Hearing Board as it deems appropriate.

In resolving any matter, the College retains discretion to take any remedial action it deems appropriate, including, without limitation, warning, demotion, transfer, suspension, training and termination.

Part Three: Disciplinary Sanctions Which May Be Imposed

1. Warning A warning in writing, in the case of a minor infraction, that further violation of the Standards of Conduct may result in a more severe disciplinary sanction.

A copy of the warning letter will be retained by the Student Judicial Committee in its files until the student permanently leaves The Cooper Union.

2. Loss of Privileges In cases that involve breaking the rules of a specific facility, students may lose the privilege of using that facility on a temporary or permanent basis.

A student who loses privileges may also be issued a warning or higher penalty.

A copy of the letter noting a loss of privileges will be retained by the Student Judicial Committee in its files until the student permanently leaves The Cooper Union.

3. Probation A letter of censure given in instances of more serious violation of the Standards of Conduct where it is believed more stringent disciplinary action is not required. Probation is a trial period during which a student who has been in difficulty has an opportunity to demonstrate that he or she can be a responsible member of the community. The terms of probation may be varied to fit the individual circumstances and may include a recommendation for psychological counseling. The probation letter will be retained by the Student Judicial Committee in its files until the student permanently leaves The Cooper Union.

4. Suspension Given in cases when it is judged that the student should be removed from the college community. This penalty is for a stated period of time, not less than one semester or the remainder of the semester. A suspended student is prohibited from being on any Cooper Union premises during the period of suspension without written authorization from the Office of the President. A record of the suspension will be retained in the files of the Student Judicial Committee until the student leaves The Cooper Union (e.g., graduates, transfers, etc.) A notification of the suspension will be sent to the academic dean, the Office of Admissions and Records and the Office of the President.

5. Dismissal Subject to the approval of the President of the college before taking effect, a disciplinary dismissal involves involuntary and permanent dismissal from the college. The President shall have the right to accept, reject or modify the dismissal proposed. A record of the student's dismissal will become a permanent part of the student's file and will be noted on his/her transcript.

6. Other Actions The Student Judicial Committee may impose other penalties it deems appropriate to the infraction of the Standards of Conduct involved. Examples of such penalties might be: financial restitution for damages done to the property of The Cooper Union or the property of individuals or for medical and other expenses incurred by individuals as a result of actions by an individual in violation of the Standards of Conduct.

7. Presidential Right of Summary Suspension Subject to prompt review, the President of The Cooper Union may summarily suspend a student from the college when, in his or her best judgment, such immediate action is necessary for protecting the health and safety of the college and/or any member of the college community. The President will consult with the dean of the school which the student attends prior to such action, unless, in his or her opinion, time does not permit. Any person so suspended shall have all rights as outlined in the Judicial Code. Summary suspensions must be reviewed by the Student Judicial Committee within seven (7) days in which regular academic business is being conducted. Until and unless the defendant is found to have violated the Standards of Conduct, his/her status as a member of the Cooper Union community shall not be altered. Any person so suspended shall

have the right, if the suspension is not upheld by the Student Judicial Committee, to be granted excused absences from all classes and academic responsibilities missed because of such action.

8. Legal Action The above listed penalties shall be in addition to any penalties or liabilities pursuant to the laws of the State of New York, both civil and criminal. The dean or his or her designee may, at his or her discretion, depending on the gravity of the violation, file a criminal or civil complaint with the appropriate public official. Filing an action under this code does not preclude the complainant from also filing a criminal or civil complaint.

Part Four: Cooper Union Student Judicial Committee

The Student Judicial Committee shall have jurisdiction of all proceedings as stated in this document over matters involving an alleged violation of any of the Standards of Conduct stated above. Two students and two alternates shall be elected from among the representatives of each of the student councils to serve on the Student Judicial Committee.

In the case of Category B offenses, six students (two from each school) from the Student Judicial Committee shall constitute the hearing panel. The person bringing charges and the person being charged each have the right to challenge the inclusion of two of these panelists for cause so long as four students, including alternates, remain available to hear the case and so long as such challenge is made before the hearing commences. The panelists shall elect their own chairperson.

In the case of Category A offenses, six students (two from each school) from the Student Judicial Committee shall be joined by any two administrative officers of The Cooper Union. The associate deans from the school in which the student bringing charges and the student being charged are registered, or other designated representative of the dean of the appropriate faculty, shall be invited to participate as administrative officers, except in cases involving academic dishonesty, when a member of the appropriate Academic Standards Committee shall be invited instead. The person bringing charges and the person being charged each have the right to challenge the inclusion of two of the student panelists for cause so long as four students, including alternates, remain available to hear the case and so long as such challenge is made before the hearing commences. The panelists shall elect their own chairperson.

The dean of students shall serve as coordinator for the committee and shall have the responsibility of inviting the administrative officers. This does not preclude the dean of students from acting as witness, if necessary.

In a case where the panel hearing either a Category A or Category B violation is equally divided on a decision, the matter will be considered by the Appeal Board, which will make the final decision.

The Committee shall adopt its own operating rules and have the power of amendment, provided such amendment(s) shall not apply to any case pending at the time of the amendment. A copy of any operating rules in effect at the time of the complaint shall be supplied to the person being charged at the time that person receives notice of the hearing.

Part Five: Procedures for Filing Charges and Conducting Hearings

- 1.** Any member of the community may initiate charges of an infraction of the Standards of Conduct by a student. Such complaint should be made in writing and addressed to the Student Judicial Committee and delivered to the Office of Student Services, 6th floor. The Student Judicial Committee may not sanction a student for any matter not included in the written complaint. The complaint shall set forth in summary fashion the basic facts in which it is stated that an infraction of a Standard of Conduct has occurred. The particular standard or standards must be likewise set forth.
- 2.** A hearing on the allegations contained in the complaint will be scheduled within ten working days by the dean of students. The dean of students shall have delivered to the person charged a copy of the papers setting forth the charges together with the time and the place of the hearing on the charges and a copy of any operating rules currently in effect for the Student Judicial Committee.
- 3.** Proceedings conducted by the Student Judicial Committee are completely independent of either civil or criminal proceedings and may act simultaneously with either. The Student Judicial Committee is administrative, rather than criminal or civil, in nature. It does not use technical "rules of evidence" and requires lower standards of proof to reach a conclusion. This lower standard is known as a "preponderance of evidence," and indicates that it is "more likely than not" that a violation did, or did not, occur.
- 4.** The failure of the student charged to appear at the stated time and place shall constitute a waiver of the right to a hearing as set forth.
- 5.** All hearings conducted by the Student Judicial Committee shall be open unless either party requests the hearing to be closed.
- 6.** Any person charged or bringing charges in a Category A offense shall be entitled to a representative of his or her choice at his or her expense.
- 7.** Every student so charged shall be presumed not to have committed the alleged violation until the Student Judicial Committee arrives at its decision.
- 8.** The Student Judicial Committee will select one of its members to be chairperson and preside over each hearing. The person presiding shall exercise control over the proceedings to avoid needless consumption of time and to achieve orderly

completion of the hearing. Any person, including the person charged or bringing charges, who disrupts a hearing may be excluded by the person presiding.

- 9.** Any person charged or bringing charges, having appeared at the hearing, shall have the right to question any witness presented and to contest the acceptance into the record of any document presented as proof in support of the charges. In this latter case, the Committee shall decide whether the document bears on the issues involved. The person charged shall have the right to present witnesses or documents in his or her defense. The names of any witnesses must be provided to the Committee at least 48 hours in advance of the hearing. The Committee has the right to refuse to hear witnesses whose testimony they deem irrelevant or to limit the testimony of witnesses to matters that the Committee deems pertinent. Prospective witnesses, other than the person charged and the person bringing charges, may be excluded from the hearing during the testimony of other witnesses.
- 10.** Formal rules of evidence shall not be applicable in disciplinary proceedings conducted pursuant to this Code. Unduly repetitious or irrelevant evidence may be excluded, as determined by the person presiding.
- 11.** Committee members may take notice of matters that would be in the general experience of Cooper Union students, faculty, or staff members.
- 12.** The Committee shall arrange for a tape recording of the hearings. The tape shall be retained until all parties to the complaint have permanently left The Cooper Union.
- 13.** Decisions, including the sanctions imposed by the Student Judicial Committee, shall be made in executive session by majority vote. Witnesses, including the person being charged or bringing charges, shall not be present at the executive session. All proceedings in this executive session except the decision itself shall be confidential and shall not be disclosed outside of the executive session, except in cases where federal, state, or municipal law mandates disclosure of the decision to the complainant or to the community.
- 14.** In the event of a recommendation of a disciplinary dismissal herein, the President shall review the recommendation before it is put into effect, as described in "Disciplinary Dismissal."
- 15.** The decision of the Student Judicial Committee may be given in hand to the student charged or mailed to the last address given by the student.
- 16.** In the written decision, if the student is found to have violated any of the Standards of Conduct, the student shall be notified in the notice setting forth the decision of the right to appeal the decision within four business days. The appeal must be in writing and set forth the reasons upon which the appeal is made.

Part Six: Appeal

A. Composition of Appeal Board

1. Members of the board shall consist of two students and one academic dean.

a. Annually, the elected student representatives who form the Student Councils from the three schools shall appoint one member and one alternate from each school for available service on the Appeal Board.

b. In a specific case, one student member must be from the school attended by the appellant.

c. The remaining student will be selected for service on a rotating basis from the remaining two schools.

d. In the event for any reason a student does not serve on the Appeal Board, the alternate student may serve and participate fully in the decision.

2. The academic dean must be from the school the appellant attends, except in the event of the unavailability of any dean so chosen, or if the dean is an interested party in the matter under appeal. In such case, the President shall select another dean to serve as a member of the board. In any event, the dean shall serve as convener of the board and as chair.

B. Limitations of the Authority of the Appeal Board

The Appeal Board shall limit its review of the Student Judicial Committee's record to these issues:

1. Does the record show that the parties had a fair and adequate opportunity to prepare and present their case?

2. Was the sanction imposed, if any, fair and proper in light of the gravity of the infraction proved?

C. Decision on Appeal

1. Appellant must present a written application for a hearing by the Appeal Board within four (4) business days of the Student Judicial Committee decision.

2. The Appeal Board may, after considering the appeal:

a. Accept the decision by the Student Judicial Committee.

b. Return the case to the Student Judicial Committee for further hearings in keeping with the Appeal Board instructions.

c. Reverse the Student Judicial Committee decision and dismiss the case.

d. Accept the Student Judicial Committee decision, but reduce the sanction. The sanction may not be increased.

If the Appeal Board accepts the report of the Student Judicial Committee (whether it lowers the sanction or not), the matter shall be deemed final.

FEES AND EXPENSES

Tuition The Cooper Union annual tuition charge for 2009–2010 is \$35,000. Each registered student receives a full-tuition scholarship.

Fees and Refunds A nonrefundable application fee of \$65 is paid by all candidates for admission.

Each student enrolled in a degree program pays a student fee of \$725 per semester. For new students, this fee is payable on acceptance of admission and is not refundable.

For continuing students, the \$725 fee per semester is payable prior to the first day class; it is 100 percent refundable prior to the beginning of classes and 50 percent refundable during the first two weeks of classes. Thereafter, it is not refundable.

Continuing students must pay each semester's student fee in accordance with the bill's "due date."

All fees are subject to annual revision. Students who do not pay the required fee will have their registration cancelled.

General Lab and Studio Materials Fee A general lab and studio materials fee of \$75 per semester will be charged to each student's account. As the title suggests, this fee covers normal usage, "wear and tear," and basic supplies for laboratory and studio projects.

Refund Policy for Student Residence A refund of housing charges resulting from an approved request to cancel the housing agreement will be made in accordance with the following schedule: 100 percent of the total housing charges for the semester if the cancelation request is made prior to August 1 for the subsequent fall semester and December 1 for the subsequent spring semester; 65 percent if made by September 30 for the fall semester and January 31 for the spring; and 35 percent if made by October 31 for the fall and February 28(29) for the spring. No refunds will be made after these dates.

Students who are evicted from the Student Residence or whose Housing Agreements are terminated for violations of the terms of the Housing Agreement are not eligible for refunds.

Health Service & Insurance Fee Cooper Union requires all students to submit proof, prior to registration, that they have health insurance. Students who fail to supply the information requested on the Student Accident and Sickness/Enrollment Waiver form by September 15 will be billed \$1,466 for the Health Service and Insurance Fee for the 2009–2010 academic year.

International Student Fee Students on visas (those who are noncitizens or who are not permanent residents with a “green card”) are responsible for an additional fee of \$1,800 per year payable by August 15.

Graduation Fee A graduation fee of \$100 is required of all students entering their last year at The Cooper Union. This fee is payable upon registration for the senior year and is refundable if a student fails to meet graduation requirements that year.

Special Fees A charge of \$100 will be made for late payment of the student fee. A charge of \$25 will be made per occasion involving change of section or registration program.

The Cooper Union reserves the right to change its fees at any time.

Graduate Student Fee The requirements for the master of engineering program must be completed within two years of admission to graduate status, except with the expressed consent of the dean of engineering. Requests for extension must be presented in writing to the dean in the final semester of the second year. Thesis adviser approval is also required. master’s students who receive approval to extend their studies beyond two years will be assessed a maintenance of matriculation fee of \$1,000 per semester. Graduate students are assessed a key/access fee of \$150 per year.

Books, Materials and School Supplies Each student must supply, at his/her own expense, textbooks, drawing materials, hand tools and other necessary items.

If laboratory apparatus, machinery or studio equipment is damaged by careless handling, the student will be charged for repair or replacement. All students enrolled in School of Art courses should be prepared to pay for consumable materials supplied by the School for student use.

FINANCIAL AID

If you are enrolled as a full-time student (minimum 12 credits), are a U.S. citizen or eligible non-citizen, can demonstrate financial need, have a valid Social Security Number, have a high school diploma or General Education Development Certificate (GED), or complete a high school education in a home school setting that is treated as such under state law, are registered with the Selective Service (if required), are making satisfactory academic progress toward completing your course of study according to the standards and practices of the school, certify that you are not in default on a Federal Perkins, Federal Family Education Loan or Federal Direct Loan, do not owe a refund on a Federal Pell or Federal SEOG Grant and certify that you will use federal student aid for educational purposes only—you may be eligible to receive financial aid.

The law suspends financial aid eligibility for any student convicted for the possession or sale of illegal drugs for offenses that occurred while the student was receiving federal student aid. If you have a conviction or convictions for illegal drug offenses, call 1-800-4-FED-AID (1-800-433-3243) to determine how, or if, this law applies to you.

The U.S. Department of Education web site can be accessed through the Financial Aid for Students home page at www.studentaid.ed.gov.

For the most current information on financial aid at Cooper Union, please visit our web site: www.cooper.edu/admin/financial/index.html.

To apply for financial aid you must complete a Free Application for Federal Student Aid (FAFSA). You may submit the FAFSA through the internet using FAFSA on the Web at www.fafsa.ed.gov or by mailing a paper FAFSA. When processed, the form will produce an expected family contribution (EFC), which determines the family resources available to meet your educational expenses and your eligibility for financial aid. From this analysis we will attempt to package financial aid to provide the greatest possible assistance to the neediest students first and then to less needy students, as resources permit. You also will be required to submit a signed copy of your parents’ prior-year Federal Tax Return, and yours, if you filed. We reserve the right to request copies of your parents’ tax return if you are considered independent under federal guidelines and your non-custodial parents’ tax return if your parents are divorced. ALL information submitted on the FAFSA as part of an application for financial aid is subject to verification, a requirement of the U.S. Department of Education. Please see our web site for more information on the verification process. First-time applicants are also required to file a CSS Profile Form.

FAFSA forms should be filed no later than April 15, and all forms should be submitted to us no later than May 1.

The Cooper Union offers financial aid awards suited to each student's need. Generally, these awards are "packaged," which means that more than one type of aid is provided. A typical award will include some grant funds and some self-help in the form of a loan, and possibly a work opportunity. It is expected that the entire package will be accepted. A student is encouraged to use a portion of summer employment earnings toward the following academic year's expenses.

Federal Pell Grants These grants are awarded to undergraduate students who have not yet earned a bachelor's degree. The amount of a Federal Pell Grant is determined by the EFC and the cost of attendance at Cooper Union. Pell Grants provide a foundation to which other aid may be added.

Federal Academic Competitiveness Grants & Federal SMART Grants The Academic Competitiveness Grants are awarded to first- and second-year undergraduates who have completed a rigorous secondary school program and have earned a minimum 3.0 G.P.A. The SMART Grants are awarded to third- and fourth-year undergraduates in the School of Engineering who maintain at least a 3.0 G.P.A. In order to be eligible for these grants, a student must be a U.S. citizen, must be eligible for a Pell Grant and must meet certain academic requirements.

Federal Supplemental Educational Opportunity Grants These grants, which usually range from \$200 to \$4,000 per academic year, are awarded to students with the greatest need. They are funded by both federal sources and The Cooper Union.

Federal Family Education Loan Program This program includes subsidized and unsubsidized Federal Stafford Loans. During the first year of undergraduate study, an eligible student may borrow up to \$3,500; \$4,500 in the second year; and \$5,500 in subsequent years. Eligible dependent students may also borrow an additional \$2,000 unsubsidized Stafford Loan.

Students who meet the federal requirements for independent student status and dependent students whose parents are not able to secure a Federal PLUS Loan may be eligible to receive additional funds through the unsubsidized Federal Stafford Loan. First- and second-year students may borrow up to \$6,000 and upper-class students may borrow up to \$7,000.

Also available under this program is the Federal PLUS Loan. Parents with good credit histories may borrow up to the cost of education, not covered by financial aid. These loans carry a fixed interest rate of 5.6 to 6.8 percent for Federal Stafford Loans and 8.5 percent for Federal PLUS Loans.

You may apply for these loans by obtaining an application from your state agency or lending institution (bank, credit union, etc.) or by completing a Stafford Loan Acceptance Form available in the Financial Aid Office.

When borrowing a Federal Stafford or PLUS Loan, students and parents have the right to select any lender of their choosing. Students and parents should always exhaust federal student loan options before considering private educational loans.

Federal Perkins Loans This is a low-interest (5 percent) loan for both undergraduate and graduate students with substantial need. Repayment of these loans begins nine months after you graduate or leave school.

Cooper Union Loans These loans are offered by Cooper Union and carry the same conditions and interest rate as Federal Perkins Loans.

Cooper Union Grants The Cooper Union has funds available from which awards are made to qualified students in need of aid.

Federal Work Study Under this program, eligible students may be employed on or off campus. Employment is generally limited to about 10 hours a week during the academic year. In addition, students may apply at the Office of Career Services for a variety of part-time jobs.

Priorities In considering applications for aid, first priority is given to first-degree undergraduates who have exceptional financial need and therefore could not complete their education without such aid. Second priority is given to first-degree students who demonstrate relative need. Second-degree students are prohibited from receiving federal grants and are not eligible for institutional grants beyond the full tuition scholarship. Therefore, second-degree students are referred to the various loan programs for financial assistance.

Rights & Responsibilities Students who receive financial aid in their first year at Cooper Union generally continue to be aided in accordance with their financial circumstances from year to year. This does not imply, however, that the aid will be the same each year. Each package depends on family resources, the availability of funds, the student's capacity for self-help and continued appropriations from the federal government. To continue to qualify for financial aid, students must maintain good academic standing and make satisfactory academic progress as determined by the standards of the school. Students on academic probation for two semesters are ineligible for federal financial aid. Reduced programs may result in a reduction in financial aid.

Federal regulations require that students who withdraw from school prior to completing 60 percent of the semester will have their eligibility for aid recalculated based on the percent of the semester completed. For example, a student who withdraws after completing only 30 percent of the semester will have “earned” only 30 percent of any financial aid received. The remaining 70 percent must be returned by the student and/or the school. Students should contact the Financial Aid Office to determine how a withdrawal will affect financial aid.

Normally, financial aid is awarded for an entire academic year, with payments made after the beginning of each semester. Amounts in excess of Cooper Union charges may be used to meet indirect costs and will be paid directly to the student each semester. If Federal Work Study is part of the financial aid package, a salary will be paid twice monthly, directly to the student.

The Cooper Union is willing to make every effort to assist the student and the student’s family in helping to meet educational costs, but the school is unable to assume the role of substitute for the family.

Students awarded a Federal Stafford Loan, a Federal Perkins Loan or a Cooper Union Loan will be required to sign a legally binding promissory note and agree to the terms of a prearranged repayment schedule. Sample repayment schedules are available on our web site. The terms of these loan obligations will be defined at the time the loans are made to the student and before the notes are executed. It should be noted that these loans must be repaid so that future students may also receive loans.

Budget Guide for Students at The Cooper Union

This budget guide has been prepared with the hope that it will assist students in anticipating their financial needs while attending The Cooper Union. Based on our experience with students, we believe this to be a realistic guide for a nine-month academic year. It should be used as a guide and obviously does not reflect the exact costs involved in individual cases.

Budget Guide for 2009–2010

Architecture & Art*

(includes an average of
\$1,800 for supplies)

Commuter	\$7,195
Dormitory Resident	\$19,375
Off-campus Resident	\$19,575

Engineering*

(includes an average of
\$1,000 for supplies)

Commuter	\$6,395
Dormitory Resident	\$18,575
Off-campus Resident	\$18,775

* Students without health insurance should add a Health Service & Insurance Fee of \$1,466

International Student Budget Guide for 2009–2010

Schools of Art and Architecture

Full-Time Matriculating

Fees	\$3,400
Room and Board	\$13,900
Other*	\$4,075
Total:	\$21,375

*Books and Supplies	\$1,800
Transportation	\$700
Personal Expenses	\$1,575
Total:	\$4,075

School of Engineering

Full-Time Matriculating

Fees	\$3,400
Room and Board	\$13,900
Other*	\$3,275
Total:	\$20,575

*Books and Supplies	\$1,000
Transportation	\$700
Personal Expenses	\$1,575
Total:	\$3,275

SCHOLARSHIPS, FELLOWSHIPS, AWARDS AND PRIZES

Named Scholarships

To alleviate the pressing financial burden of the ever-increasing cost of living in New York City, many alumni and non-alumni have supported Cooper's students by establishing named scholarships. The income generated by these special funds offers vital supplemental financial aid to deserving students in addition to the full-tuition scholarship awarded to each student who is admitted.

Samuel J. Jaffe Medici Scholarship was fully funded in 2008 to help preserve the full-tuition scholarship policy and ensure that this tradition continues far into the future. Medici Scholarships underwrite the full-tuition scholarship of individual students—one after another—in perpetuity.

The Irwin S. Chanin School of Architecture Robert O. Brown; Gus J. & Helen Condaris; Ismar David; Manuel & Flora Fernandez; John Q. Hejduk; George & Selma Klett; John Loeb & Frances Loeb; Mari Souval Spacedrafting Foundation.

School of Art Sylvia Appleman; Danny Arje; Alice Noble Ball & Francis M. Ball; William & Mary Jane Brinton; Frank Chesek Memorial; Joseph and Robert Cornell Memorial Foundation; Ismar David; Lillyan deCaro Santo; Alice Trimble DuBois; Antonya Eisen; Roberta Strauss Feuerlicht & Herbert A. Feuerlicht; Ellen Fox; Dan Friedman; Adele & Louis Gruber; Yip Harburg Foundation; William Randolph Hearst Foundation; Abraham Hersch; Rose Kleinfeld; George & Selma Klett; Walter S. Kut; Mollie Levenstein; John Loeb & Frances Loeb; Rhoda Lubalin; Sylvia Drucker Mavis; Henry & Sylvia Mavis; Alphonse Normandia; Peter Ostuni; Veronica Lapinski Pastorini; Marvin A. Schwam; Henry & Joan Wolf Slawson; Henry Wolf Foundation; Barbara White.

Albert Nerken School of Engineering Abdul Azimi; Edward J. Barlow; Robert W. Bassemir; Meredith B. Blaustein; Brunswick/Ennis; Leon Chernick; Tunny Chin; Henry Chu; Horacio Cundari; David Davis; Franklin W. Diederich; Henry & Freda Eckhardt; Margaret Lappin Fich; Samuel & Sally Gilman; Roger Gilmont; Charles Greenfield; Robert Greenwald; William Grimshaw; Dr. Michael S. Gross; Elizabeth and Robert Hammond; Edward & Lillian Hawthorne; Fanny & Irving Katz Memorial; Alfred Laufer; John Loeb & Frances Loeb; Henry Mankin; Robert P. Muhlsteff; Emil Parente; William F. Partridge; Norman L. Perry; John F. & Olga Petrowsky; Michael F. Roberti; Emanuel Salma Memorial; Walter L. Schwartz; Lester D. Seymour; The Starr Foundation; Switzer Foundation; Sol Tanne; Peter Torraco; Ralph Torraco; Dale & Charlotte Zand.

General Financial Aid Scholarships Irwin & Lillian Appel; H. Carl Bauman; Robert C. Bosch; Julius Dingenthal; Edward Durbin; Kathleen Gerla; Mindy & Drew Greenwald; Alexander C. Grove; Salvatore & Tina Guzzardi; Julian Hirsch; Marilyn Hoffner; Samuel J. Jaffe; Dr. Peter Kabasakalian; Estelle & Donald Maggin; Vincent P. Malahan; William H. Okun; Nathan G. Ramer; Michael A. Rampino; Benjamin Reich; Charles Lowery Robertson; Louis Schmidt; Emil Schweinberg; Shakespeare and Company; Allen Speiser; The Starr Foundation; Charles Stumpp; Solon E. Summerfield Foundation; Arlene and Irving Tashlick; Clifford Warren; Bert Weinstein

Book Funds Rose Sylvia Berger; Z. Braude; Anthony Carbone; Julius Dingenthal; Clare W. Gerber; Adele & Louis Gruber; Mary Hirsch; Joseph & Lucy Koosman; Norman S. Levy; Sheridan A. Logan; Joseph Mechanik; Joseph Meltzer; Albert Nerken & Jean Nerken; Oswald Ottendorfer; Frank O. Reisler; Michael Robinson; Ruth Schwartz; George F. Sexton; Charles Stubbe.

Fellowships

The Irma Giustino Weiss Cultural Enrichment Fellowship

Launched in 2002–2003, the Irma Giustino Weiss Cultural Enrichment Fellowship Program at The Cooper Union for the Advancement of Science and Art provides extraordinary access to cultural resources for exceptional students who seek a deeper understanding of the context of art and architecture. Endowed by Mrs. Irma Giustino Weiss, a 1945 alumna of the School of Art, this unique program to enhance the undergraduate experience is open to high-achieving, highly-motivated students in art and architecture, beginning in the freshman year. Throughout their years at The Cooper Union, Irma Giustino Weiss Fellows will take part in a focused exploration of the cultural riches in these select cities including visits to museums and galleries, concerts, theatrical and dance performances, specialized libraries and historical sites. Guidance Counselors are encouraged to communicate this new fellowship program—available only to entering freshman students of The Cooper Union—to top high school students with strong interests in higher education in art and architecture. Applications will be made available to formally accepted students to the School of Art and the Irwin S. Chanin School of Architecture. To view a sample application form, please visit our Web site at: www.cooper.edu/administration/admissions/weiss.html.

The Irwin S. Chanin School of Architecture William Cooper Mack Thesis Fellowship, supports primary research and inquiry in the thesis year and honors William Cooper Mack (AR'2006).

The Irwin S. Chanin School of Architecture William Cooper Mack Thesis Fellowship, *supports primary research and inquiry in the Thesis year and honors William Cooper Mack, class of 2006.*

School of Art Rhoda Lubalin Senior Fellowship, *The Rhoda Lubalin Senior Fellowship has been designated to the Herb Lubalin Study Center of Design and Typography and honors Mrs. Lubalin's husband.*

Albert Nerken School of Engineering Henry C. Enders Fellowship. *Funding available to students wishing to pursue graduate study in engineering; The Maxwell Lincer Fellowship. Mr. Lincer was a 1942 Cooper Union Civil Engineering graduate. The Harry Ploss Fellowship in Engineering, awarded annually based on merit and financial need to students who have completed their junior year in engineering. Mr. Ploss is a 1968 graduate of The Cooper Union.*

Faculty of Humanities and Social Sciences Benjamin Menschel Fellowships for Creative Inquiry. *The Horace W. Goldsmith Foundation endowed this fellowship with a grant in 1994 to support students in the fields of art, architecture, design and engineering.*

Fellowships for Study Abroad

The Irwin S. Chanin School of Architecture Palmer Hayden Travel Fellowship. *Travel Abroad For African-American Students In Art and Architecture.*

School of Art Helen Dubroff Dorfman Travel Fellowship; Palmer Hayden Travel Fellowship. *Travel Abroad For African-American Students In Art and Architecture;* The O'Brien Fellowship for Study Abroad; Martin Rothenberg Travel Fellowship.

Awards and Prizes

Edwin Sharp Burdell Award, *to that member of The Cooper Union community who during the past year has done most to further the mutuality of science and art.*

The Irwin S. Chanin School of Architecture The Irma Giustino Weiss Prize, *presented to a graduating student who demonstrates exceptional potential for creative achievement upon earning a bachelor's degree in art or architecture;* The New York Society of Architects Matthew W. Del Gaudio Award, *for excellence in total design;* The American Institute of Architects Henry Adams Medal and Certificate of Merit, *to the first-ranked graduating student in a*

first professional degree program; The American Institute of Architects Henry Adams Certificate of Merit, *to the second-ranked graduating student in a first professional degree program;* Alpha Rho Chi (National Professional Architectural Fraternity) Medal, *to a graduating student who has shown an ability for leadership, who has performed willing service for his/her school or department and who gives promise of real professional merit;* The Cooper Union Alumni Association Annual Award, *to a graduating student for outstanding service to the school;* Abraham E. Kazan Award, *to a graduating student for outstanding performance in urban design;* George Ledlie Prize, *to a graduating student as suggested by the dean;* Peter W. Bruder Memorial Prize, *to a graduating student for excellence in structures;* Allen N. Goldfischer Memorial Award, *for a fifth-year graduating student whose thesis project best explores relationships between humanistic and aesthetic principals in an urban context.*

School of Art The Irma Giustino Weiss Prize, *presented to a graduating student who demonstrates exceptional potential for creative achievement upon earning a bachelor's degree in art or architecture;* The Jacques and Natasha Gelman Trust Award, *presented to a graduating student who demonstrates exceptional ability in the field of painting or sculpture;* The Cooper Union Alumni Association Annual Award, *to a graduating student for high academic achievement and outstanding service to the school;* Sylvia Appleman Painting Award, *to a third year student;* Richard Lewis Bloch Memorial Prize; Vena T. Carroll Award; Ethel Cram Memorial Prize Mary M. Doyle Memorial Prize, *to a second-year student;* Henry Dropkin Award, *for excellence in graphic design;* Dan Friedman Award; Betty Morton Goldin Memorial Prize; Rolf Haerem Award, *to a fourth-year student for excellence in painting;* Sarah Cooper Hewitt Prize; Fred A. Lane Prize, *to the most deserving student in the third-year class;* Elliot Lash Memorial Prize, *for excellence in sculpture;* Eleanor Gay Lee Gallery Prize *to a deserving third- or fourth-year student;* A. A. Low Prize; Carin Tendler Lurkis Prize for Watercolors, *to a deserving second- or third-year student;* Vincent J. Mielcarek, Jr. Photography Award, *to a student in the third-year class for excellence in photography;* Pietro & Alfrieda Montana Prize, *for excellence in drawing and sculpture;* Michael S. Vivo Memorial Prize, *for excellence in drawing;* New York Central Art Supply Awards; Robert Breer Film Award; Hans G. and Thordis W. Burkhardt Foundation Prize, *to three graduating students.*

Albert Nerken School of Engineering The Harold S. Goldberg Prize, *presented to a graduating student who demonstrates technical leadership upon earning a bachelor's degree in engineering*; The Cooper Union Alumni Association Annual Award, *to a graduating student for high academic achievement and outstanding service to the school*; The William C. and Esther Hoffman Beller Fund for Merit in Engineering Studies, *to the most meritorious graduate in each of the following fields: chemical, civil, electrical and mechanical engineering*; The Leon Machiz Prize; Harald Kiel Award, *for service to the Cooper Union Computer Center*

Chemistry Awards: Chemical Rubber Company Freshman Chemistry Achievement Award, *to an outstanding freshman Chemistry student*; Robert Spice Fund Prize, *for the best record in Instrumental Analysis and Electronics*

Chemical Engineering Awards: American Institute of Chemical Engineers Award, *to the AIChE student member having achieved the highest scholastic; record after two years*; The American Institute of Chemists Student Award, *to a Chemical Engineering graduate who has demonstrated scholastic achievement in Chemistry and Chemical Engineering, leadership, ability and character*; Herbert Baldwin Fund Prize, *for the best record in the third year of Chemical Engineering*; Frederick Urban Memorial Scholarship Award, *to a Chemical Engineering graduate*

Civil Engineering Award: Joseph Kalb Fund Prize, *to a civil engineering graduate on the basis of scholarship and professional interest*; Maxwell Lincer Prize Fund, *for excellence & achievement in the study of civil engineering*

Electrical Engineering Awards: Yusuf Z. Efe Award, *for the outstanding electrical engineering master's thesis*; Abraham Pletman Fund, *for excellence in electrical engineering*; Eugene Ogur Memorial Award, *for excellence in electrical engineering*; Dale E. Zand Prize, *for outstanding achievement in electrical engineering*

Mechanical Engineering Awards: Wallace Chinitz Prize, *for excellence in thermal studies*; Alexander C. Grove Prize, *to the student who demonstrates scholarship, personal integrity and professional promise in the field of mechanical engineering*; Tyler G. Hicks Prize, *to a mechanical engineering Junior for academic achievement during the first and second years*; Wilson G. Hunt/Class of 1905 Prize, *to a mechanical engineering graduate, based on general excellence in engineering studies*; Harold E. Rue Prize, *for a senior in either electrical or mechanical engineering*; Nicholas Stefano Prize, *for an outstanding senior project in mechanical engineering*

Mathematics Awards: Day Class of 1907 Prize, *for excellence in calculus*; Irving Leon Lynn Prize, *for excellence in mathematics*; Harry W. Reddick Fund Prize and Medal, *for meritorious work in mathematics*

Bachelor of Science Award: Henri D. Dickinson Fund Prize, *to the student having the highest cumulative rating at graduation in a bachelor of science curriculum*

Faculty of Humanities and Social Sciences The John L. Alpert Assistantship; The Academy of American Poets Elizabeth Kray Poetry Prize; The Raymond G. Brown Memorial Prize, *for excellence in the Raymond G. Brown Seminar*; Professor Frank Caldiero Humanities Award, *for the best essay written in the first-year core courses (HSS1 and HSS2)*; Second-year Core Curriculum Prize, *for the best essay written in the second-year core courses (HSS3 and HSS4)*; The Dale Harris Prize, *for the best essay written in an art history course*; Charles Goodman Essay Fund Award in Humanities, *open to seniors in the School of Engineering*; Dr. Martin J. Waters Memorial Prize, *for excellence in the humanities and social sciences*

THE IRWIN S. CHANIN SCHOOL OF ARCHITECTURE

MISSION STATEMENT

The mission of The Irwin S. Chanin School of Architecture is to provide for its students the finest professional education available within an intellectual environment that fosters and expands their creative capacities and sensibilities and establishes the foundation for a productive professional life. The school is committed to the belief that one of society's prime responsibilities is toward learning and education in the deepest sense: that the exercise of individual creativity within a willing community is a profoundly social act. Fundamental to the mission of the school is the maintenance of an atmosphere in which freedom of thought and exploration can flourish, where students can explore and utilize their special and individual talents, interests and modes of working, to their highest potential.

BACHELOR OF ARCHITECTURE PROFESSIONAL DEGREE CURRICULUM

Aims and Objectives The School of Architecture offers a five-year program leading to the bachelor of architecture, a first professional degree accredited by the NAAB. The architecture curriculum is designed to prepare students for a rich array of opportunities in the profession, offering a broad cultural and intellectual foundation in the liberal arts as they relate to the design of the environment at all scales. The discipline of architecture interpreted in the widest possible sense as a cultural practice is seen as a basis for a fully-rounded education at the undergraduate level. Students develop their knowledge and design skills within a framework of studios and courses that stimulate research and debate into the nature and role of architecture as a cultural practice with profound social and environmental implications.

The content of the curriculum, based on a wide cultural view of architecture, reflects broad ethical values. Faculty-student interaction is conducted on an intensive basis in the design studio and other classes. Within this framework faculty members encourage students to develop their individual interests and strengths, with a constant stress on fundamentals and a basic commitment intended to equip the graduate with a lasting ability to produce an architecture that is a meaningful synthesis of the social, aesthetic and technological. The relationship between architecture and other creative disciplines is stressed through the five years. Students are encouraged to express themselves both verbally and visually.

In a moment where the nature, role and scope of the architect is rapidly assuming new directions and dimensions in both the social and technological domains, the school emphasizes the principles of design and their underlying human values, while preparing students to respond positively to change. The program seeks to engender a strong sense of the responsibilities of service and leadership, team-work and individual creativity essential to the development of principled professionals dedicated to interpreting and constructing the spatial needs of the community.

The five-year design sequence is carefully structured to introduce the student to the principles of architectonics, the investigation of program and site, structures and environmental and building technologies, in a comprehensive and integrated curriculum. The studios comprise an introduction to the basic elements of form, space and structure; complex institutional design problems in their urban context; and a year-long thesis that demonstrates the student's ability to synthesize a comprehensive understanding of architecture in society. The traditional and

essential skills of drawing, model-making and design development are complemented by a full investigation of the analytical and critical uses of digital technologies. The study of world architecture and urbanism is deepened by the understanding of individual cultures, environmental and technological issues at every scale. The theory of the discipline, past and present, is investigated through the close analysis of critical texts and related to the theory and practice of other arts, such as public art, film and video. The position of the School of Architecture, together with the Schools of Art and Engineering and the Faculty of Humanities and Social Sciences, offers a unique opportunity for interaction and interdisciplinary research and experience.

The Cooper Union's location in New York City in the heart of downtown Manhattan provides a stimulating professional, social and cultural context for the education of an architect and an urban laboratory for the study of design in society. The numerous cultural institutions of the city provide an inexhaustible resource for research and experience outside the studio and classroom. The school's faculty includes nationally and internationally recognized architects; the school's diverse student body consists of highly talented and motivated individuals and its distinguished alumni are leaders in architecture and related fields.

The Irwin S. Chanin School of Architecture offers a five-year program leading to the bachelor of architecture degree. The degree requirements are intended to provide students with a rigorous training in and exposure to the creative and technical aspects of architecture. The professional courses in the curriculum are supplemented and enhanced by required courses both within and outside the discipline of architecture. The requirements are as follows:

Courses	Credits	
	Sem 1	Sem 2
First Year		
Arch 111 Architectonics	4	4
Arch 114 Freehand Drawing	3	3
Arch 115 History of Architecture I	3	3
Arch 118 Computer Applications and Descriptive Geometry	2	2
FA100R Introduction to Techniques	1	1
Ma 163-4 Calculus and Analytic Geometry	3	3
Literary Forms and Expressions	3	-
Texts and Contexts	-	3
Total Credits First Year	19	19
Second Year		
Arch 121 Design II	5	5
Arch 122 Structures I	2	2
Arch 125 History of Architecture II	3	3
Ph 165-6 Concepts of Physics	2	2
The Making of Modern Society	3	-
The Modern Context	-	3
Total Credits Second Year	15	15
Third Year		
Arch 131 Design III	5	5
Arch 132 Structures II	2	2
Arch 134 Environmental Technologies	3	3
Arch 135 Building Technology	2	2
Electives*	3	3
Total Credits Third Year	15	15
Fourth Year		
Arch 141 Design IV	5	5
Arch 142 Structures III	2	2
Arch 143 Construction Management	1	1
Arch 153 Town Planning	2	2
Electives *	6	6
Total Credits Fourth Year	16	16
Fifth Year		
Arch 151 Thesis	6	6
Arch 152 Structures IV	2	-
Arch 154 Professional Practice	1	1
Arch 205/225 Advanced Concepts/Topics	2	2
Electives *	4	6
Total Credits Fifth Year	15	15
Total Credit Requirement for B.Arch. Degree	160	

*The elective component for bachelor of architecture candidates can be fulfilled by elective courses in areas such as humanities and social sciences, visual arts, mathematics and science and languages. Approval for these elective courses must be granted by the appropriate academic faculty. A minimum of six elective credits must be taken in the humanities and social sciences.

The School of Architecture curriculum includes 32 credits of *required* coursework in general studies (non-professional coursework outside the discipline of architecture). In addition, students are required to complete 13 more credits of *elective* coursework outside the discipline of architecture.

Minor Students who complete a minimum of 15 upper-division credits in a specific field of liberal arts may qualify for a minor in that field of humanities and social sciences. Minors are offered and will be designated on student transcripts in the following fields: American studies; art history; literature; history and society. Additional information is available from the office of the dean of humanities and social sciences.

Accreditation

NAAB The National Architectural Accrediting Board mandates that the following statement be included in catalogs: In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes three types of degrees: the bachelor of architecture, the master of architecture and the doctor of architecture. A program may be granted a six-year, three-year or two-year term of accreditation, depending on the extent of its conformance with established educational standards. Masters degree programs may consist of a preprofessional undergraduate degree and a professional graduate degree that, when earned sequentially, constitute an accredited professional education. However, the preprofessional degree is not, by itself, recognized as an accredited degree.

NAAB Conditions for Accreditation and Student Performance Criteria available on the NAAB website.

Conditions

http://www.naab.org/accreditation/2004_Conditions.aspx

Student Performance Criteria

http://www.naab.org/accreditation/2004_Conditions_2.aspx
(Section 3.13)

ACADEMIC STANDARDS AND REGULATIONS

Credits Only those students who are officially registered in a course (i.e., by approval of the dean of the School of Architecture or a faculty adviser and notification of the Office of Admissions and Records) will have grades and credits entered on their records.

Satisfactory Progress Toward Degree The bachelor of architecture degree program is a rigorous course of study that seeks to prepare students intellectually and professionally for the investigation and making of architecture. The privilege of studying at The Cooper Union, with the benefit of a full-tuition scholarship for all admitted students, brings with it certain responsibilities. For students in the School of Architecture, these responsibilities include meeting the requirements of a demanding professional curriculum. All students who accept our offer of admission are expected to fully commit themselves to completing the degree requirements in accordance with the curriculum, which has been designed with great attention to sequence, prerequisites and the relationships between course work and the goals of each design studio. All classes that comprise the curriculum are essential to the education of an architect, and must be successfully completed by each student in the order intended. Students admitted as freshmen will complete the program in five years; transfer students will complete the program in accordance with their placement in the design sequence.

Students who do not successfully complete required courses as outlined in the curriculum will not be permitted to advance to the next year of study until the missing requirement(s) is/are completed. Since make-up classes are not offered at The Cooper Union, missing requirements may need to be fulfilled through coursework taken outside The Cooper Union. The intention to complete requirements outside The Cooper Union requires a meeting with the appropriate academic adviser or faculty member in order to obtain advance approval of the potential substitute course, and to confirm the minimum grade required in order for transfer credit to be awarded. It is the responsibility of the student to locate an eligible course at a college/university that allows part-time/summer study, which will be taken at the student's expense. It is in the best interest of each student to complete their coursework here at Cooper Union in conformance with the approved curriculum.

Students must pass a sufficient number of credits each semester to complete their degree requirements within five years of study. When dropping or adding courses, a student must follow all degree requirements for their particular year of study.

The normal course load is 16–19 credits per semester. Students are required to be registered for a minimum of 12 credits per semester. Failure to maintain satisfactory progress toward the degree may be grounds for dismissal.

Students are eligible to register for more than 18 credits per semester, but not more than 20, if they have received at least a 3.0 rating for the previous semester.

Transfer Credit Incoming students who have completed college-level academic work outside The Cooper Union may be eligible to receive transfer credit. Approval of transfer credit will be made by the appropriate dean or faculty based on transcripts from other schools and additional materials, including a course description, a course syllabus with topics and course requirements, a reading list and any quizzes, examinations, papers or projects, etc. that demonstrate the level, content and requirements of the course, as well as the student's proficiency with the course topics. If necessary, a proficiency/placement exam may be administered in certain subject areas. Transfer students must be prepared to present these and other requested materials for each course for which transfer credit is sought. Transfer credit evaluation must be completed by the end of the first semester of study.

When admitted, transfer students are offered admission into a specific year of the five-year design sequence. This decision is final, and acceptance of the offer of admission represents agreement on the part of the admitted student with this decision. It will be necessary for the matriculating transfer student to successfully complete the design studio to which he/she is admitted, as well as all subsequent studios, as part of their degree requirements. The official academic transcript of a transfer student will be reviewed prior to the student's first registration. This review will determine what, if any, additional coursework may be eligible for transfer credit.

Any credits or coursework below the minimum established for a given year of a student's curriculum must be made up in summer courses at other schools (these courses to be approved by the dean) at the student's personal expense. Students making up courses in this manner will be permitted to register for Cooper Union classes in September only after the Office of Admissions and Records receives a transcript showing the successful completion of these courses.

Currently enrolled students who find it necessary to complete degree requirements at another institution for transfer credit to The Cooper Union must have appropriate advance approval.

Credit may be granted for work done at another institution by any student upon examination by the dean. This credit is to be recorded after satisfactory completion of one semester's work at The Cooper Union.

Grades used, with their numerical equivalents, are: A (4.0), A- (3.7), B+ (3.3), B (3.0), B- (2.7), C+ (2.3), C (2.0), C- (1.7), D+ (1.3), D (1.0), D- (.7), F (0). The assigned numerical equivalents are used in computing semester and annual ratings by multiplying the numerical equivalent of the grade for each subject by the credits assigned to the subject. The sum of such multiplications for all the subjects carried by a student is divided by the total credits carried by him/her for that period to determine the average rating.

The official meanings for letter grades are as follows:

- A** Outstanding performance
- B** Above average performance
- C** Requirements satisfactorily completed
- D** Minimum requirements met; passing but unsatisfactory
- F** Failure to meet the minimum requirements of a subject
- I** The designation I indicates that the work of the course has not been completed and that assignment of a grade and credit has been postponed. An I designation is permitted only in cases of illness (confirmed by a physician's letter) or documentation of other extraordinary circumstances beyond the student's control.

The deadline for removal of an I designation will be determined by the instructor and recorded at the time the designation is given, but will not be later than two weeks after the start of the next semester. If the I is not removed within the set time limit, either by completing the work in the subject or by passing a reexamination, the I will automatically become an F unless the dean of the School of Architecture extends the time or the student withdraws from school.

The designation of I will be granted only with the approval of the dean.

W The student has received permission from the instructor and the dean of the School of Architecture and has withdrawn from a course while passing the course requirements at the time of withdrawal. This permission must be obtained before the end of the sixth week of the semester. The grade is not included in the calculation of the student's semester rating but remains on the student's transcript. (See Change of Program: Withdrawing from a Course, p.37.)

WF The student has received permission from the dean of the School of Architecture and the instructor and has withdrawn from a course while failing the course requirements at the time of withdrawal. This permission must be obtained before the end of the sixth week of the semester. This grade is included in the calculation of the student's semester rating, its numerical equivalent is 0, and it remains on the student's transcript. (See Change of Program: Withdrawing from a Course, p.37.)

When appropriate, certain courses may be designated as Pass/Fail courses.

Pass Requirements completed. This designation is not included in the calculation of the student's semester rating.

Fail Failure to meet the minimum requirements of a course. This grade is included in the calculation of the student's semester rating; its numerical equivalent is 0.

Academic/Final Probation A semester rating below 2.0 and/or a grade less than C in Architectonics, Design or Thesis places a student on automatic probation and may be the basis for final probation or dismissal, as determined by the Academic Standards Committee.

A second probation may result in final probation or the dismissal of the student. The Academic Standards Committee may place a student on final probation.

A student placed on automatic probation may be subject to academic requirements as determined by the Academic Standards Committee.

A student on final probation who receives a semester rating below 2.0 and/or a grade less than C in Architectonics, Design or Thesis at any point in the remainder of his/her academic career in the School of Architecture will be immediately, automatically and permanently dismissed from The Cooper Union with a forfeit of the right of appeal. Automatic dismissal on final probation unconditionally and irrevocably terminates a student's academic career in the School of Architecture.

A student on probation may not carry more than 18 credits a semester.

Each student is responsible for his/her total accomplishment and for being continuously aware of the standards defined in the preceding paragraphs. Students whose records by mid semester indicate a possible failure to meet minimum standards may be so informed.

A student must have a cumulative grade point average of 2.0 or better in order to graduate from The Irwin S. Chanin School of Architecture.

Any student who fails Arch 151 (Thesis) twice will be dropped automatically from the program.

Change of Grade A change in an official grade of record cannot be made by the dean of Admissions and Records without the express consent of the dean of the School of Architecture. The dean of Admissions and Records will automatically convert an I designation to an F if an official change of grade is not submitted within the two-week deadline after the start of the following semester. Grade changes will not be accepted after one year has elapsed from the completion of the course.

Change of Program: Adding a Course Students are permitted to add a course only during the first two weeks of a semester, during the drop/add period. They must receive the approval of the dean and must report the addition to the Office of Admissions and Records.

Adding courses after the drop/add period is not permitted even if the student has been attending the class(es).

Change of Program: Withdrawing from a Course Students may withdraw from a course with appropriate written permission by notifying the Office of Admissions and Records during the first two weeks of a semester, during the drop/add period. A withdrawal from class during this period will result in the deletion of the course from the student's record. Students are not permitted to withdraw from courses if doing so would impede satisfactory progress towards the degree.

Withdrawal from a course during the drop/add period must be accompanied by an addition of equivalent credits in another course in order to maintain satisfactory progress toward the degree.

Students who wish to drop a course after this deadline must first receive permission from the dean. If the student is passing the course at the time of withdrawal, a designation of **W** will appear on his/her record. If the student is failing the course at the time of withdrawal, a grade of **WF** will be recorded. It is the student's responsibility to obtain the necessary permission from the school and to submit proper notification to the Office of Admissions and Records in order to withdraw from a course.

Students are not permitted to withdraw from a course after the sixth week of the semester. Failure to attend a class does not constitute withdrawal. Students are not permitted to withdraw from a class as a means of avoiding a failing grade.

Change of Program: Change of Section Students are permitted to transfer from one section to another of the same course before midterm if they are passing the course at that time. Permission of the dean is required for the change of section.

Leave of Absence Students who have completed at least one year of study and need to interrupt their studies may be granted a leave of absence for up to one year by permission of the dean. Only students in good academic standing and making satisfactory progress toward the degree may request a leave of absence. A meeting with and permission from the dean of the School of Architecture is necessary.

Required Leave of Absence A student who fails Architectonics, Design or Thesis will come before the Academic Standards Committee. If the student is permitted to continue, the student will

be required to repeat that semester of studio (Architectonics, Design or Thesis) as well as meet any other conditions set by the Academic Standards Committee. If it is not possible for the student to make significant progress towards the degree requirements in the semester prior to repeating the studio course (as determined by the Academic Standards Committee and/or the dean), the student will be placed on a mandatory leave of absence for one semester and will resume his/her studies in the following semester by repeating the required studio and enrolling in other classes for a total registration of at least 12 credits. The student's registration must be approved by the dean.

Medical Leave of Absence Students who are forced to interrupt their studies for medical reasons must submit with their request for reinstatement an opinion from the student's physician or therapist. Cooper Union reserves the right to require a second opinion by a physician of its choosing.

Interim Year/Independent Study Architecture students in good standing and making satisfactory progress toward the degree may elect to interrupt their studies at The Cooper Union for a period of one year for purposes of study or travel. This interim year option is available to architecture students who have completed at least one year of study at The Cooper Union. A meeting with and permission from the dean of the School of Architecture is necessary.

Students who intend to accomplish academic credit outside The Cooper Union while on an interim year must consult with the dean to plan an appropriate program in affiliation with another institution. Credit will only be considered upon the student's return and after review of his/her portfolio and appropriate academic documentation.

Readmission Students who have withdrawn from the School of Architecture and have completed at least one year of study at The Cooper Union must reapply to the school to be considered for readmission in competition with transfer applicants.

Students who have withdrawn from school before they have completed one year of study at The Cooper Union must reapply through the freshman admission procedure.

Students who have been dismissed for academic deficiencies and are eligible for readmission must apply within two years to the chairman of the Academic Standards Committee before May 15 for admission in September and before November 15 for admission in January. They should be prepared to demonstrate a change from the circumstances that warranted their dismissal.

Former students who have been dismissed due to academic deficiencies and who have been out of The Cooper Union for more

than two years (four semesters) at the time of anticipated return must apply through the regular admission procedure. If offered admission, previous Cooper Union credits earned may be evaluated for transfer credit.

Residence A candidate for a degree must be enrolled during the entire academic year immediately preceding the granting of the degree and in residence during the last semester.

Graduation To be eligible for graduation, a student must complete the minimum number of credits listed for his/her curriculum and must spend a minimum of four semesters in full-time resident study at The Cooper Union.

Students are responsible for their total accomplishment and for being continuously aware of the standards for graduation.

Graduation requirements as outlined in this catalog are guidelines that are subject to change.

MASTER OF ARCHITECTURE II POST-PROFESSIONAL DEGREE CURRICULUM

Aims and Objectives In spring 2006, the School of Architecture registered a new master of architecture II program with the State Education Department of the University of the State of New York. This new post-professional degree program will extend the vision and intellectual rigor of the undergraduate program and allow a further development of the school's preeminent position in the education of architects.

The master of architecture (M.Arch. II) is a design research, post-professional degree open to applicants with a first professional degree in architecture (bachelor of architecture or master of architecture I) from a program accredited by the NAAB or equivalent accrediting agency in another country. The program will serve professionals who wish to continue in practice with higher research and design skills in those areas in which the program offers specialization. It will additionally prepare those with first professional degrees who wish to develop parallel careers in teaching and/or continue to engage in research toward an appropriate Ph.D. degree at another institution.

The program seeks to address modern and contemporary issues in the practice and theory of architecture and urbanism, incorporating considerations from history as well as the present condition of globalization and the continual emergence of new scientific developments and technologies.

The program will offer concentrations in one or a combination of three areas: theory, history and criticism of architecture, urban studies and technologies. Students will declare their area(s) of concentration during the application process. Applicants are required to complete a minimum of two years of work experience after obtaining their first professional degree before applying to the program.

The design studio will be a major component of the program; students from all three concentrations will work together on a common program under the direction of a studio critic during the first two semesters. Seminars will address issues particular to the concentrations as well as other topics making use of the interdisciplinary resources offered by The Cooper Union.

Theory, History and Criticism of Architecture This area will concentrate on questions concerning the theory and criticism of modernism and contemporary architecture, the philosophy and aesthetics of architecture, the mediatization of architecture and broader cultural and historical issues through the critical readings of texts as well as research through studio work.

Urban Studies This area will concentrate on issues central to the design, planning and development of cities and regions, including study of the morphological, social and cultural effects of globalization; the survival of local urban cultures; redevelopment of central cities, suburbs and exurbs; and issues specific to New York and comparative cities.

Technologies This area will concentrate on technological issues of architectural design, representation, planning and production, such as the impact of new information technologies, new materials and manufacturing processes; hardware and software development; mapping and modeling techniques; and the technologies of fabrication as they influence new design strategies. This area will focus as well on the economic, ethical and technological dimensions and design potentialities of sustainability and developments in new structural systems, materials and building assemblies.

Program Requirements All admitted M.Arch II students must have previously obtained a bachelor of architecture or a masters of architecture first professional degree from a school accredited by the NAAB or equivalent accrediting agency in another country. The program is structured to be completed in two full-time consecutive semesters with a final thesis semester during the summer session. Final thesis presentations will take place during the first week of the fall semester following the student's year of study. Graduate students are expected to complete all 30 credits of the M.Arch II degree requirements in full-time continuous resident study at The Cooper Union.

Courses		Credits
Semester 1 (Fall)		
Arch 411	Graduate Research Design Studio I	6
Arch 401	Proseminar	2
	Seminar in concentration	2
	Seminar out of concentration	2
Total Credits First Semester		12
Semester 2 (Spring)		
Arch 412	Graduate Research Design Studio II	6
Arch 402	Thesis Research Tutorial	2
	Seminar in concentration	2
	Seminar out of concentration	2
Total Credits Second Semester		12
Semester 3 (Summer)		
Arch 413	Graduate Thesis (written or studio)	6
Total Credit Requirement for M.Arch II Degree		30

Thesis In April of the spring semester prior to advancing to Arch 413 Thesis, each student will be required to present an elaboration of his/her thesis topic and program for review and acceptance by the faculty. Final thesis presentations will be made during the first week of fall semester following the student's year of study.

Seminars Out of Concentration It is recommended that students register for courses originating in the graduate program (Arch 482, Arch 483 and Arch 485) to satisfy their out-of-concentration seminar requirements. As an alternative, the lecture component of elective courses originating in the undergraduate program at the advanced level (such as Arch 190 Structures Elective, Arch 225 Advanced Topics in History, Theory and Criticism, etc.) as well as Arch 205 Advanced Concepts, will be open to students in the graduate program for credit with tutorial meetings and with graduate-level requirements for written or project based work, to satisfy requirements for their out-of-concentration coursework.

The undergraduate curriculum course numbering system is structured such that a first digit of "2" or greater OR a second digit of "4" or greater indicates an upper level course, which students in the undergraduate program would normally take in their 4th or 5th year of study.

Graduate courses in the Albert Nerken School of Engineering as well as select upper level undergraduate elective courses could be made available to M.Arch. II students with prior permission from the student's academic adviser and the individual course instructor. Undergraduate courses may be used to satisfy requirements for out-of-concentration coursework only.

First Entering Class The first entering class of the M.Arch II (post-professional) degree was admitted to begin their studies in September 2009.

ACADEMIC INTEGRITY

Built upon Peter Cooper's vision of education, The Cooper Union for the Advancement of Science and Art from its inception has been dedicated to the highest ethical standards. The School of Architecture, founded on principles of independent and exploratory thought, maintains that individual creativity within a willing community is a profoundly social act. In fostering a context of intellectual rigor, the program gives emphasis to a broad spectrum of cultural and ethical concerns which are of significance in the preparation of students for a professional degree and their role in society as practicing professionals of intelligence, creativity and integrity.

Authorship Acts of academic dishonesty are extremely serious violations of both the spirit and the substance of this community. The Academic Standards Committee of The Irwin S. Chanin School of Architecture will review acts of academic dishonesty including cheating, plagiarizing or the submission of work that has not been prepared by the person claiming authorship. Such acts are viewed as an extremely serious violation, punishable by probation, suspension or dismissal. The action of the Academic Standards Committee in such cases will become part of the student's permanent academic record.

The Studios Central to maintaining a creative environment for intellectual investigation and intuitive exploration are the shared design and computer studio spaces on the third and seventh floors of the Foundation Building.

In the studios, students work together as a community of individuals. Here, students and faculty from all years engage in a process of rigorous inquiry, discussion and critique, freely sharing knowledge, ideas and methodologies. Students study the principles and works of architecture that have contributed to the betterment of the human condition in the development of their own projects. Students of the upper years serve as mentors for the lower years. Diversity and balance are critical values in generating an academic ambiance where humanistic ideals and ethical views serve as a constant reference for individual growth and development. The social and intellectual environment thus created is considered a vital part of the students' experience at The Cooper Union. Students are required to be present in studio for all hours that their design studio meets and to develop their work in the studio.

Students should be aware of and observe all policies and conditions for the use of the studios, including hours of access. Studio use policies and responsibilities are distributed at the beginning of each academic year.

Annual Exhibition of Student Work The End of Year Show is a major event of the School of Architecture, exhibiting the work developed during the previous academic year to the academic and professional communities and the public at large. It is an opportunity to present the pedagogical framework of the school and faculty and to celebrate the rigor and diversity of the student work.

The exhibition occupies the lobbies, halls and classrooms of the third and seventh floors, and the Houghton Gallery on alternate years. Preparation of these spaces and hanging the work is a tremendous task that must be accomplished in the very short period of time between the end of classes and commencement. Students of all years are required to make requested projects available for the exhibition and are expected to fully participate in the installation.

In addition to making their work available for the Annual Exhibition, individual student work may be requested for other purposes (other exhibitions, accreditations, etc.). Students are required to provide requested projects or other materials, which will be returned to them in a timely manner.

FACILITIES

The facilities of the School of Architecture are housed on the third and seventh floors of the Foundation Building, initially completed in 1859 and now a National Historic Landmark widely referred to as one of New York City's grand monuments. In 1974, John Hejduk, the first dean of the School of Architecture, designed a major alteration of the interior; in 2002, the restoration of the brownstone exterior was completed.

The Studios All students in the School of Architecture are provided individual workspace on the third floor within a shared studio. With the first through fourth years sharing a single large studio and the fifth-year thesis class in more intimate individual spaces, a unique environment fostering cross-fertilization between classes and individual students is maintained. School of Architecture students have individual studio workspace with a full-size drawing/drafting table as well as a small individual or larger shared work table for reference, model building, etc.

Computer Studio The School of Architecture has developed a computing facility on the seventh floor of the Foundation Building. It is specifically intended to support a design curriculum that recognizes the growing use of computing as an instrument of practice and which urges students to explore its formal and cultural implications. The facility now has both Macintosh and Dell Precision PCs (including a high-end multiple-processor rendering station), scanning and printing capabilities and two large-format plotters. Software includes an array of imaging, drawing, drafting and 3D modeling and rendering programs. This facility is open to all students of The Cooper Union. Considered integral to the activities of the design studio, this computing facility is open whenever the design studios are open, giving students access an average of 17 hours a day. A student trained to assist in the effective use of the facility and to do simple troubleshooting on the hardware is present whenever the center is open.

In addition to the School of Architecture's new 3D plotter, other three-dimensional output capabilities include a laser-cutter in the School of Art and a CNC machine in the School of Engineering.

Computing facilities in the Schools of Art and Engineering are open for use by students of the School of Architecture.

Personal Laptops The School of Architecture Computer Studio is open to all architecture students and is equipped with all of the hardware and software necessary for their work and study. We recommend that students who wish to purchase their own laptop computers complete a year of study in order to fully test a variety of programs and platforms. Current students have selected a variety

of laptop models in both Mac and PC platforms for individual use. The Cooper Union assumes no liability for personal laptops. Students who use/bring their personal laptops to school are solely responsible for the safety and security of their equipment and are strongly advised to store their laptops in their lockers when not in use.

Lecture Room A small auditorium on the third floor is used for lecture classes and invited lecturers. Special lectures are open to all interested Cooper Union students.

Shop An outstanding all-college sculpture shop administered by the School of Art is located on the fourth floor. Integral to both the program and pedagogy of the School of Architecture, the shop is equipped for projects in wood, metal, plastics, plaster and clay, and includes a bronze casting foundry. For a complete description of the sculpture shop facility, please refer to the School of Art section (page 46).

Study Collection The School of Architecture has fostered the growth of a non-circulating Study Collection of books and other visual material that are not otherwise accessible through the Cooper Union library system, sometimes including rare or limited edition items, often on loan from private collections. Students make use of the room for quiet reading and study. The room can also be used for small seminar meetings.

School of Architecture Archive The Archive is responsible for the ongoing collection, documentation and storage of student work, and now has a record of student work produced at the school since 1983, an invaluable record of the pedagogy of the school used for exhibitions, publications and student research. In addition, the Archive's Blueprint Collection, Lantern Slides, New York Postcard Collection, Stanley Prowler Slide Collection and New York City Waterfront Archive are resources available for use by students and faculty for research and study. The Archive also manages the loan of analog and digital video cameras as well as still cameras for student use on class projects.

41 Cooper Square In September 2009, The Cooper Union will open its new academic building at 41 Cooper Square, opposite the landmark Foundation Building. The Cooper Union's first new academic building in 50 years will house the School of Engineering and the Faculty of Humanities and Social Sciences as well as studio, computer and classroom space for the Schools of Architecture and Art. Equipped with studio-learning labs, 41 Cooper Square will provide all students of The Cooper Union with access to state-of-the-art tools to pursue creative and original research and design in the course of their learning.

COURSES

Students should consult official class lists for courses offered in a given semester. There is no assurance that a course listed in this catalog will be given every year.

Be advised that each school offers certain electives that are open to all students; consult each school's course listing.

Undergraduate

Design (Required)

All Architectonics students are required to take an Introduction to (Shop) Techniques course.
1 credit

Arch 111 Architectonics

Introduction to the study of architecture; investigation of the interrelationships of space, structure and visual composition. Exploration of the syntax of architecture. Models and orthographic drawing.
4 credits

Arch 121 Design II Projects comprise elemental architectural programs wherein the student is required to sustain the formal investigations of first year while integrating the complexities of program, context and site. Spatial, structural, material, environmental and visual design are integrated. Emphasis is placed on communicating concepts through drawings and models.
5 credits

Arch 131 Design III Study and analysis of historical precedents followed by a sequence of design problems of increasing complexity. Emphasis on the planning of buildings and the interrelationships among form, structure, detail and technologies.
5 credits

Arch 141 Design IV Investigation of urban programs and sites requiring the integration of form, structure and space. Examination of the complexities implicit in the resolution of urban problems. Analytic studies and explorations generate specific programs for development of each project. Emphasis given to large-scale integrations and the impact of urban transformations upon existing fabric.
5 credits

Arch 151 Thesis A synthesis of four years' educational experience. The choice of the area of study is the responsibility of the student. The scope of the problem is defined by each student, who also decides on his/her method of exposition. Problems are analyzed and studied with the aid of faculty from each discipline and by visiting critics.
6 credits

Structures (Required)

Arch 122 Structures I A qualitative examination of the behavior of structures. Characteristics and development of the stresses generated from the simple to the complex. A study of the materials of construction used in structures.
2 credits

Arch 132 Structures II The study of strength of materials is applied to the quantitative design procedures for wood and steel structures. Students complete individual projects in wood and low-rise steel structures.
2 credits. Prerequisites: Ma 163/164, Ph 165/166, Arch 122 Structures I

Arch 142 Structures III The design of reinforced concrete using stress methods and plastic design is combined with individual projects in low-rise concrete structures. Elements of soil mechanics and soil investigations are included (fall only) in foundations design.
2 credits. Prerequisite: Arch 132 Structures II

Arch 152 Structures IV Intensive seminars are completed on prestressed concrete, wind and earthquake design for tall structures and special structures, while the student becomes the structural consultant for individual assignments for the structural solution of real architectural projects covering prestressed, high-rise steel and concrete buildings and shells.
2 credits. Prerequisite: Arch 142 Structures III

Environmental Technologies (Required)

Arch 134 Environmental Technologies

Environmental and life safety systems as they affect program and building form, including mechanical (heating, cooling, ventilating), water supply and disposal, electrical, lighting, acoustics, vertical transportation, communication, security and fire protection. Principles of sustainability. Passive and active systems.
3 credits

Building Technology (Required)

Arch 135 Building Technology

Materials and methods of architectural construction, lectures, examination and discussion of classic as well as current building techniques. Students assemble full-size "mock-ups" of details for class study germane to their design classes. In general, this course does not separate "construction" from "design" but attempts to supplement, by means of a more detailed study of design assignments. Field trips may be made to buildings under construction.
2 credits

Drawing (Required)

Arch 114 Freehand Drawing

Basic drawing skills, composition and color perception. Studio and homework assignments.
3 credits

History of Architecture (Required)

Arch 115 History of Architecture I

(Sem. I) An introduction to the study of the concepts, designs and built examples of architecture from antiquity through approximately the third century C.E. Selected projects from throughout the world will be analyzed in terms of planning, design, structure, technique, function, social context and meaning.
3 credits

Arch 115 (Sem. II) An introduction to the study of the concepts, designs and built examples of architecture from approximately the fourth through the 15th century. Selected projects from throughout the world will be analyzed in terms of planning, design, structure, technique, function, social context and meaning.
3 credits

Arch 125 History of Architecture II

(Sem. I) An introduction to the study of the concepts, designs and built examples of architecture from approximately the 15th through the 18th century. Selected projects from throughout the world will be analyzed in terms of planning, design, structure, technique, function, social context and meaning.
3 credits

Arch 125 (Sem. II)

An introduction to the study of the concepts, designs and built examples of architecture from approximately the 18th through the 20th century. Selected projects from throughout the world will be analyzed in terms of planning, design, structure, technique, function, social context and meaning.
2 credits

Arch 153 Town Planning

A modernist response to the problems of large metropolitan cities. Taking a historical perspective, the course will analyze town planning responses of specific architects and groups for cities such as Paris, London, New York, Vienna and Chicago, questioning the cultural determinants that made town planning a modernist stance.

2 credits

Advanced Concepts and Topics
(Required)**Arch 205 Advanced Concepts**

This course is intended to be an advanced course dealing with the relationship between architectural space and some other discipline in the humanities. The course deals with an interdisciplinary approach toward a new poetic and the phenomenology, psychology and metaphysics of space. (After fulfilling the Arch 205 Advanced Concepts degree requirement, a student may enroll in other additional Arch 205 Advanced Concepts classes for elective credit.)

2 credits

Arch 225 Advanced Topics in History, Theory, Criticism

Advanced study in history, theory, criticism of architecture, urbanism and technology. (After fulfilling the Arch 225 Advanced Topics degree requirement, a student may enroll in other additional Arch 225 Advanced Topics classes for elective credit.)

2 credits. Prerequisites: ARCH 115 History of Architecture I, ARCH 125 History of Architecture II, ARCH 175 Modern Architectural Concepts or permission of the instructor

Professional (Required)**Arch 118 Computer Applications and Descriptive Geometry**

Descriptive geometry as a science of graphical representation of three-dimensional lines, surfaces and solids with emphasis on development of drawing and drafting skills. Understanding how graphical and construction information is represented in the computer, how information is represented in drawings, nature of the overlap between the two. Develop a critical facility to appreciate limitations and strengths of representational techniques. Computer as a mechanism for communication and research.

2 credits

Arch 143 Construction

Management Introduction to construction management principles, techniques and methods including scheduling, cost-estimating, planning and controlling construction process.

1 credit

Arch 154 Professional Practice

The role of the architect in relation to the community, client, builder, worker and engineer. Societal, ethical, legal and personal obligations. Office organization and administration.

1 credit

Elective Courses**Arch 165 Analysis of Architectural**

Texts Introduction to analytical methods and techniques and their relationship to synthetic activity in the design process.

2 credits. Prerequisite: permission of instructor

Arch 175 Modern Architectural

Concepts The concepts and generators of form and space relative to architecture of the 20th century are explored and investigated.

2 credits. Prerequisite: Arch 115 History of Architecture I, Arch 125 History of Architecture II or permission of instructor

Arch 176 Theory of Landscape

Architecture Lecture/studio course explores the interrelationships of nature, site design and built form. Focus on basic elements of nature addressed ideologically, poetically, culturally and practically through an interdisciplinary study of works by selected artists, writers, landscape architects and architects. Work with landscape fundamentals, continue on to more complex issues of natural processes and aesthetics, such as atmosphere, ephemerality and time, and of site planning, such as site selection, topography, drainage, ecology and climate, especially as related to architecture and art in the land.

2 credits. Open to all students

Arch 177 Computer Graphics, Image Processing and Vision

Introduction to basic concepts of spatial description and manipulation by computer enables student to use these techniques as an aide in problems of formal spatial drawing with a computer. Examination of the issues of "hand-eye axis" in computer-based drawing and "paint" systems as well as more abstract algorithmic methods of drawing. Image acquisition and transformation by computer, its relation to computer vision and control of robots and machines which build will be another area of emphasis. Survey of a wide variety of applications including typeface design, page layout and make-up, animation and interactive control of video systems.

2 credits. Open to all students

Arch 178 Advanced Drawing

Seminar The course will focus on the dialogue between figuration and abstraction. Students will be expected to plan and elaborate an ongoing series of drawings. The class will meet on a seminar basis to critique work in progress and to discuss issues relevant to the language of drawing. There may be an open studio available for those students who wish to pursue drawing from the model. However, students will be encouraged to investigate a broad spectrum of imagery and materials.

2 credits. Prerequisite: permission of instructor

Arch 185 Crossings This project-oriented studio course will explore and investigate developments in architecture, art, literature and engineering that reinforce or reintroduce the interrelationships of these diverse disciplines including the implications of recent scientific developments that cross and disrupt established boundaries and foundations of compartmentalized disciplines, giving us new insights into the natural processes within the rich diversity of nature. A revitalized and stimulating field of inquiry is now offered to architects, artists and engineers, with technological and cultural implications.

2 credits. Prerequisite: permission of the instructor

Arch 185 Crossings The Feltman Seminar

This seminar will investigate the principles, aesthetics and methodologies of lighting perception and design. The Feltman Fund, a gift to the school, makes this seminar possible and supports its chairs.

2 credits. Open to all students

Arch 190 Structures Elective

The reason for the unique structural solutions for existing building structures is presented in depth. These studies will include structures of all sizes subject to gravity, wind and/or seismic forces. The path followed to arrive at the best solution is analyzed in open discussion. The correlation between the architectural, structural and mechanical needs, as well as considerations related to the actual erection of these structures, is presented.

2 credits. Prerequisites: Arch 122, Arch 132, Arch 142, Arch 152 or permission of the instructor

Arch 194 Environmental Technologies Elective

Advanced study in environmental issues to include such topics as cultural and environmental sustainability, resource allocation, new materials and methods, global networks, urban growth, etc. as they relate to architecture on many scales.

2 credits. Prerequisite: Arch 134 Environmental Technologies or permission of the instructor.

Arch 300 Computer-Aided Design and Descriptive Geometry

Architecture-specific exploration into perception, methods and conventions of the geometric representation of space through the new perspective of computer applications. Introduction to concepts of projections, hinge and projector lines as well as absolute and relative coordinate systems through local deduction by considering parallel, axial, radiant and stereoscopic projections as variations of the same system. Introduction of CAD specific methods such as Solid, NURBS and Parametric Modeling, hierarchical- and command-based programs. Critical comparison of computer capabilities and architectural tangible scale modeling methods to understand possibilities and limitations of computer-aided design in architecture. Critical exploration of methods and media for representation and design of specific works of architecture.

2 credits. Open to all students

Graduate

Required for students in all concentrations. All courses are one semester.

Arch 401 Proseminar

An introduction to research in architecture and urbanism: theory, research (methods and techniques) and writing, for M.Arch. II degree students only. Selected readings in historiography, theory, criticism and design and methods. Includes lectures and seminars by faculty and visiting specialists in the fields of history and criticism, architecture and urban design methods, research in representational techniques, digital technology, etc. Presentations by each student in the program will encourage interdisciplinary comparison and shared knowledge.
2 credits

Arch 402 Thesis Research Tutorial

Individual thesis research conducted under the supervision of an adviser or advisers leading to the preparation of a Thesis Prospectus required for advancement to the third semester of the program.
2 credits

Arch 411 Graduate Design

Research Studio I The Design Research Studio 1 will establish a general problem incorporating aspects of architectural, urban and technological design research to be undertaken by the class, with each student contributing to their specific area of expertise. The studio will include seminars by invited guests on topics relevant to the program's principal areas of study.
6 credits

Arch 412 Graduate Design

Research Studio II Individual design projects within general guidelines established by the faculty, each emphasizing the special area(s) of research of the student.
6 credits

Arch 413 Graduate Thesis

The choice of the area of study is the responsibility of the student. The scope of the project and method of exposition is defined by each student in consultation with their thesis adviser and must be approved prior to the beginning of the summer term on the basis of a thesis prospectus presented to the group of faculty. Students will develop a mutually agreed upon schedule for meetings with their adviser and for regular project reviews.
6 credits

Arch 482 Graduate Seminar in Technologies

Selected topics in the advanced study of technological issues in architectural design, representation, materials, planning, production and construction. Open to undergraduate fourth- and fifth-year architecture students as an elective with permission of the instructor and the dean.
2 credits

Arch 483 Graduate Seminar in Urban Studies

Selected topics in the advanced study of urban form including readings and case studies in urban analysis, global development, historic preservation and typological transformation. Open to undergraduate fourth- and fifth-year architecture students as an elective with permission of the instructor and the dean.
2 credits

Arch 485 Graduate Seminar in Theory, History and Criticism of Architecture

Selected topics in the advanced study of the theory and criticism of modernism and contemporary architecture, the philosophy and aesthetics of architecture, the mediatization of architecture and broader cultural and historical issues, through the critical readings of texts as well as case studies. Open to undergraduate fourth- and fifth-year architecture students as an elective with permission of the instructor and the dean.
2 credits

FACULTY

Administration

Anthony Vidler, *Dean*, Professor
B.A. Hons., Dipl. Arch., Cambridge
University; Ph.D., Delft University
of Technology (The Netherlands)

Elizabeth O'Donnell, *Associate Dean*

Monica Shapiro,
Administrative Associate

Pat De Angelis, *Secretary*

Emmy Mikelson,
*Assistant to the Deans for Public
Programs and Research*

Steven Hillyer, *Director,
Architecture Archive*

Barbara Choit,
*Collections Assistant,
Architecture Archive*

Sara Jones, *Special Projects Assistant,
Architecture Archive*

Full-Time Faculty

Professors

Diana I. Agrest
Dipl. Arch., School of Architecture and
Urbanism, University of Buenos Aires
Université de Paris: Ecole Pratique des
Hautes Etudes VI Section
R.A.

Diane H. Lewis
B.Arch., The Cooper Union
The American Academy in Rome
R.A.

Ysrael A. Seinuk
Degree in Civil Engineering,
University of Havana
P.E., F.A.C.I., C.Eng., F.I.C.E.,
F. A. S. C. E.

Proportional-Time Faculty

Professors

Kevin Bone
University of Colorado
Wright/Ingraham Institute
B.Arch., Pratt Institute
Royal Danish Academy of Art
R.A.

Anthony Candido
Georgia Institute of Technology
B.Arch., Illinois Institute of Technology

David Gersten
New York Institute of Technology
B.Arch., The Cooper Union

Roderick Knox
B.Arch., B.F.A., The Cooper Union
M.Arch., Harvard University
R.A., N.C.A.R.B.

Stephen Rustow
B.A., University of Rochester
M.Arch., M.G.P., Massachusetts
Institute of Technology
R.A., N.C.A.R.B.

Sean W. Sculley
B.A., Harvard University
B.Arch., Columbia University
R.A.

David Turnbull
B.A. Hons, Dipl. Arch., University
of Bath (England)

Lebbeus Woods
University of Illinois; Purdue University

Guido Zuliani
Diploma (M.Arch.), Istituto
Universitario d'Architettura di Venezia,
Italy

Associate Professors

Tamar Zinguer
B.Arch., The Cooper Union
M.Sc., Technion-Israel Institute of
Technology;
M.A., Ph.D., Princeton University

Michael Young
B.Arch., California Polytechnic Institute
M.Arch., Princeton University
R.A.

Adjunct Faculty

Professors

William Clark
B.A., Pennsylvania State University
M.A., Ph.D., Columbia University

Elizabeth O'Donnell
University of Minnesota
B.Arch., The Cooper Union
R.A.

D. Grahame Shane
Diploma (B.Arch.), The Architectural
Association School, London, England
M.Arch., Ph.D., Cornell University

David Shapiro
B.A., Ph.D., Columbia University
B.A., M.A., University of Cambridge
(England)

Michael Webb
Diploma, Regent Street Polytechnic
(England)

Assistant Professors

Hayley Eber
B.A.S., The University of Cape Town
B.Arch., The Cooper Union
M.Arch., Princeton University

Louis Katsos
B.C.E., M.B.A., New York University

Pablo Lorenzo-Eiroa
Dipl. Arch., University of Buenos Aires
Escuela Superior de Bellas Artes
Ernesto de la Carcova (Argentina)
M.Sc. University of Buenos Aires
M.Arch., Princeton University

Sheng Shi
B.S.C.E., M.S.S.E., Drexel University
P.E.

Anthony Titus
B.Arch., The Cooper Union
M.F.A., University of Chicago

Georg Windeck
Dipl. Ing., Technical University of Berlin
R.A.

Visiting Professors

Samuel M. Anderson
A.B., Harvard College
Sussex University (England)
B.Arch., The Cooper Union
R.A.

Ashok Raiji
B.Sc., University of Bombay (India)
B.S., M.S., Texas A&M University. P.E.

Peter Schubert
B.S.Arch., Ohio State University;
M.Arch., Columbia University
R.A.

Visiting Associate Professor

Lyn Rice
B.S. Env. Des., B.Arch.,
University of Oklahoma
M.S.A.A.D., Columbia University
R.A.

Visiting Assistant Professor

Michael M. Samuelian
B.Arch., The Cooper Union
M.Arch., Harvard University
R.A., N.C.A.R.B.

Instructors

Jane Lea
B.A., Barnard College
M.Arch., Columbia University

Mersiha Veledar
B.Arch., The Cooper Union
M.Arch., Princeton University

Uri Wegman
B.Arch., The Cooper Union

Other Adjunct/Visiting Professors

In order to indicate the distinction and level of professional accomplishment of these professors, we take pleasure in listing appointments of the past years: Anders Abraham, Wiel Arets, John Ashbery, Manuel Baéz, Norman Bryson, Sverre Fehn, Jay Fellows, Robert Freeman, Remo Guidieri, Janis Hall, John Hawkes, Christopher Janney, Josef Paul Kleihues, Jana Leo de Blas, James Merrill, Don Metz, Francesco Pellizzi, Ahmad Rahimian, Gaetano Pesce, John Rajchman, George Ranalli, Aldo Rossi, Joseph Rykwert, Antonio Sanmartín, Jürgen Sawade, Massimo Scolari, Catherine Seavitt, Bernhard Strecker, Bernard Tschumi, Hans Tupker, Wim van den Bergh, Michael Webb and Bruce McM. Wright

Emeriti

Peter D. Eisenman
The Irwin S. Chanin Distinguished
Professor Emeritus of Architecture
B.Arch., Cornell University
M.S.Arch., Columbia University
M.A., Ph.D., University of Cambridge
(England)
R.A., N.C.A.R.B., F.A.I.A.

Sue Ferguson Gussow
Professor Emerita of Architecture
Pratt Institute
The Cooper Union
The Brooklyn Museum
B.S., Columbia University
M.F.A., Tulane University

John Q. Hejduk,*
Dean of the Irwin S. Chanin School
of Architecture
Professor Emeritus of Architecture
The Cooper Union; B.S. in Arch.,
University of Cincinnati
M.Arch., Harvard University
Università degli Studi, Rome
Hon. L.H.D., University of Illinois
at Chicago
R.A., N.C.A.R.B., F.A.I.A.
Fellow of the Royal Society

Richard Henderson
Associate Dean of The Irwin S. Chanin
School of Architecture
Professor Emeritus of Architecture
B.Arch., Cornell University
R.A.

Ricardo Scofidio
Professor Emeritus of Architecture
The Cooper Union
B.Arch., Columbia University
R.A., N.C.A.R.B.

Chester Wisniewski
Professor Emeritus of Architecture
B.Arch., Syracuse University
Taliesin. R.A., N.C.A.R.B.

THE COOPER UNION SCHOOL OF ART

MISSION STATEMENT

The mission of the School of Art is to educate artists in the broadest sense, both as creative practitioners engaged with a wide range of disciplines in the visual arts and as enlightened citizens of the world who are prepared to question and transform society. The program is structured around an integrated curriculum that fosters connections between disciplines, as well as between traditional and new media. The studio experience affords the opportunity for the development of individual artistic vision in dialogue with collective debates and experiments within an intimate community of artists. The study of history, theory and criticism in the visual arts and general studies in the humanities and social sciences are considered essential in intellectually grounding studio practice. Central to the school's philosophy is the advancement of the artist's role in initiating critical responses and alternative models in relation to the prevailing forms and institutions of cultural production. Students are challenged to expand their research and experimentation across The Cooper Union, as well as in the surrounding urban environment and in the wider public sphere.

Bachelor of Fine Arts Curriculum

Goals and Objectives The goal of the B.F.A. program is to educate students in the skills, knowledge and understanding necessary for professional practice in art- and design-related fields. An integrated program not only teaches students in specific disciplines, but also in the complex interrelation of all visual vocabularies.

The Foundation Program consists of a series of prerequisite courses taken during the first year. This introductory year is designed as a basis for the educational program of the School of Art and is intended to prepare students for studies in all of the disciplines offered within the curriculum. Through exposure to a variety of two- and three-dimensional projects, students are given a general introduction to the specifics of visual and spatial phenomena, and to concepts, principles and techniques of the visual arts.

Following the completion of the Foundation Program, the disciplines of concentration are drawing, film and video, graphic design, painting, photography, printmaking and sculpture. Elective studio classes and seminars are also offered on a rotating basis. Students may choose to concentrate in one or more areas of specialization and are encouraged to follow an integrated approach by selecting from various areas while observing a prerequisite system designed to allow in-depth study in specific disciplines.

Bachelor of Fine Arts Requirements Candidates for the bachelor of fine arts degree are expected to complete 130 credits within eight semesters of study and within the following disciplinary credit distribution. (See chart at right.)

Certificate in Art Requirements A certificate in art program is available for a small number of students for whom the B.F.A. program is not appropriate. Candidates for the certificate program must complete 60 credits in two years of full-time study (with a minimum of 30 credits per year) or in four years of part-time study (with a minimum of 15 credits per year). All Foundation studio courses must be completed and students must follow prerequisite course requirements in selecting advanced studio electives.

The certificate program consists of 24 credits in Foundation studio and a minimum of 27 credits in advanced studio. Students may take up to nine credits in art history.

All academic standards and regulations of the School of Art apply to the certificate program.

Students in the certificate program may apply through the Office of Admissions for transfer to the B.F.A. program after completing 42 credits at Cooper Union.

Transfer students applying to the certificate program may transfer, at the time of admission, a maximum of 12 credits from another institution.

For Students who entered on or after September 2008

Course	Credits
Required Foundation Courses	
Basic Drawing (Analytical and Descriptive)	6 ¹
2-Dimensional Design	6 ¹
3-Dimensional Design	6 ¹
Color 21	
Introduction to Techniques	2 ¹
Foundation Project	1 ¹
Required Art History Courses	
Introduction to Art History I	2 ¹
Introduction to Art History II	2 ¹
Introduction to Art History III	2 ²
Art History Electives	8
Required General Academic Studies	
Literary Forms and Expressions	3 ¹
Texts and Contexts: Old Worlds and New	3 ¹
The Making of Modern Society	3 ²
The Modern Context: Figures and Topics	3 ²
Science	3
General Academic Studies Electives	
To be elected from Art History ³ , Foreign Language ⁴ , History of Architecture, Humanities, Social Sciences and Sciences	12
Prerequisite and Advanced Studio Courses	
To be elected from any studio discipline	55
Required Senior Presentation	0
Free Electives	
To be elected from courses in any discipline at Cooper Union or at other institutions approved by the dean of the School of Art	11
Total Credit Requirement B.F.A. Degree	130

¹ First-year requirement for all students

² Second-year requirement for all students

³ Maximum of three credits

⁴ With permission of the dean of the School of Art

For Students who entered on or after September 2006

Course	Credits
Required Foundation Courses	
Basic Drawing (Analytical and Descriptive)	6 ¹
2-Dimensional Design	6 ¹
3-Dimensional Design	6 ¹
Color	4 ¹
Introduction to Techniques	2 ¹
Required Art History Courses	
Introduction to Art History I	2 ¹
Introduction to Art History II	2 ¹
Introduction to Art History III	2 ²
Art History Electives	8
Required General Academic Studies	
Literary Forms and Expressions	3 ¹
Texts and Contexts: Old Worlds and New	3 ¹
The Making of Modern Society	3 ²
The Modern Context: Figures and Topics	3 ¹
Science	3
General Academic Studies Electives	
To be elected from Art History ³ , Foreign Language ⁴ , History of Architecture, Humanities, Social Sciences and Sciences	12
Prerequisite and Advanced Studio Courses	
To be elected from any studio discipline	54
Required Senior Presentation	0
Free Electives	
To be elected from courses in any discipline at Cooper Union or at other institutions approved by the dean of the School of Art	11
Total Credit Requirement B.F.A. Degree	130

¹ First-year requirement for all students² Second-year requirement for all students³ Maximum of three credits⁴ With permission of the dean of the School of Art

Studio Courses The student's choice of studio courses is based on individual interest in various disciplines, on prerequisite courses for advanced areas of study and on the student's interest in working with particular instructors.

There are limitations on the number of credits a student may take each semester in any one area of study, depending upon the student's progress in the program (number of credits completed toward the degree). The number of credits allowed is determined as listed below:

	Credits Completed	Maximum Credits per Semester per Area of Study*
B.F.A.	32 (Sophomore)	6
	64 (Junior)	9
	96 (Senior)	no limit
Certificate	30	9
	45	no limit

* Includes related techniques courses

General Academic Studies Requirements and Electives During the first two years, B.F.A. candidates must take four core courses in the humanities and social sciences (12 credits), as well as one course each semester in art history (three required courses and one elective course, eight credits total). At any time after the first-year they must take a three-credit science course.

Throughout the last two years, they must complete a minimum of 18 elective credits, six of which are required to be in art history; the remaining 12 may be taken in humanities, foreign languages (with permission of the dean of the School of Art), social sciences, art history (maximum three credits), history of architecture and the sciences.

Foreign language credit for intermediate and advanced courses, e.g., FL20J, FL21J, FL30J, FL31J, taught by language instructors with appropriate academic credentials, will be granted two general studies credits per semester with a limit of four credits accepted in the category of general academic studies electives with permission of the dean of the School of Art. Intermediate or advanced foreign language studies beyond four credits counted toward general academic studies will be acceptable for free elective credit, limited to two credits in language studies per semester.

Free Electives During the last three years, students have a choice of electives in the School of Art in addition to the required curriculum. Courses designated with the prefix **TE** or **SE** receive free elective credit, as do studio courses taken beyond the 54 or 55 credit requirement. Only one TE course per semester may be

taken. Students may also enroll in engineering or architecture courses at The Cooper Union or courses at other accredited institutions with the permission of the dean of the School of Art (or the academic adviser). Free elective credits are approved and granted by the dean of the School of Art (or the academic adviser).

Outside Electives These electives may be used only to meet free elective and/or general academic studies credit requirements; they cannot substitute for prerequisite or advanced studio electives. Students may take up to three credits per semester at a college other than The Cooper Union. For credit to be counted toward the B.F.A. degree, permission of the dean of the School of Art (or the academic adviser) is required before registration at another institution for the semester concerned. No such credit will be awarded retroactively.

Senior Presentation Requirement A public presentation of each senior student's work is a requirement for graduation. Each student may satisfy this requirement with an exhibition or, where appropriate, a screening, performance or publication. No student will be permitted to receive a degree unless this requirement is completed to the satisfaction of the faculty and the dean of the School of Art at a mutually agreed upon time and venue. Completion of the requirement will be reflected on the student's transcript. The 41 Cooper Gallery will be reserved for senior student exhibitions during much of the spring semester; other appropriate exhibition spaces will also be made available.

Progress Toward the Degree Students are expected to maintain normal progress toward their degrees, i.e., passing enough credits each semester to complete degree requirements within four years of study.

The normal work load is 17 credits per semester during the Foundation year and 16 credits per semester thereafter (= 130 credits = B.F.A. degree requirement).

Students should consult with the Office of Academic Advisement in order to assess their progress towards the degree.

Requirements for Nonresident Study Eligibility for non-resident study, i.e., the exchange and mobility programs, is as follows: Students who have completed at least 64 credits toward the bachelor of fine arts degree, have a cumulative G.P.A. of 3.0 in studio and a cumulative G.P.A. of 2.7 overall, are in good academic standing and have no outstanding first- and second-year requirements, may apply for one semester of non-resident study.

Transfer students must have completed at least 32 credits in residence at The Cooper Union before applying for non-resident study and must have an additional 32 credits to complete in residence upon their return. Transfer students must also have met all first- and second-year requirements and be in good academic standing.

Students applying for non-resident study must be in residence during the semester when they are completing the application process.

Students may earn a maximum of 12 credits in studio courses for one semester of study on exchange or mobility. A maximum of six credits may be awarded by any one faculty member for work done while on exchange or mobility.

Since foreign schools may have academic calendars at variance with that of The Cooper Union, students studying on exchange who cannot return in time for the start of the next semester at the School of Art must request an elective leave of absence for that semester.

Students may participate in non-resident study only once during their stay at The Cooper Union.

For information on details governing these programs, please inquire at the Office of Academic Advisement and Off-Campus Programs.

Exchange Programs The School of Art offers a number of exchange programs with schools abroad. They currently include opportunities to study in the Czech Republic, England, France, Germany, Israel, Italy, Japan, the Netherlands, Spain, Sweden and Switzerland.

Mobility Program The Cooper Union School of Art is a member of the Association of Independent Colleges of Art and Design (A.I.C.A.D.). A list of schools participating in the mobility program in the U.S. and Canada is available in the Office of Academic Advisement.

Schools in the metropolitan area are not available for a semester exchange. By special arrangement of The Cooper Union and Parsons School of Design, Cooper Union students may enroll in an outside elective course at Parsons.

Students should consult the Office of Off-Campus Programs for information about these exchange and mobility opportunities.

Students from other institutions who are enrolled at the School of Art as exchange or mobility students may not apply to transfer to The Cooper Union School of Art while in residence at The Cooper Union.

ACADEMIC STANDARDS AND REGULATIONS

Credits A credit is an academic unit of measure used for recording progress in the program of study and in meeting the academic requirements of the degree. In studio and lecture courses, one (1) credit represents a minimum of three (3) hours of work during each week of a 15-week semester dedicated solely to that course. These criteria apply to each course in which the student is enrolled.

Example in studio courses:

Sculpture, 3 credits, equals 9 hours of work per week (i.e. 4 hours in class and 5 hours outside work (studio or home) or 3 hours in class and 6 hours outside work).

Example in a lecture course:

English Literature, 3 credits, equals 9 hours of work per week (i.e. 3 hours in class and 6 hours of outside work).

The number of credits awarded in each course represents the fulfillment of an agreement by the student to satisfy the course requirements as defined by each instructor, on time, and in accordance with the definition of credit.

Additional Credits in an Advanced Course Permission to add credits to individual course commitments may be granted only under special conditions and must receive the written approval of the instructor and the dean of the School of Art (or the academic adviser) during the registration process.

Juniors and seniors in good academic standing (defined as having earned a minimum 2.7 G.P.A. overall for the previous semester and a minimum 3.0 G.P.A. in School of Art studio courses for the previous semester) may add credits to their individual course commitment under the following conditions: no more than two (2) additional credits in one course and no more than a total of three (3) additional credits in any one semester.

Additional Credits in a Semester Normal progress towards a degree is 16 credits per semester. Students may register for up to 19 credits only if they earned a minimum 2.7 G.P.A. overall for the previous semester as well as a minimum 3.0 G.P.A. in School of Art studio courses for the previous semester. Under special conditions, students may register for more than 19 credits only with the permission of the dean of the School of Art (or the academic adviser). Students who wish to register for less than 16 credits must do so in consultation with the Office of Academic Advisement of the School of Art.

Independent Study Independent study is an alternative to classroom study and may be taken only with a member of the resident faculty (defined as full-time or proportional-time faculty members or adjunct faculty members on three-year appointments). Only juniors and seniors in good academic standing (defined as having earned a minimum 2.7 G.P.A. overall for the previous semester and a minimum 3.0 G.P.A. in School of Art studio courses for the previous semester) are eligible for independent study. Independent study may be taken only once during a semester in an advanced subject for one (1), two (2) or three (3) credits. One (1) credit of independent study represents a minimum of three (3) hours of work during each week of a 15-week semester.

The major consideration in approving proposals for independent study is the educational value of the study project within the structure of the degree requirements. Permission to undertake study off-campus can be given only when it is required by the nature of the specific project and when the experience has been evaluated to be valid by the instructor and approved by the dean of the School of Art.

Transfer Credits All incoming students (freshman with advanced standing and transfer) may apply for transfer credits to be counted toward the B.F.A. degree requirements or certificate in art. These credits must be approved by the dean of the School of Art, with the evaluation based on transcripts from other schools. The transfer credits will be officially recorded only after one semester of satisfactory work is completed at The Cooper Union.

Transfer credits may be granted specifically in lieu of the School of Art's foundation, prerequisite or elective courses. A maximum of 60 credits may be transferred toward the B.F.A. degree, at the time of admission only. An accepted applicant who has previously earned a baccalaureate degree in a discipline other than art will be treated as a transfer student for purposes of evaluating completion of degree requirements and length of time allotted at The Cooper Union to complete the B.F.A.

The required 11 credits of free electives, however, must be completed during the student's stay at The Cooper Union. No previously earned credits may be transferred into this category. Exceptions to this rule may be granted by the Admissions Committee, with the approval of the dean of the School of Art, at the time of admission only. (See also page 12.)

Attendance Attendance at classes is mandatory. Unexcused absences and excessive lateness will be cause for probation or dismissal.

Registration Only those students who are officially registered in a course (i.e., by approval of the dean of the School of Art and notification to the Office of Admissions and Records) will have the grades and credits entered on their records. Students are required to register for each semester during the announced registration period.

A student who receives a grade of F, W or WU in the first semester of a one-year course will not be allowed to register for the second semester of that course. In such a situation the student will be called before the Academic Standards Committee for individual review and/or counseling in order to determine a future program of study. Students whose records by mid-semester indicate a possible failure to meet required standards, may be so informed.

Grades At the end of every semester each student receives a grade for his/her semester's work in each subject.

The grades, expressing the faculty's evaluation of students' work in School of Art courses, are: A (4.0), A- (3.7), B+ (3.3), B (3.0), B- (2.7), C+ (2.3), C (2.0), C- (1.7), D+ (1.3), D (1.0), D- (.7), F (0).

The numbers in parentheses give the assigned numerical equivalents of the letter grade for each course. These are used in computing semester index and cumulative index ratings by multiplying the numerical equivalent of the grade for each course by the credits assigned to that subject. The sum of such multiplications for all the subjects carried by a student is divided by the total credits carried by him/her for that period to determine the index or grade point average.

The meanings for the letter grades are as follows:

- A** Outstanding performance
- B** Above average performance
- C** Requirements completed; average performance
- D** Passing, but unsatisfactory
- F** Failure to meet the minimum requirements of a subject
- I** The designation **I** indicates that the work of the course has not been completed and that assignment of a grade and credit has been postponed. An **I** will be given only in cases of illness (confirmed by a physician's letter) or documentation of other extraordinary circumstances beyond the student's control.

The designation of **I** will be granted only with the approval of the dean of the School of Art.

The deadline for removal of an **I** designation will be determined by the instructor and recorded at the time the designation is given, but will not be later than two weeks after the start of the next semester. If the **I** is not removed within the set time limit, either by completing the work in the subject or by passing a reex-

amination, the **I** will automatically become an **F** unless the dean of the School of Art extends the time or the student withdraws from school before the deadline date.

W Indicates that the student has received permission from the dean of the School of Art and the instructor to withdraw from a course while passing the course requirements at the time of withdrawal. This permission must be obtained no later than the end of the eighth week of the semester. The grade is not included in the calculation of the student's semester rating.

WU Indicates that the student has dropped a course without permission of the dean of the School of Art and the instructor after the end of the eighth week of the semester. This grade is not included in the calculation of the student's semester rating.

When appropriate, certain courses may be designated as Pass/Fail courses.

Pass Requirements completed. This designation is not included in the calculation of the student's semester rating.

Fail Failure to meet the minimum requirements of a course. This grade is included in the calculation of the student's semester rating; its numerical equivalent is 0.

A change in an official grade of record, other than the **I** designation, cannot be made by the dean of Admissions and Records without the express written consent of the instructor and the dean of the School of Art. Grade changes will not be accepted after one year has elapsed from the completion of the course.

Change of Program: Dropping a Course Students may drop a course by notifying the School of Art office and the Office of Admissions and Records during the first two weeks of a semester. A withdrawal from class during this time will result in deletion of the course from the student's record and must be accompanied by an addition of equivalent credits in another course as needed to maintain normal progress toward the degree.

Students who wish to drop a course after this deadline must first receive permission from the dean of the School of Art and the instructor. If the student is passing the course at the time of withdrawal, a designation of **W** will appear on his/her record. Any course dropped by the student without permission of the instructor and the dean of the School of Art and without notification to the Office of Admissions and Records will be recorded as **WU**, however the instructor is free to record an **F** grade in such cases.

If, in the opinion of the instructor, a student's presence is hindering the educational progress of the class, the student may be dropped from the class at the request of the instructor. A grade of **W** will be recorded for the course.

After the eighth week of the semester, a course may be dropped only after consultation with the Academic Standards Committee and with the approval of the dean of the School of Art.

Change of Program: Adding a Course Students are permitted to add a course only during the first two weeks of a semester. They must receive the approval of the dean of the School of Art and must report the addition to the Office of Admissions and Records.

Change of Program: Change of Section Students who have completed the Foundation program are permitted to transfer from one section to another of the same course before midterm if they are passing the course and if space is available at that time. Permission of the dean of the School of Art and both instructors is required for the change of section and students must notify the Office of Admissions and Records.

Dismissal from The Cooper Union and Academic Probation

A semester rating of all courses, (i.e., School of Art and Faculty of Humanities and Social Sciences) below 2.0 places students on automatic probation and makes them subject to dismissal or withdrawal.

Students whose semester rating in School of Art studio courses only is below 2.7 in any one semester are automatically placed on probation and are subject to dismissal or withdrawal.

Students must maintain normal progress toward the degree. Failure to observe this standard is grounds for dismissal.

Students with unexcused absences and excessive lateness are subject to dismissal or withdrawal.

Appeal Students may appeal to the Academic Standards Committee of the School of Art in writing and/or in person when notified of their dismissal.

The Academic Standards Committee shall either confirm the dismissal or determine a probationary period. The decision of the committee shall be final.

Students on academic probation who do not improve their academic standing during the probationary semester or who fail to meet minimal academic standards during any subsequent semester will be notified that they are subject to dismissal from The Cooper Union.

Leave of Absence

Elective Leave Elective leave may be granted for up to a year's duration to students who are in good academic standing (defined as having earned a cumulative G.P.A. of 3.0 in studio courses and a cumulative G.P.A. of 2.7 overall). This form of leave is only available upon completion of the first-year Foundation Program.

Medical and Emergency Leave Medical and emergency leave may be granted with the approval of the dean of the School of Art and the dean of students and requires supporting documentation.

If a leave has been granted for medical reasons, a recommendation from the student's physician or therapist must support the student's request for reinstatement and/or extension of leave. Approval of the dean of students is required for reinstatement. The Cooper Union reserves the right to require a second opinion by a physician of its choosing.

Students must request all leaves of absence in writing. A written request for reinstatement is also required.

Withdrawal from School Written requests for withdrawal from school should be addressed to the dean of the School of Art.

Readmission Students who have withdrawn from the school and wish to be readmitted must reapply jointly to the Academic Standards and Admissions Committees.

Students dismissed by the Academic Standards Committee must reapply to the Academic Standards Committee, which will make a recommendation to the Admissions Committee. At the time of application for readmission, students dismissed from The Cooper Union should demonstrate a change in the circumstances that warranted their dismissal.

Graduation To be eligible for graduation students must complete the minimum number of credits required for the B.F.A. degree or the Certificate and must have been enrolled for a minimum of four semesters at The Cooper Union as a full-time student for the B.F.A., or a minimum of four semesters as a part-time student for the Certificate in Art.

All candidates for the B.F.A. degree must satisfactorily complete the requirement for a senior presentation.

Students must have a cumulative grade point average of 2.0 or better in order to graduate from The Cooper Union School of Art.

Students eligible to graduate and participate in commencement exercises must be approved by the Faculty of the School of Art.

Students who have not fulfilled the requirements for graduation will normally not be permitted to participate in commencement exercises.

Graduation requirements as outlined in this catalog are guidelines that are subject to change.

Students are responsible for their total accomplishment and for being continuously aware of the standards defined in the preceding paragraphs.

Residence A candidate for a degree must have been enrolled during two academic semesters preceding the granting of the degree and in residence during the last semester.

FACILITIES

The School of Art is primarily housed in the 1859 landmark Foundation Building. The renovated studios and labs offer complete facilities for a visual arts education. Seniors, juniors and many sophomores are assigned individual studio spaces by lottery. In addition, some Foundation Program classrooms, many student studio spaces, the Herb Lubalin Study Center, and the 41 Cooper Gallery are housed in the new academic building located at 41 Cooper Square.

Graphic Design Two multimedia classrooms at 41 Cooper Square are equipped with high-definition projection, surround sound and with Apple MacPros, which are connected to the Internet via T1 lines. In addition, the college-wide Computer Center provides hands-on use of scanners, black-and-white and color printers and copiers. Photocopying and professional imagesetting are offered at student rates. A metal type shop, located on the fifth floor of the Foundation Building, with Vandercook presses is also available with technical staff assistance. The students' personal studio areas provide individual drawing tables and flat file storage for advanced students.

A professional staff of technical assistants is available during posted Computer Center hours.

Painting/Drawing Both the historic Foundation Building and 41 Cooper Square house facilities for Painting and Drawing. In the Foundation Building, skylight ceilings flood abundant natural daylight throughout a number of classrooms, workrooms and student studio spaces dedicated to painting and drawing. Additional painting studios and a drawing classroom are located on the ninth floor of 41 Cooper Square. Classrooms are equipped with easels, model stands, palette tables, sawhorse tables and storage room for props. Common workrooms are furnished with slop sinks, worktables and storage racks to accommodate the preparation and storage of artwork.

The painting office has equipment for check-out and a limited number of art supplies for sale. Staff technicians are available during the week to provide technical support and help facilitate a healthy and safe work environment.

Photography The lab area is equipped with 16 4x5-inch enlargers in a large black-and-white communal darkroom. There are eight individual color darkrooms that accommodate 35mm to 4x5-inch negatives, as well as one color enlarger that can take 35mm to 8x10-inch negatives. In addition, there is a 32-inch-wide professional

color print processor, a large black-and-white film processing area with automatic temperature control and a dedicated alternative-processes room with UV exposure units up to 30" X 48".

A well-equipped studio provides the space and tools to photograph two- and three-dimensional sets with tungsten and/or electronic flash lighting systems for traditional or digital imaging.

Large- and medium-format film cameras are available for checkout as well as several professional digital SLR cameras. The lab has nine Macintosh work stations and the ability to print digitally up to 44" X 90".

A professional staff of technical assistants is available continuously during posted studio hours.

Printmaking A well-equipped and ventilated printmaking shop accommodates intaglio, lithography, silkscreen and relief printing processes and papermaking. The facility includes three lithography presses, three etching presses and three silkscreen vacuum tables. There is a dedicated computer facility with two large format printers for digital imaging and pre-press photographic work. There are more than 100 stones for lithography and a collection of rollers for lithography, monotype, and surface rolling in etching. The paper mill is complete with beater, a 75-ton hydraulic press, vats and the capability for both Western and Japanese papermaking.

A professional staff of technical assistants is available continuously during posted studio hours.

Sculpture A large, all-college sculpture shop supports opportunities for production of a wide range of three-dimensional work. This facility is equipped with machinery for wood- and metal-working, mold-making, bronze casting and projects using wax, clay, plaster and some plastics. An Epilog 36EXT 60 Watt Laser cutting/engraving system has recently been implemented.

A professional staff of technical assistants is available continuously during posted shop hours for management and supervision, as well as consultation and collaboration on projects from many different studio disciplines.

Film The film area offers basic production equipment in Super 8 and 16mm formats. Accessories include analog and digital audio recorders, microphones, lighting kits, tripods and various other production equipment. The studio space houses Super 8 and 16mm telecine (film to tape) transfer machines, animation stands, a 16mm rotoscope stand and a JK optical printer. Editing equipment includes a Final Cut Pro system, two Steenbeck editing tables and various other editing/viewing set-ups. The sound room is equipped with a ProTools HD digital audio workstation with surround mixing capabilities and a vocal isolation booth. ProTools

LE Mbox systems are also available. The projection booth has playback facilities for magnetic film and tape, analog and digital audio sources and projection sound, with ties to the main classroom/screening room, which doubles as a theater for large-screen projection of film and video.

A professional staff of technical assistants is available continuously during posted studio hours.

Video The video facilities provide portable video recording capability using Mini-DV and 3-CCD DVcam and 24p and HDV camcorders. Accessories include microphones, lighting kits, tripods and various other production equipment. The video lab has eight complete DV workstations with Final Cut Studio, Adobe Creative Suite and other audio and video software. Additional outboard equipment includes digital audio/video mixers, special effects devices and various analog audio and video decks. Other equipment (monitors, projectors, VCRs and DVD players) is also available for video installation work. The video lab is networked and equipped with a video/data projector for instruction and viewing student work. Videos can also be viewed in the screening room equipped with a video projector and surround sound system.

A professional staff of technical assistants is continuously available during posted studio hours.

Animation Lab The computer lab adjacent to the film and video areas provides Mac and Windows workstations for two- and three-dimensional animation, stop motion capture, image processing and audio/video editing and compositing. Software includes Final Cut Studio, Adobe Creative Suite and various other software for producing animation and digital artwork. Additional hardware includes a flatbed scanner, digital copy/animation stands, a digital rotoscope station and various analog and digital audio/video decks, as well as a vocal isolation booth. The animation lab also serves as an auxiliary facility for students working with film, video and sound projects and is networked and equipped with a video/data projector for instruction and viewing student work.

A professional staff of technical assistants is continuously available during posted studio hours.

The Computer Center The School of Art Computer Studio has recently been integrated into the college-wide facility, now located on the eighth floor of 41 Cooper Square. The Center supports both PC and Mac technology, and provides students with a wide range of digital media and imaging options. The facility houses Apple MacPro computers; high-resolution reflective and transparency scanners; a film recorder; black-and-white and color laser printers and copiers; and large-scale color printers. There are dedicated

audio-video workstations capable of producing quality digital/analog video for broadcast, new media and web publishing.

Media equipment such as digital video cameras, digital still cameras, DAT sound recorders and microphones is available to loan by students. Software includes applications for graphic design, multimedia, audio-video and animation. The fully-networked studio also provides complete Internet access, CD and DVD production capabilities and a number of removable storage options.

A staff of professionals is continuously available during posted studio hours.

Center for Design & Typography The Center, located at 30 Cooper Square, combines education with public service. Advanced graphic design students work in guided classroom situations with actual outside non-profit agencies as clients, and on internal Cooper Union print and web design projects.

Galleries Several galleries around the campus are available to exhibit the work of students and outside artists in solo or group shows. Opening in Fall 2009 in the new academic building, the 41 Cooper Gallery and the Lubalin Center Gallery will feature a series of exhibitions open to the public. With glass walls that offer views into the building's entrance lobby from Third Avenue and East 7th Street, the 41 Cooper Gallery is intended to serve as a highly visible site of artistic activity consisting of exhibitions, programs, and screenings for the Cooper Union community, neighborhood and city at large.

Beginning late in each fall semester and carrying through the spring, gallery spaces in both the Foundation Building and 41 Cooper Square showcase work by seniors in The School of Art, with additional exhibitions of exchange student work, class projects and work by fellowship recipients. These exhibitions offer an opportunity for students to contextualize and showcase projects developed throughout the course of the year. The annual student exhibition at the end of the school year is mounted throughout the school's exhibition, studio and classroom spaces and features the work of art, architecture and engineering students at all levels.

Herb Lubalin Study Center of Design and Typography Now in its new location at 41 Cooper Square, adjacent to the Lubalin and 41 Cooper Galleries, this archive of seminal works in graphic design includes an extensive print and slide collection, as well as a reference library pertaining to the history and theory of visual communication. In addition to the archive, the Center maintains a rich and varied programming schedule, including exhibitions and lectures addressing major trends in design with leading international practitioners.

COURSES

Students should consult official schedules for courses offered in a given semester. There is no assurance that a courses listed in this catalog will be given every year.

Each school offers a range of elective courses that are open to all students; consult each school's course listing.

Prefix Key

FA designates studio courses (meet three or four hours per week)

SE designates seminars or lecture courses (meet three hours per week)

TE designates techniques courses (meet four hours per week)

Required Foundation Courses

FA 100.1 Introduction to Techniques

An introduction to the physical aspects of working with wood, metal, plaster—and plastics, as well as an introduction to on-campus computer facilities and resources. A basic introduction to the Adobe interface, specifically Photoshop and Illustrator will be provided.

1 credit per semester. One-year course. Pass/Fail. Staff

FA 101 Color A study of the physical, perceptual, art historical and cultural aspects of color. The phenomenon of color and principles of light are explored in various media towards an understanding of color application in all of the fine art disciplines and architecture.

2 credits. Ellis/Osinski/Vanni

FA 102 Two-Dimensional Design

Exploration of the visual and intellectual aspects of form on the two-dimensional surface, in a variety of media. Investigations into the relationships of perception, process and presentation.

3 credits per semester. One-year course. Essl/Lindell/McCarty/Morton/Tochilovsky

FA 104.1 Basic Drawing (Analytical and Descriptive) A course in freehand drawing designed to emphasize perceptual and inventive skills in all drawing media.

3 credits per semester. One-year course. Brown/Lawley/Richter/Villalonga

FA 109 Three-Dimensional Design

Students work on projects that explore the fundamentals of forms and space and investigate the properties of materials, structure, mass, scale, light and motion.

3 credits per semester. One-year course. Adams/Boyd/Friedman/Lins

SE 150 Foundation Project

A course that brings together all Foundation year students around a series of presentations that introduce various artistic practices, critical languages, and criticism. The course intends to present contrasting historical and contemporary models of creating, seeing, speaking and thinking about art.

1 credit. Spring semester only. Pass/Fail. TBA.

Elective, Prerequisite and Advanced Courses

Calligraphy

Prerequisite Course

TE 216 Calligraphy Geometry, optical balance and the stroke of the broad-edge pen are primary influences that shape the Roman alphabet. Students learn the fundamentals of "beautiful writing" through the study of historical models and the principles that are the basis of classical and modern letterforms. Exercises in ink train the hand kinaesthetically to write letters with graceful movement. Exercises in pencil train the eye to see and analyze the subtle geometry and skeletal "ideal" form of letters. Precise rhythm in letter-spacing and careful line-spacing create the color and texture of the page. The class will have an emphasis on page design involving hand written compositions. Roman and Italic capitals and small letters will be the focus of first semester students. Those who repeat may be introduced to other historical hands.

2 credits. One-semester course. May be repeated once. Free elective credit. DiEdwardo

FA 419 Independent Study in Calligraphy

1-3 credits. Requires approval of instructor and the dean of the School of Art

Computer Techniques

TE 303.1 Projects in Photoshop and Illustrator

This course explores techniques and projects in Photoshop and Illustrator. Students will complete projects that demonstrate their skill and understanding of digital image creation. Students may take either session for 1 credit or both sessions for 2 credits.

1-2 credits. One-semester course. Cannot be repeated. Free elective credit. Not offered 2009–2010

TE 304 Projects in Final Cut Pro and After Effects

This course explores techniques and projects in Final Cut Pro and After Effects. Students will complete projects that demonstrate their skill and understanding of video editing and motion graphics. Students may take either session for 1 credit or both sessions for 2 credits.

1-2 credits. One-semester course. Cannot be repeated. Free elective credit. McWreath

TE 305 Projects in XHTML and Programming

This course explores techniques and projects in XHTML and programming. Students will complete projects that demonstrate their skill and understanding of building web sites and basic programming. The primary software used in the course will be BBEdit, Flash and Processing. Students may take either session for 1 credit or both sessions for 2 credits.

1-2 credits. One-semester course. Cannot be repeated. Free elective credit. Sparling

Contemporary Art Issues

SE 401A&B Contemporary Art Issues: On Wildness

Topic for Fall 2009: This course will explore the idea of wildness and its relationship to contemporary creative practice. Through a careful look at the history of the term and its emergence in opposition to the concepts of domestication and taming, we will trace the appearance of the linguistic and conceptual binary and begin to uncover the way it operates in current cultural practice. We will move into the complex ethical territory that surrounds the idea of wildness—paying particular attention to issues of inclusion and exclusion—that will take us through theories of primitivism, essentialism, post-colonialism, exoticism, theorizations of race and notions of gender.

In so doing, we will investigate how certain practices/individuals come to

be aligned with reason and rationality, and others with wildness. Can institutional frameworks hold practices inclusive of wildness? And is this something to be desired or viewed with suspicion? Where does the practice of art fall within these questions and is it commensurate with the place given to art's reception? Does economic collapse lend itself to the flourishing of wildness or to further social domestication? Does wildness help us distinguish where play ends and art begins?

Coursework will be comprised of readings drawn from a broad range of disciplines, film screenings, and conversations with practicing artists and curators. Students will sharpen their analytical skills and facility with theoretical concepts in order to develop their ability to both understand and articulate the themes of their own creative practice.

2 art history credits. One-semester course. May be repeated once for art history credit. Perta/TBA

Drawing

Prerequisite Course

FA 240.1 Drawing I

The course is designed to explore the phenomena of drawing as basic to the visual language of all disciplines. The fundamental notion of observation and analysis in drawing is investigated. As preparation for work in an advanced level, the course involves further development of drawing skills and techniques, as well as an emphasis on individual aesthetic development. Assignments and group critiques are central to the course.

3 credits per semester. One-semester course. May be repeated once.

Prerequisite to all Advanced Drawing. Gleeson/Goldberg/Lawley/Masnij/ Merz

Advanced Courses

FA 341.1 Advanced Drawing

Advanced studies in drawing emphasizing the student's conceptual independence from traditional draftsmanship. This course is for students who have an established direction in drawing.

3 credits. One-semester course. Barth

FA 342.1 Advanced Drawing

Students are encouraged to explore and experiment with drawing as a way to further develop visual understanding of pictorial and sculptural space. The issues surrounding representation and perception are addressed. The focus of

this class is to help students to use drawing as a critical and procedural tool. Using notebooks and journals as well as reading and research methods to process ideas, students will work with drawing to advance and integrate their individual studio practice both technically and conceptually. Group critiques and drawing sessions as well as individual meetings with the instructor are integral components of the course.

3 credits. One-semester course. Bordo

FA 344.1 Advanced Drawing

Offered to students working independently in any medium. Must be self-motivated. There will be group and individual critiques.

3 credits. One-semester course.

Lawley.

FA 345.1 Advanced Drawing

This course offers an opportunity to develop a vital vocabulary in drawing through exploration of figuration, abstraction, observation or imagination. There will be an emphasis on the development and evolution of concepts, ideas—and observations from the sketchbook to completed works.

3 credits. One-semester course. L.A.

Miller

FA 346.1 Advanced Drawing

This course will focus on the conceptual basis of drawing as a medium unto itself—drawing as a finished and complete form of art, not merely a tool for constructing a painting, drawing or installation. Such techniques as duration, repetition, endurance, language and the body will be explored. Drawing will also be looked at in the context of contemporary art practices: what do the films of Andy Warhol have to do with drawing? How does the influx of text into 20th-21st-century art practice intersect with drawing? How does minimalism affect drawing? How is drawing reflected in "sampling?" What if any are the political implications of drawing in a time of high-speed computer technology?

3 credits. One-semester course.

McCarty

FA 347.1 Advanced Drawing

Offered to students working independently in any medium. Must be self-motivated. There will be group and individual critiques.

3 credits. One-semester course.

Gleeson/Merz

Advanced Drawing/Visiting Artists

Course description varies according to the instructor. For fall 2009:

FA 343.1 Advanced Drawing (cross-listed with FA 334 Advanced Painting)

Offered to students working independently in any medium. Must be self-motivated. There will be group and individual critiques.

3 credits. One semester course.

Visiting Artist James Siena.

FA 346.1 Offered to students working independently in any medium.

Must be self-motivated. There will be group and individual critiques.

3 credits. One-semester course.

Visiting Artist Adia Millett.

For spring 2010 and later semesters, please see course schedule and registration materials for course descriptions specific to Visiting Artists teaching that semester.

FA 449 Independent Study in Drawing

1-3 credits. Requires approval of instructor and the dean of the School of Art.

Film/Video

Prerequisite Courses

FA 270.1 Film I An introduction to the techniques and aesthetics of filmmaking. In a mixture of theory and practice, participants will be required to produce at least two film projects in response to concepts and issues raised. The course is in three parts: technical instruction, critique and screenings of artists' work. Students are trained in all aspects of filmmaking from shooting, lighting and sound to editing in film or on computer and DVD authoring. There are weekly reviews of student works-in-progress and each class will include survey of the history of artists working in film.

3 credits. One-semester course.

May not be repeated. Prerequisite to all advanced film courses; pre- or co-requisite to Animation I. McLaren/Schlemowitz

Note: Film I is required of all students who wish to pursue additional work in the medium.

FA 375.1 Film II This introduction to 16 mm filmmaking covers a wide range of techniques such as shooting with the reflex Bolex, lighting, single-frame construction, sound and editing. Students learn 16mm filmmaking with hands-on experience and are encouraged to use the unique qualities of the medium to express their original visions. This course integrates theory and analysis of cinematic language with film practice. Films made by independent filmmakers and artists will be screened and discussed and advanced filmmaking techniques such as optical-printing and multiple-exposure will be taught. Critiques of student work will take place at various points during the semester and students are required to complete their own final 16mm sound film by the end of the course.
3 credits. May not be repeated. Prerequisite: Film I. Perlin

FA 208.1 Video I An introduction to video production, postproduction, history and criticism. Students are introduced to basic camera operations, sound recording and lighting, as well as to basic editing using Apple's Final Cut Pro software, and to DVD production using Apple's DVD Studio Pro. Three assignments are to be completed during the semester: two are assigned in conjunction with the professor. Critiques of the assignments are crucial to the course as students are expected to speak at length about the formal, technical, critical and historical dimensions of their works. Weekly readings in philosophy, critical theory, artist statements and literature are assigned. The course will also include weekly screenings of films and videos, introducing students to the history of video art as well as to other contemporary art practices.
3 credits. One-semester course. May not be repeated. Prerequisite to Video II; pre- or co-requisite to Computer Image in Motion I. Raad(sabbatical 2009-10)/Ghani/Hayes

Note: Video I is required for all students who wish to pursue additional work in the medium.

FA 209 Video II Video II offers an advanced approach to conceiving, shooting and editing projects utilizing the moving image. The class will lead to a deeper understanding and control over the image, both in shooting and editing. Through screenings, readings and assignments, students will explore the dominant languages used in the moving image, as well as experimental works that actively avoid, subvert, confuse or mix these languages.

Students will complete several short assignments leading the conceptualization and completion of an ambitious project of their choice.
3 credits. May not be repeated. Prerequisite: Video I. Gerdes

Advanced Courses

FA 376.1A Animation I Students will learn an arsenal of physically-based film animation techniques from line animation, direct-on-film and rotoscoping to cut-out animation. Students will apply their skills and passions based in their own work in other art forms (drawing, painting, photography) and will make a few short animation projects over the semester. The course emphasizes the creation of meaningful and realized films through the integration of content and ideas with aesthetics and technique. All animation artwork will be created non-digitally, though students will learn to shoot and finish their projects both digitally and to film. Classes will incorporate basic technical instruction, viewings and discussions about a variety of classic and contemporary animation films, hand-on animation work and critiques.
3 credits. May not be repeated. Reeves

FA 376.1B Animation II
3 credits. Spring only. TBA

378 Computer Image in Motion I
(Not offered 2009–2010)

FA 379.1 Computer Image in Motion II
(Not offered 2009–2010)

FA 377.1 Advanced Film Independent projects workshop in Super 8 and 16mm film. As well as working in depth with film, students are encouraged to explore all possibilities of the moving image from expanded projection techniques to kinetic constructions.
3 credits. One-semester course. May be repeated. Prerequisites: Film I and one of the following: Film II or Animation II or Computer Image in Motion II. Hayes/Visiting Artist

FA 380.1 Advanced Video Advanced students use all the facilities of the video lab and continue to develop their personal styles through close individual instruction. Students complete two fully realized independent projects. Analysis and discussion of current video exhibitions supports group critiques.
3 credits. One-semester course. May be repeated. Prerequisite: Video II. Hayes/Visiting Artist

FA377.1/FA 380.1 Advanced Film/Advanced Video: Remake/Remodel

Topic for Fall 2009: Since the 1990's, many artists' tools such as flatbed editors, slide projectors, Super 8, and videotape have been replaced by various digital media. Currently, almost all Hollywood filmmakers edit their films digitally, and all film and television passes through multiple forms of digital mediation. Online fan films, organized and disorganized piracy, peer-to-peer networks, YouTube, and video-on-demand services have changed the way we understand authorship and distribution. This class will explore the artistic and theoretical effects these technological changes have on culture today. Specifically this course uses two cult American films - The Beaver Trilogy and Heavy Metal Parking Lot - as points of departure. Made in the last thirty years, both films prefigure many of the issues facing digital cinematic production today. Further screenings and lectures will focus on fan films, the history of piracy, artistic appropriation and lo-fi filming.

Although this class is themed, during the semester students will be asked to create works based on their own interests. Class time will be reserved for discussion of student works, readings and screenings related to the class' main themes.
3 credits. One-semester course. May be repeated. Prerequisite: Film II or Video II. Visiting Artist John Menick (fall 2009).

FA 381 Digital Sound Design Workshop An investigation of the structures of the sounds around us and how to listen to, analyze and manipulate them, with special emphasis on sound for picture. Discussion of how the gulf between the sounds of the environment and composed music was bridged in the 20th century. Training in the use of Protools, an all-inclusive system for recording, editing and mixing sound, which has become the system of choice in the modern studio.
3 credits. Offered fall and spring. Pre- or co-requisite: Film I or Video I or Motion Graphics. May not be repeated. Burckhardt

FA 382 The Question of the Document This class is open to students working in all forms. Students are expected to initiate and work on independent projects—individually or in groups and must be willing to show work in class while in the process of making it. The focus of the class will be on the question of the document in media art and related themes of

history, facticity, testimony, witnessing and evidence. Students are expected to attend all screenings and exhibitions, keep up with the assigned readings and write short papers.
3 credits. Pre- or co-requisite: One advanced studio course. TBA

FA 479 Independent Study in Film
1-3 credits. Requires approval of instructor and the dean of the School of Art

FA 489 Independent Study in Video
1-3 credits. Requires approval of instructor and the dean of the School of Art

Design

Prerequisite Courses

FA 210.2A Graphic Design I: Visual Sequencing The sequential aspects of composition are introduced in conjunction with studio projects. Contemporary examples as well as cave painting, pictographic writing systems and medieval painting cycles are presented. Basic image-making processes, such as graphic translation, photography and computer illustration are explored. Bookbinding and computer illustration are provided in relation to specific projects.
3 credits. Fall only. Essl/Joel

FA 210.2B Graphic Design II: Word and Image

The complex relationship between word and image is explored. The study of semiotics, emphasizing the philosophy of communication, provides a rich historical and intellectual base for experimental projects combining verbal and pictorial information.
3 credits. Spring only. Prerequisite: Graphic Design I. Essl/Joel

FA 213.2A Typography I

The history, formal elements and practice of typography are introduced. Lectures present the origins and evolution of writing systems, as well as the history, technological developments and social impact of type design. Studio projects explore a wide variety of typographic processes, such as hand and computer composition. Copyfitting, preparation of layouts and comps, mechanicals and printing methods are included.
3 credits. Fall only. Craig/Essl/Tochilovsky

Advanced Courses

FA 214B Typography II

Empirical explorations of typographic messages through placement, massing, weight, size and color are analyzed to develop an understanding of aesthetic composition of typographic form and meaning. Legibility, unpredictability and sequencing, as well as the use of grid structures, are investigated. The development of critical judgment about typography is emphasized.

3 credits. Spring only. Prerequisite: Typography I. TBA

FA 310.1A Information Design

The visual communication of complex information is introduced through presentations and studio projects that explore organizational structures such as charts, diagrams, maps, illustrations, photographs and typography. Computer instruction will be provided as it relates to specific projects.

3 credits. Fall only. Prerequisites: Graphic Design I and II; Typography I. Essl/Pressman

FA 310.1B Publication Design

The complex issues unique to editorial and publication design are explored through studio projects and presentations that emphasize the grid, effective sequencing and typographic form. Computer instruction will be provided as it relates to specific projects.

3 credits. Spring only. Prerequisites: Graphic Design I and II; Typography I. Corbitt

FA 312.1 Experimental Typography

This course will emphasize innovation, imagination and creativity in the realm of typography, manipulating it freely as a means of expression. Computer techniques as well as hand drawing, collages and pictures will be used to compose layouts, including posters, limited art books and animated typography for the web. Students will choose a theme and develop it with abstract type expression.

3 credits. Prerequisite: Typography I and II. Visiting Artist Ali Madad (fall 2009).

FA 313.1 Art of the Book

In this course the book will be explored as an interdisciplinary medium, placing emphasis on integrating and experimenting with form, content, structure and ideas. During the first half of the semester, students will make a number of books, examining sequence, series and text/image relationships, using various book structures. These "sketches" will prepare students for an

extended book project during the second half of the term.

3 credits. Fall only. Morton

FA 315 Advanced Design

Topic for Fall 2009: Designing by doing, this will be a class of many short and a few longer assignments, some executed directly and quickly within the class setting. Students will push boundaries, take risks, and explore different ways of doing things.

3 credits. Fall and spring semesters. Prerequisites: Graphic Design I and II; Typography I; two additional graphic design courses. Frank Stanton Chair in Graphic Design Jan Wilker (fall 2009).

FA 320.1 Visual Identities

Design issues unique to creating a coherent, yet diverse visual system will be analyzed and applied in a variety of contexts. Concepts and methods for integrating symbols, images, words and objects will be explored.

3 credits. Prerequisites: Graphic Design I and II; Typography I; one additional graphic design course. Essl

FA 322 Professional Practice

Graphic design projects for non-profit institutions, under the direction of faculty and in cooperation with the staff of the Center for Design and Typography, provide students with an opportunity for professional experience. Portfolio presentation and professional ethics will be addressed.

3 credits. One-semester course. Prerequisites: Graphic Design I and II; Typography I; two additional graphic design courses. Lang

FA 326 Interactive Design Concepts

An exploration of the nature of interactive design and how it informs and transforms experience. Information structures, navigational issues, design strategies and social implications of interactive experiences using traditional as well as electronic media will be examined.

3 credits. One-semester course. May not be repeated. Prerequisite: Graphic Design I or Typography I. Selvadurai

FA 327 Advanced Interactive Design Concepts: Computational Media

An advanced design course in interactive computational media. The course will explore advanced interactive design concepts utilizing software which that includes Processing and Macromedia Flash as well as XHTML coding. Students will complete two fully realized independent projects. Analysis of relevant work and readings support group critiques.

3 credits. One-semester course.

Prerequisite: Interactive Design Concepts. TBA

FA 328 Motion Graphics

Students will explore the conceptual and technical challenges of design for the television screen. All aspects of industry video/ broadcast production are introduced and integrated into a design core focused on strong communication. Projects include identity design, combining kinetic typography, animation, sound and video. The course includes workshops in After Effects, Final Cut Pro and Protocols.

3 credits. One-semester course. Prerequisites: Graphic Design I and II; Typography I; two additional graphic design courses. Vondracek

FA 429 Independent Study in Graphic Design

1-3 credits. Requires approval of instructor and the dean of the School of Art.

Techniques

TE 324.1 Design Production: From Digital To Press

Study of the planning, materials and techniques involved in producing printed material from digital files, transparencies and photographic prints. Familiarizes students with offset lithography's terminology, options, limitations, costs and trade customs. This course covers line, halftone and color separation theory; scanner functions; Photoshop enhancement of photographs for reproduction; manual film assembly; electronic imposition; proofing, press and paper options; binding techniques; finishing methods; and printing quality evaluation and control throughout the process.

2 credits. May not be repeated. Free elective credit. N. Sanders

Intra-Disciplinary Seminar

SE 403 Intra-Disciplinary Seminar
The course is designed to provide a stimulating and rigorous forum among students, faculty and visiting speakers. Discussions will center on presentations by artists, filmmakers, curators, writers and designers involved in visual culture. Issues being addressed in studio practice will influence the topics and shape of the class. By alternating between discussions of students' working practice and presentations from professionals, the instructors hope to synthesize a productive environment for artistic ideas. Students will be expected to show some form of

creative relationship with class discussions in the form of written, visual or presentational effort.

2 credits. Free elective credit. Ashford/Raad (sabbatical fall 2009)/Geyer

Junior Seminar

SE 400 Junior Seminar

This course is designed to present an open critical forum among students, faculty and visiting speakers on ideas of what it means to be an artist today. The Junior Seminar introduces students to a collective conversation that will present opportunities to explore the personal, social, formal, technical and economic dimensions of artistic research and production. Accordingly, students will be asked to demonstrate their participation in planning the discursive form of each presentation, to devise research methods and to participate in the public platforms and analysis. Open only to students with junior standing.

2 credits. Free elective credit. Pass/Fail. TBA

Legal Issues for Artists

TE 310 Legal Issues for Artists

This class will enable students to protect their most valuable resource—their creative work—by providing a basic understanding of intellectual property rights. Practical concerns such as contracts, generally accepted terms and conditions, business formations (i.e. incorporation, partnerships, etc.) and new developments (i.e. digital altering of images, internet usage, concepts like the Digital Millennium Copyright Act and the "Creative Commons" will be addressed. Copyright, trademarks and patents will also be discussed in relation to creative work. Weekly presentations will include new rulings involving issues of ownership, fair use, parody and sampling as well as other concerns for artists.

1 credit; 5 weeks. Free elective credit. Pass/Fail. A. Sanders

Mathematics in Art

Ma 151.1 Mathematics in Art

This course deals with the period beginning with Pythagoras in ancient Greece and goes up to the present day. Topics included: Godel's work on the limits of mathematics, Euclidean and non-Euclidean geometries, infinity, paradoxes and soap film experiments. Also discussed are black holes, the Big Bang theory, relativity, quantum theory and atomic particles. The course is

open to all Cooper Union students but is primarily oriented toward making the above-mentioned concepts comprehensible to those with very little mathematics in their background. The relatedness of seemingly disparate fields (science, art, mathematics, music) is a central theme of the course. *3 general studies credits. Spring only. Bailyn*

Painting

Prerequisite Course

FA 130 Painting

A studio experience with the physical, compositional and conceptual components of pictorial invention and image-making. Readings, assignments and critiques will enhance the development and articulation of an inventive individual approach to the painting discipline in preparation for advanced level work.

3 credits per semester. One-year course. Prerequisite to all Advanced Painting courses. Bordo/Conway/True

Advanced Courses

FA 331 Advanced Painting For students who wish to have their work critiqued primarily on an individual basis. High motivation and dedication are of primary concern. There will be occasional group critiques. *3 credits. One-semester course. True*

FA 332 This class is open to a wide range of approaches to painting. Students will be encouraged to identify and develop their own sources for ideas and inspiration—from the popular to the esoteric. Attention will be paid to both the quality and vitality of ideas as well as to the form those ideas take. Students will be encouraged to have familiarity with museum and gallery exhibitions. The class will have individual and group critiques and some individual and group reading assignments. *3 credits. One-semester course. Krashes*

FA 335 A seminar course for students who have the ability to work independently in their studios with a primary focus in drawing or painting. Students will be expected to develop their ideas and work independently, but the class will meet together every week or two for discussion of each other's work, as well as various museum and gallery shows, readings or slide presentations of current work. The course will emphasize experimentation and expansion of one's visual language

and process, and the ability to articulate these ideas in discussion. *3 credits. One-semester course. Bordo*

FA 337 Advanced Painting

Students will explore the inner reservoirs of the imagination and investigate, as well, specific external resources for imagery. The course will seek to develop a range of expressive vocabulary including representation and abstraction. Group and individual critiques will be augmented through discussions of museum and gallery exhibitions and slide presentations. Emphasis will be upon developing a personal visual direction.

3 credits. One-semester course. L.A. Miller

FA 338 Advanced Painting/Water Media

Students will focus on water media—acrylic, transparent watercolor and gouache—through work on canvas and paper. The class will explore the specific technical challenges and characteristics inherent in these media including the range from transparency to opacity. Individual approaches will be encouraged in developing the aesthetics of the evolving image from spontaneity to studied expression, from figuration to abstraction. Exposure to selected examples of historical and contemporary imagery will be accomplished through slides, exhibitions and gallery or studio visits. *3 credits. One-semester course. L.A. Miller*

FA 339 Advanced Painting/Guest Artist Series

This course is for students who have made a strong commitment to painting. Students are expected to work independently in their studios on a series of paintings that will develop during the semester in response to a dialogue with the different guest artists.

3 credits. One-semester course. Bordo

Advanced Painting/Visiting Artists

Course description varies according to the instructor. For fall 2009:

FA 334 Advanced Painting (cross-listed with FA 343.1, Advanced Drawing)

Offered to students working independently in any medium. Must be self-motivated. There will be group and individual critiques.

3 credits. One-semester course. Visiting Artist James Siena (fall 2009)

FA 335 Advanced Painting (cross-listed with FA 391, Sculpture)

The course will cross over among painting, sculpture and architecture. Students will question the ways in which space is made and perceived. There will be a wide range of approaches (formal, social and political), while using the framework of tradition to question the construction of space.

3 credits. One-semester course. Visiting Artist Lisa Sigal (fall 2009)

FA 336 Advanced Painting

This course will explore painting in all its contemporary manifestations: abstraction, representation, figuration, appropriation, etc. Self-motivated independent study is expected. Students will be encouraged to experiment with traditional painting media as well as with drawing, photography and the computer. The class will focus on individual studio assignments, and museum and gallery visits will contribute to the structure. Content will be examined in terms of ideas, form and methodology, and context as every stage of the creative process will be considered.

3 credits. One-semester course. Visiting Artist Wayne Gonzales (fall 2009)

For spring 2010 and later semesters, please see class schedule and registration materials for course descriptions specific to Visiting Artists teaching that semester.

FA 439 Independent Study in Painting *1-3 credits. Requires approval of instructor and the dean of the School of Art.*

Techniques

TE 417.1A Painting Techniques and Materials

Differences in scope, techniques, appearance and behavior between oil-base and water-base media, as well as emulsion techniques, acrylics and other plastifiers, are covered. Their qualities and limitations are examined through experimentation and comparison. The work of the old masters of the 13th-15th centuries is understood through the study of water-base and emulsion techniques on hard surfaces and gesso grounds. The majority of class time is used to study egg tempera and its derivatives. Elements of ancient paintings are copied to understand certain effects. Students produce work using the techniques learned.

Original paintings are produced by the students in distemper, egg tempera, emulsion, acrylics or encaustic. Students produce an authentic fresco.

Execution of a 1:1 detail preparing the arriccio, sinopia and veil of a fresco is required.

2 credits. One-semester course. May not be repeated. Pre- or co-requisite: Junior standing, or FA 130B. Free elective credit. Vanni

TE 417.1B Painting Techniques and Materials

The semester begins with the same general review of materials and safety as the fall semester. Students are introduced to the specific characteristics of the materials as well as the historical developments of various techniques. To be included: pigments, stretchers, canvases, panels, brushes, oil binders, varnishes, retarders and dryers. The class thoroughly investigates the techniques of oil painting from the Flemish monochrome-color glaze to the stratifications of thick and thin impasto with Italian glazing. Experiments feature opaque/transparent painting, hiding and stressing the brush stroke and more. Students copy and interpret a detail of an old painting to better grasp technique. Students are encouraged to apply these techniques to their work through experimentation. Investigation of new or unusual materials is encouraged.

2 credits. One-semester course. May not be repeated. Pre- or co-requisite: Junior standing or FA 130B. Free elective credit. Vanni

TE 418.1 Water Media Techniques

This course provides a foundation for techniques, processes and materials involved in painting with watercolor, gouache and acrylic. The class explores the specific technical challenges and characteristics inherent in these media, including the range from transparency to opacity. Acquaintance with a wide range of brushes, tools, materials, pigments and papers will be offered. A range of approaches will be introduced from traditional to experimental so that the student can acquire mastery of the medium through a variety of experiences. The relevance of technique and imagery to each student's personal work and interests will be developed through discussions and resource examples.

2 credits. One-semester course. May not be repeated. Free elective credit. L.A. Miller

Photography

Prerequisite Courses

FA 106.1 Photography I

A one-semester course which explores the visual language of photography through both black-and-white and color mediums. Students will learn camera controls through the use of 4x5 and digital cameras. 35mm cameras are optional. Darkroom printing augments class assignments and student projects.* 3 credits. One-semester only. May not be repeated. *Osinski/Visiting Artist Miranda Lichtenstein.*

FA 206 Photography II The emphasis of this class is on the development of ideas within photo-based work. Student work will be discussed in relation to contemporary art practice as well as significant ideas in the history of photography and in the context of larger cultural issues. Readings and discussions will provide students with a critical backdrop. Fundamentals of digital work: calibration of monitors, scanning and color correction will be explored along with medium format cameras and lighting options.* 3 credits. One-semester only. Pre- or co-requisite: *Photography I* or by permission of instructor. Prerequisite or co-requisite to *Advanced Photography*. May not be repeated. *Osinski/Vahrenwald*

**It is recommended that students have digital cameras. Instructors will make camera recommendations on the first day of class for those students who may wish to purchase one.*

Advanced Courses

FA 361A Advanced Photography: Large Scale This course will concentrate on subject matter, methodology, size, scale, genre, style, theory and history of photography. The orientation will be the development of projects, from the inception of ideas to professional presentation and execution of artistic work with an emphasis on making large negatives and/or producing large prints. Students are encouraged to take advantage of the full range of image-making resources available to aid in the creation of works that challenge perceptions. Various options of cameras and large scale printing will be explored. 3 credits. Spring only. TBA

FA 363 Advanced Photography/Digital Photography

This studio course focuses on issues related to digital imaging. Students will explore ideas related to digital work as well as techniques such as color management, various corrective measures, and options in digital cameras and printers. Issues central to photography in the digital era will be explored. Students will pursue individual projects that will be discussed in group and individual critiques. 3 credits. *Osinski/N. Sanders*

FA 364 Advanced Photography

This course will concentrate on critiques of the students' work. Personal vision will be the subject and interpretation of the print will be the focus. Individual projects will be set for each student. Students will also be required to see exhibitions as well as research books and other forms of image reproduction. 3 credits. TBA

FA 365A Advanced Photography: Photographic Craft and Technology

Projects provide students with the technical resources to address the broad spectrum of photographic practice. Students learn how to produce photographic prints and transparencies that meet publication standards. Seminars cover an evaluation and application of photographic tools, including digital cameras and scanners. 3 credits. Fall only. *N. Sanders*

FA 365B Advanced Photography: Studio Photography

The course will provide a practical application of FA 365A in a studio setting, including the use of—incandescent and electronic flash light for direct, bounce and diffused illumination as well as various camera formats, films, filters and lenses. Instruction and use of digital cameras and scanners will be included. Weekly assignments and critiques are part of this course. 3 credits. Spring only. Prerequisite: *FA365A*. *N. Sanders*

FA 366A Advanced Photography: Alternate Processes

A course for students who wish to explore the possibilities of hand-applied photographic emulsions and alternative methods of printing. Processes will include liquid light, cyanotype, palladium, color copier and digital printing options. Student work will be discussed in relation to contemporary art issues. 3 credits. TBA

FA 366 Advanced Photography

Students will produce work using photographic material(s), camera or any photographic device of their choice. Work will be discussed in group critiques as well as individual conferences with the instructor. Photographic issues and representation will be the subject of reading and class discussions. 3 credits. *Osinski/Vahrenwald.*

FA 368A Advanced Photography: Guest Artist Series

This course is intended to help students clarify and further the growth of their own work through group and individual critiques, classroom presentations and discussions with contemporary guest artists and the instructor. 3 credits. *Osinski*

FA 369A Advanced Photography

This course is an advanced studio course. Emphasis will be on students' ongoing studio/history/theory works. The course will consist of a number of faculty-led presentations about particular artists, writers, filmmakers, concepts and exhibitions. Work will be discussed in group critiques as well as individual conferences with the instructor. 3 credits. Fall only. *Raad (Sabbatical 2009–10)*

FA 369B Advanced Photography

This course will explore multiple-image structures in photography and will include issues and examples of sequencing, time, fictional and non-fictional narratives and meta-narratives and image and text relationships. Studio projects will be combined with lectures, presentations, field trips, readings and class discussions to provide the critical framework leading to the development and production of projects that address traditional as well as experimental methods of multiple-image structures. Projects can include but are not limited to: color/black and white, film/digital/film stills. 3 credits. Spring only. *Morton*

Advanced Photography/Visiting Artists

Course description varies according to the instructor. For fall 2009:

FA 368 Advanced Photography

3 credits. *Henry Wolf Chair Lorna Simpson (fall 2009)*

For spring 2010 and later semesters, please see class schedule and registration materials for course descriptions specific to Visiting Artists teaching that semester.

FA 469 Independent Study in Photography

1-3 credits. *Requires approval of instructor and the dean of the School of Art.*

Printmaking

Prerequisite Courses

FA 250 Silkscreen I

This course explores screen printing as a means of communication with emphasis on the execution of these images. Students visit museums to learn to appreciate posters from various historical periods. The actual screen printing will be taught with the use of images, type and color. The goal of the course is to combine the components of art, printing and communication. 3 credits. One-semester course. May not be repeated. *Clayton*

FA 251 Lithography I

An introduction to traditional and contemporary image-making on lithographic stones and commercial aluminum plates, with emphasis on the technical aspect of the medium. The various areas to be examined include stone graining, crayon and tusche drawing, processing, proofing and edition printing procedures, etc. 3 credits. One-semester course. May not be repeated. *Nobles*

FA 252 Etching I

An introduction to etching images on metal plates, through the use of hardground, aquatint softground. The emphasis is on the technical understanding of the medium. Other image-making processes to be covered are drypoint and engraving. 3 credits. One-semester course. May not be repeated. *Osterburg*

Advanced Courses

FA 350 Silkscreen Workshop

An advanced workshop in which the students are free to explore screen printing, graphic arts and photography. There will be formal teaching of advanced photographic processes such as halftone and color separation. 3 credits. One-semester course. Prerequisite: *Silkscreen I*. *Clayton*

FA 351 Lithography Workshop

An advanced workshop concentrating on individual projects and further investigations into the reproducible image and its implications. Discussion and demonstration will be offered both in the direction of a more technical and chemical understanding of lithography

and working in conjunction with other traditional print techniques.

*3 credits. One-semester course.
Prerequisite: Lithography I. Nobles*

FA 352 Etching Workshop

This course will involve individual directions in etching as well as the development of projects combining print technique and aesthetic goals. The understanding and use of the contemporary professional print shop will be discussed.

*3 credits. One-semester course.
Prerequisite: Etching I. Osterburg*

354 Experimental Printmaking

The course will supplement the traditional printmaking techniques of etching, lithography and silk screen with an introduction to linoleum woodcut techniques and monoprint/monotype combination of methods appropriate to developing an aesthetic understanding of the vocabulary of the print. Color, multiple printing, work in series or book formats will be discussed in developing student projects.

*3 credits. One-semester course.
Prerequisites: 2 of the following 4 courses—Silkscreen I, Lithography I, Etching I, or Papermaking Techniques. Gleeson/Nobles*

FA 355 Relief

Students will be instructed in various relief printing techniques, including traditional Japanese water-based woodblock and Western techniques with oil-based inks on wood and linoleum. Use of the hydraulic press will allow large format works to be produced. Hand-printing techniques will be taught as well. Small edition printing in multiple colors will be emphasized.

*3 credits. One-semester course.
Shibata*

FA 356 Etching Workshop: Photogravure

This class will primarily teach approaches to the 19th century process of photogravure. Photogravure is a truly continuous tone photographic intaglio process. Tonalities are created by an ink layer, gradually varying in depth, with a very fine aquatint to hold the ink. Photogravure will be the starting point for the projects rather than the final step. Students should be open to continuing to work on plates with traditional intaglio techniques.

*3 credits. One-semester course.
Prerequisite: Etching I or Photo I. Osterburg*

FA 459 Independent Study in Printmaking

1-3 credits. Requires approval of instructor and the dean of the School of Art.

Techniques

TE 353.1 Papermaking Techniques

This course includes the making of traditional Western paper from rags to a finished sheet and the making of traditional Oriental paper from tree bark to a finished sheet. Students learn to use a pulp beater, dyes, sizings and a small vacuum table for molding the pulp. Simple binding and box-building techniques as well as marbling are demonstrated.

*2 credits. One-semester course.
Free elective credit. DiEdwardo*

Science

RS 201 Science Topics vary.

3 general studies credits. Required science course. To be taken during the sophomore, junior or senior year. Nadin/Neves/Uglesich

RS 201a Physics/Astronomy

A non-mathematical, conceptual and historical introduction to science with emphasis on the unifying principles of physics. Recurrent themes are connections between science and art, differences between science and technology and the evolution of natural philosophy into modern physics. Topics selected from: Newtonian mechanics, astronomy, electromagnetic fields and optics, the structure of space and time and the atomic nature of matter.

RS 201b Botany

An introductory, scientific study of the plant kingdom and the relationships between plants and people. Topics to be covered include aspects of plant physiology, genetics, morphology, anatomy, ecology, diversity and evolution of plants. The cultural uses of plants for medicine, clothing, food and ritual will also be presented.

RS 201c Science of the Mind

Over the last 10 years there has been a revolution in our understanding of the workings of the mind. This course offers a comprehensive yet accessible survey of these new developments in the understanding of the workings of the brain. It will explore how these discoveries are altering the most basic concepts we have about ourselves and how we perceive the world. The course begins by familiarizing the students with an outline of the anatomy of the brain and its neurological function and

then progresses to consider new theoretical models of consciousness. The course also explores the laws of the visual brain and how those laws govern our perception of the visual world.

RS 201d Optics for Artists

This course covers the fundamentals of optics using a non-mathematical approach, relying on provocative demonstrations and hands-on experimentation with an emphasis on explaining phenomena observed in everyday life. Topics will include the nature of light, optical elements (lenses, mirrors, prisms), cameras, the theory of "color," visual perception and optical illusions, light detection (eye, film, digital cameras) and more advanced concepts of particular interest to the students (holography, lasers, liquid crystals, etc.).

RS 201e Pattern Formation

Patterns, both in space and time, are ubiquitous in the natural world. In this course, we will distinguish between patterns that arise from explicit design and construction and those that arise spontaneously from the actions and behaviors of simple units. Concentrating on these self-organizing systems, we will explore topics such as: the characteristic stripes and spots of animals, the shifting landscapes of desert sand dunes, the hexagonal forms of honeycombs, the symmetry of snowflakes, the synchronization of flashing in firefly swarms, the transformation from embryos to organisms, convection patterns in fluids, the development of social networks and the growth of cities. Our focus will be on understanding the mechanisms that can explain how such systems come to be. The course will be conducted as a combination of lectures, seminars, laboratory exercises, and independent projects.

RS 201f Current Issues in Biology

This introductory course will provide an understanding of the science behind many of the current issues facing society. The goal is to provide biological literacy in order to evaluate scientific arguments presented in topics related to human disease and current events affecting human health such as stem cell research, genetically-modified food and genetic testing.

Sound Art

FA 281 Project in Sound Art

This class will introduce strategies for understanding and participating in the aural world. The course is divided into specific weekly topics, including

acoustic ecology, circuit-bending, radio transmission, synaesthesia and others. Screenings, readings and discussion are supported by hands-on workshops in capturing, manipulating and reproducing sound in unconventional ways. Grading is based on three student projects and participation in class discussions.

3 credits. One-semester course. Poff

Sculpture

FA 391 Sculpture

This course helps students develop projects related to their own vision and ideas. Class discussions address the full range of conceptual and material processes that generate production. Research and development will be given equal weight to finished work. Intention, form, materiality and context will be analyzed against larger questions of culture in relation to artistic practice. Student work will be reviewed by the entire class and by the instructor on an individual basis. Lectures, readings and field trips will complement studio critiques.

3 credits. One-semester course. Adams

FA 394 Sculpture

This course takes a concrete approach to the development of critical discourse about works of art. It exercises the student's ability to analyze the activity of making sculpture in particular and advances the student's understanding of how to proceed in the studio. Problems of structure, materials, meaning, intention and context are the subject of class discussion.

3 credits. One-semester course. Logis

FA 395 Sculpture: Performance

Performance or the live event has been a continuous element of art practice throughout most of the 20th century. The changing technologies of sound and digital recording devices and their increasing availability have enhanced the possibilities of documentation and allowed artists to consider the mediation and documentation of a live event as an integral part of the work itself. In this course, students will examine the interaction between performance and its documentation through practical, historical and theoretical interrogation. The class proposes to address documentation, not as an inadequate representation nor as a nostalgic marker but as something that operates within a distinct system that can become a vital site of art production. This class takes an interdisciplinary approach to making performance work. The medium of performance and its utilization of

photography, video and sound will be explored. Students will read and discuss texts, looking at the work of other artists and making their own work.

3 credits. One semester course. Hayes

FA 396 Sculpture: Seminar in Public Art This course focuses on the production of artworks that question and/or re-invent the boundaries between public and private spheres. Student projects will be generated and analyzed in relation to current transformations in culture and technology as they affect the meaning of "publicness." Complementing studio production will be lectures, readings and discussions that engage social, political and urban issues relevant to the topic. Traditional approaches to public art, such as enhancement and commemoration will be challenged by more temporal and critical strategies. Historical examples will be examined, including the Flaneur, Russian Constructivism, the Situationists, Fluxus and Conceptualism, as well as the most recent example of public interventions.

3 credits. Adams

FA 397 Sculpture This course takes a concrete approach to the development of critical discourse about works of art. It exercises the student's ability to analyze the activity of making sculpture in particular and advances the student's understanding of how to proceed in the studio. Problems of structure, materials, meaning, intention and context are the subject of class discussion.

3 credits. One-semester. Ashford/Lins

FA398 Sculpture This course helps students explore and develop their personal process of making art, with an emphasis on sculpture. Formal and material choices will be discussed in relation to intention, meaning, context and contemporary culture. Research and development are given equal weight to finished work. Students will discuss their process individually with the instructor and present work for review to the entire class. In-class slide presentations, readings and field trips will complement class discussions.

3 credits. One-semester. Magid

Sculpture/Visiting Artists

Course description varies according to the instructor.

For fall 2009:

FA 391 Sculpture (cross-listed with FA 335 Advanced Painting)

The course will cross over among painting, sculpture and architecture. Students will question the ways in which space is made and perceived. There will be a wide range of approaches (formal, social and political), while using the framework of tradition to question the construction of space.

3 credits. One-semester course. Visiting Artist Lisa Sigal (fall 2009)

FA 393 This course will explore a wide range of approaches to art making with an emphasis on sculptural practices. Workshops, readings, slide presentations and screenings will complement individual and group critiques. Students will determine goals and will be judged on their completion.

3 credits. Visiting Artist Laura Parnes (fall 2009)

FA 393 Sculpture This class will consider each student's work as part of the dialogue surrounding contemporary art practice. We will approach artistic production with a commitment to understanding the historical context of each particular material and method, and the freedom to employ any material or method. We will also take care to locate the practice of making art within a larger cultural context.

A primary part of the learning experience in the classroom will be both individual and group critiques, however classroom conversation will also respond to readings, lectures and presentations. Students are expected not only to develop a body of work for class, but also to participate in all class conversations and critiques.

3 credits. One-semester course. Visiting Artist Colleen Asper (fall 2009)

Spring 2010 and later semesters, please see class schedule and registration materials for course descriptions specific to Visiting Artists teaching that semester.

FA 499 Independent Study in Sculpture

1-3 credits. Requires approval of instructor and the dean of the School of Art.

Techniques

TE 390.1A Casting Techniques

Students will be involved in learning fundamental casting techniques: making waste mold, piece molds and flexible rubber molds. A variety of materials to be cast into these forms will be explored: plaster, ultracal, concrete, plastic and wax. Elementary gating, and investing of small pieces, to burnout for translation from wax to bronze will be a hands-on experience. The centrifugal method of casting will be used primarily, limiting the size of the project. Chasing, soldering and mechanical joining, and patination of the finished pieces will complete the course requirements.

2 credits. One semester course. May not be repeated. Free elective credit. Alwin/Wilhelm

FACULTY

Administration

Saskia Bos, *Dean*

Steven Lam, *Associate Dean*

Judith Cantor Bernstein
Coordinator of Academic Operations

David William
*Coordinator of Student Exhibitions
and Special Projects*

Tia Shin, *Budgets Coordinator*

Margaret Wray, *Assistant to the Dean*

Elizabeth Marshall
Administrative Assistant

Amy Westpfahl,
Coordinator, School of Art Admissions

Office of Academic Advisement and Off-Campus Programs

Day Gleeson
Academic Adviser

Margaret Morton
Director, Off-Campus Programs

Joyce Bishop, *Administrative
Associate*

Full-Time Faculty

Professors

Dennis Adams B.F.A., Drake University;
M.F.A., Tyler School of Art

Lee Anne Miller B.S., Utah State
University;
M.F.A., Cranbrook Academy of Art;
Pratt Graphics Center;
The Slade School of Art

Margaret Morton
B.F.A., Kent State University;
M.F.A., Yale University

Christine Osinski
B.F.A., School of the Art Institute
of Chicago;
M.F.A., Yale University

Associate Professors

Robert Bordo
McGill University
New York Studio School

Day Gleeson
B.F.A., Rhode Island School of Design

Walid Raad (sabbatical 2009–2010)
Rochester Institute of Technology;
M.A., Ph.D., University of Rochester

Assistant Professors

Mike Essl
B.F.A., The Cooper Union;
M.F.A., Cranbrook Academy of Art

Sharon Hayes B.A., Bowdoin College;
M.F.A., University of California,
Los Angeles;
Whitney Museum Independent
Study Program

Proportional-Time Faculty

Associate Professors

Douglas Ashford
B.F.A., The Cooper Union

Niki Logis
B.A., Brooklyn College, CUNY

David True
B.F.A., M.F.A., Ohio University

Adjunct Faculty

Professors

Jack Barth
B.A., California State University
M.F.A. University of California at Irvine

Larry Brown
B.A., Washington State University;
M.F.A., University of Arizona

Jacob Burckhardt
B.A., University of Pennsylvania

Lorenzo Clayton
B.F.A., The Cooper Union

James Craig
B.F.A., The Cooper Union;
M.F.A., Yale University

Cara DiEdwardo
B.F.A., The Cooper Union

Stephen Ellis
B.F.A., Cornell University;
New York Studio School

Glenn Goldberg
New York Studio School;
M.F.A., Queens College, CUNY

Mindy Lang
B.F.A., The Cooper Union

Lisa Lawley
B.F.A., The Cooper Union;
M.F.A., Yale University

Pamela Lins
M.F.A., Hunter College, CUNY

Ross G. McLaren
A.O.C.A., Ontario College of Art

Peter Nadin
B.A., University of Newcastle- upon-
Tyne, United Kingdom

Lothar Osterburg
Diploma in Fine Arts, Staatliche
Hochschule fur Bildende Kunst,
Braunschweig, Germany

R. Scott Richter
B.F.A., Parsons School of Design

Norman Sanders
Champlain College;
B.S., New York University

Yasuyuki Shibata
B.F.A., Kyoto Seika University, Japan

Gian Berto Vanni
University of Rome

Will Villalongo
B.F.A., The Cooper Union;
M.F.A., Tyler School of Art

Instructors

Betsy Alwin
B.A., B.F.A., Mankato State University;
M.F.A., Illinois State University

Robert Boyd
Tyler School of Art

Anna Conway
B.F.A., The Cooper Union;
M.F.A., Columbia University

Warren Corbitt
B.A., Vassar College;
M.F.A., Cranbrook Academy of Art

Martha Friedman
B.F.A., School of the Art Institute
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M.F.A., Yale University

Benj Gerdes
B.A., Brown University;
M.F.A., Hunter College of CUNY;
Whitney Museum Independent
Study Program

Andrea Geyer
Diploma in Fine Arts, Academy of Fine
Arts, Braunschweig, Germany;
Whitney Museum Independent
Study Program

Mariam Ghani
B.A., New York University;
M.F.A., School of Visual Arts

Beverly Joel
B.F.A., The Cooper Union

Peter Krashes
B.A., Middlebury College;
B.F.A., New College, University
of Oxford

John Lindell
B.A., University of California, Berkeley

Marlene McCarty
University of Cincinnati;
Schule für Gestaltung (Basel)

Jeremy Mores McWreath
B.F.A., The Cooper Union;
M.F.A., University of Southern

California

Jill Magid
B.F.A., Cornell University;
M.A., Massachusetts Institute
of Technology

Yuri Masnyj
B.F.A., The Cooper Union

Katie Merz
B.F.A., The Cooper Union

Susana Neves
B.A., Rutgers University;
Ph.D., Mt Sinai School of Medicine
of New York University

Scott Nobles
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M.F.A., Hunter College (CUNY)

Jenny Perlin
B.A., Brown University;
M.F.A., School of the Art Institute
of Chicago;
Whitney Museum Independent
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Litia Perta
B.A., Vassar College;
M.A., Ph.D., University of California,
Berkeley

Zach Poff
B.A., Unniveristy of Maryland
Baltimore County

Andrew Pressman
B.F.A., The Cooper Union

Jennifer Todd Reeves
B.A., Bard College;
M.F.A., University of California,
San Diego

Joel Schlemowitz
B.S., Itahca College

Naveen Selvadurai
B.S., M.S., Worcester Polytechnic
Institute

Erin Sparling
School of the Art Institute of Chicago

Alex Tochilovsky
B.F.A., The Cooper Union;
M.F.A., Cranbrook Academy of Art

Michael Vahrenwald
B.F.A., The Cooper Union;
M.F.A., Yale University

John Vondracek
B.F.A., The Cooper Union

Andrew Wilhelm
B.F.A., Kutztown University;
M.F.A., Virginia Commonwealth
University

Visiting Artists

Colleen Asper (fall 2009)
B.F.A., Maryland Institute College
of Art;
M.F.A., Yale University

Matthew Buckingham (spring 2010)
B.A., University of Iowa;
M.F.A., Bard College

Wayne Gonzales (fall 2009)
B.A., University of New Orleans

Miranda Lichtenstein (fall 2009)
B.F.A., Sarah Lawrence College;
M.F.A., California Institute of the Arts

Ali Madad (fall 2009)
B.F.A., Rochester Institute of
Technology;
M.F.A., Cranbrook Academy of Art

John Menick (fall 2009)
B.F.A., The Cooper Union

Adia Millett (fall 2009)
B.F.A., University of California,
Berkeley;
M.F.A., California Institute of the Arts

Laura Parnes (fall 2009)
B.F.A., Tyler School of Art

James Siena (fall 2009)
B.F.A., Cornell University

Lisa Sigal (fall 2009)
B.F.A. Tyler School of Art;
M. F.A. Yale University

Lorna Simpson, *Henry Wolf Chair
in Photography* (fall 2009)
B.F.A., School of Visual Arts;
M.F.A., University of California,
San Diego

Jan Wilker, *Frank Stanton Chair in
Graphic Design* (fall, 2009)
MFA, Staatliche Akademie Bildenden
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THE ALBERT NERKEN SCHOOL OF ENGINEERING

MISSION STATEMENT

The Albert Nerken School of Engineering will create an educational culture with a commitment to excellence. We will bring together the best and brightest engineering students; we will nurture and develop their talents; we will encourage them to work and learn at their highest levels; and we will instill in them the desire and the ability to use their engineering background to fulfill their potential as knowledgeable, creative and responsible leaders in society.

OVERVIEW

With an average enrollment of about 550 undergraduate students, engineering is the largest of The Cooper Union's schools. The school maintains small class sizes in courses and laboratories in order to provide for personal attention. It offers bachelor of engineering (B.E.) degree programs in chemical, civil, mechanical and electrical engineering, accredited by the EAC commission of ABET¹.

In addition, the school offers an interdisciplinary engineering program (B.S.E.). This program empowers students to create their own curricula (within carefully set parameters) in those areas of engineering that cross traditional boundaries—for example, bioengineering, energy engineering, infrastructure engineering, environmental engineering, electro-mechanical engineering, robotics, etc.

The (B.S.E.) program provides an excellent preparation for graduate work in law, medicine, business, etc.

The integrated master's program offers the opportunity to earn both a bachelor's and a master's degree in an engineering discipline at The Cooper Union within four, five or six years. A thesis is required.

Another master's program is being planned; it will be for practicing professionals on a tuition basis. Also, clusters of courses may be offered toward a tuition-based graduate certificate in engineering. This is in keeping with the commitment to provide life-long learning. Both the tuition master's and certificate programs are in development.

Degree programs are designed to prepare students to enter the engineering profession immediately after graduation or to pursue graduate study. An extraordinary number of Cooper Union engineering graduates have gone on to earn Ph.D. degrees at the nation's most prestigious graduate schools. Other graduates have gone on to study in fields such as medicine, law or business. Many of our graduates have risen to leadership positions in industry, education and government.

The early curricula in engineering are based on intensive work in the sciences, mathematics, computer science and engineering sciences, which serve as preparation for in-depth study within the various engineering fields. Building on a strong base of mathematics and sciences, and emphasizing the integration of knowledge, these curricula are concerned with an understanding of nature, the limitations of our present knowledge and the potential for advancing that knowledge.

Strong mathematical and computer skills are developed in all engineering students. This includes the ability mathematically to model and then to solve problems algorithmically, in a suitable language, and to use existing commercial packages for analysis and design. Students are expected to be fluent in at least two computer languages, and many specialized packages are used both in elective and in required courses. The faculty expect assignments to be carried out using the computer in appropriate ways, both as a design tool using packages and also as a platform for original software.

Defining characteristics of the School of Engineering's programs are the emphasis on project-based learning and opportunities for undergraduate research. Students and their peers regularly join the faculty in solving real-life problems that exist in contemporary society. Multi-disciplinary teams work together, frequently cooperating with outside professionals, who act as mentors. Superior analytical abilities and thorough grounding in engineering fundamentals and design enable students to participate with faculty members on these research projects. Their results may be published, presented at conferences or even patented.

A strong background in engineering design threads throughout the curriculum, starting with the first year. This design experience takes into consideration factors such as environmental issues, sustainability, economics, teamwork, societal impact, safety and political climate—showing students that a “design” is much more than a purely technological solution.

Some design problems are offered in collaboration with foreign universities to increase awareness of the global nature of the engineering profession (e.g., The Cooper Union's “Globotech” program). Others may involve collaboration with industry or hospitals.

Ample electives are offered so that interested students can add a background in business and entrepreneurship, additional mathematics and science or a “concentration” in an additional engineering area.

Like The Cooper Union's other schools, the Albert Nerken School of Engineering is intimately involved with the New York metropolitan area. Sometimes, the city and its infrastructure are used as a laboratory. The school also draws on the region's abundant talent and resources, including an outstanding array of engineers and scientists employed at major corporations, governmental agencies and consulting firms in the New York region. The school calls on physicians, lawyers and other specialists to collaborate in research and mentoring and to give unique insights into contemporary problems and social issues confronting modern engineers.

Students benefit from close contact with the faculty, who are devoted teachers, and the school's loyal alumni, who delight in sharing their experiences and insights with students, and in

¹ ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012

serving as role models. Our students are encouraged to participate in The Cooper Union's rich seminar and cultural programs as well as to attend talks by guest speakers. They join various appropriate professional societies, many of which have chapters at The Cooper Union. Students are inspired to qualify for membership in national engineering honor societies. They also participate in student government and sports, and take advantage of the vast cultural environment offered by New York City and the neighborhood.

In preparation for their responsibilities as engineers who are affected by the dynamics of technological advance and social change, students are exposed to and challenged in the fields of social science, humanities and other general studies.

Graduates of The Cooper Union are recruited regularly by major national and international corporations and graduate schools nationwide. Alumni are found in the top management and research leadership of many American corporations; hold key positions in federal, state and city agencies; and distinguish themselves on university faculties and administrations nationwide. Through their many and varied professional accomplishments, alumni have earned for the school its reputation for excellence.

FACILITIES AND RESEARCH

The Brooks Computer Center is available to all students and faculty. It provides a centralized administration and technological support for all academic computing needs, and allows students to take advantage of rapidly emerging hardware and software technologies. The center maintains an ample supply of computers of all major types—Intel™ based machines, Apple Macintosh™, Sun Microsystems™ IBM™ are examples. The machines are concentrated in computer classrooms, offices, laboratories, the residence hall and special centers.

The Department of Information Technology provides a wired and wireless network designed to give a rich and reliable computing environment. It is locally accessible through the intranet, which connects all but specialized stand-alone systems. Students have access to all of the major operating systems such as the varieties of Microsoft Windows™, Solaris™, Linux™ and Mac/OS™.

The Department of Information Technology has both formal classroom instructional facilities and informal drop-in accommodations. Currently, there exist no restrictions or charges for computer time and availability of machines is widespread.

A full complement of applications, programming languages and internet tools are available. Multimedia hardware includes audio/video capture and output, print and film scanners, digital cameras, CD burners and large-format color plotters.

Data communications with the outside community are maintained via multiple dedicated high-speed internet connections. Students and faculty have access to software packages and programming languages on the local network and can download content from all internet sites worldwide. Students are expected to pay careful attention to copyright and ethical uses of the internet and to conduct themselves professionally at all times.

C.V. Starr Research Foundation The C.V. Starr Research Foundation, whose forerunner was established in 1976 as The Cooper Union Research Foundation, is a not-for-profit corporation and sponsors many of the externally funded research projects in the School of Engineering. By encouraging and supporting research, the foundation augments the educational opportunities for students, enhances professional development of faculty, promotes multi-disciplinary research and serves the community through its research and development efforts and as a sponsor of public seminars and conferences.

Participation in research activities by faculty and students is essential to the vitality of the educational programs. In attempting

to meet this objective, The C.V. Starr Research Foundation plays an important role for faculty and students having research talent who wish to pursue sponsored research individually or in concert with other faculty and students. The foundation facilitates collaboration with other universities, hospitals, industry and government.

Projects undertaken by The C.V. Starr Research Foundation are externally funded. Faculty serve as project directors, assisted by other faculty members, outside consultants and undergraduate and graduate students of The Cooper Union.

The C.V. Starr Research Foundation is poised to support all programs in all of the schools at The Cooper Union, both at the undergraduate and graduate levels, by providing real-life research projects throughout the curriculum. To this end, several inter-disciplinary research centers have been developed.

Each of the centers aims to draw upon the varied faculty expertise across The Cooper Union and uses laboratory resources in the School of Engineering, as well as the resources of the Schools of Art and Architecture.

Recent research sponsors of The C.V. Starr Research Foundation include Zimmer, Pfizer, EPRI, Con Edison, the National Security Agency, the City of New York Departments of Transportation, Environmental Protection and Design and Construction, Transpo, Lucent, NYSERDA, the U.S. DOE, Lenox Hill Hospital, Verdant Technologies and The Howard Hughes Medical Institute.

The C.V. Starr Research Foundation has a proprietary interest in several new technologies, all of them patented and most of them developed at The Cooper Union. Examples include several patents in asphalt technology, a clean-coal burning technology, an innovative hydro-electric generation process, fuel-cell processes, a micro-balance sensor and several patents in telecommunications and environmental measurement devices.

The Maurice Kanbar Center for Biomedical Engineering, where research is ongoing in orthopaedic bio-mechanics, tissue engineering, rehabilitation, neurology, etc. This center has established collaborative relationships with several hospitals and medical research institutions in the New York City area.

The Center for Urban Systems and Infrastructure has started research in the areas of urban security and protective design, infrastructure rehabilitation, new energy technologies, acoustics and noise abatement and sustainable environment. Industrial partnerships have been formed with various corporations and government agencies. The Cooper Union Institute for Urban Security operates under the auspices of this center, and the following institutes are being developed:

- The Institute of Water Resources and the Environment,
- The Institute of Renewable Energy and
- The Institute for Soil Structure Interaction and the Underground Built Environment.

The Center for Materials and Manufacturing Technology will be engaged in research in composite materials, fire-resistant and blast-resistant materials, robotics, mechatronics, nano-technologies and nano-biosensors. The center will also be active in innovative product design and automation.

The Center for Signal Processing, Communications and Computer Engineering (S*PROCOM²) engages in recent and ongoing research in biomedical signal and image processing, neuroscience, software engineering, mapping algorithms to FPGA and other specialized architectures, network security, Monte Carlo simulations and wireless communications. Other areas of interest include sensor arrays and networks, embedded control systems and cognitive systems. Partnerships and collaboration have been established with technology firms, both small and large, medical research institutions and financial firms in and around New York City.

The Center for Sustainable Engineering, Art and Architecture—Materials, Manufacturing and Minimalization (SEA²M³), which involves projects within engineering, art and architecture.

BACHELOR OF ENGINEERING CURRICULUM

The requirements for the bachelor's degree programs must be completed within four years of first registration, except with the explicit consent of the dean/associate dean. Requests for extension must be presented in writing to the dean's office prior to the sixth semester of registration (or the end of the junior year). It is the responsibility of the student to maintain normal and reasonable progress toward the degree. If courses are made up elsewhere for credit, the student is responsible for all costs incurred. Prior appropriate adviser(s) approval is required. If a student elects to take additional courses at other institutions, he or she must do so (a) with prior academic approval if transfer credit is desired and (b) at their own expense. Additionally, ABET accreditation requires:

- one year of a combination of mathematics and sciences (some with experimental experience) appropriate to the discipline
- one and a half years of engineering topics consisting of engineering sciences and engineering design appropriate to the student's field of study and.
- a general educational component that complements the technical content of the curriculum and is consistent with the program and institutional objectives.

In order to graduate, all students must meet the following conditions:

- A minimum of 135 credits are required;
- Satisfaction of all program curricula;
- Satisfaction of the residence study requirements;
- A minimum grade point average (G.P.A.) of 2.0;
- A minimum grade point average (G.P.A.) of 2.0 for the junior and senior years combined.

Humanities and Social Sciences The requirements in this area are satisfied by courses offered by The Cooper Union Faculty of Humanities and Social Sciences or by transfer credit for liberal arts courses taken at other institutions. The courses in this area are intended to provide both breadth and depth and should not be limited to a selection of unrelated introductory courses.

The Cooper Union liberal arts courses, shown elsewhere in the Faculty of Humanities and Social Sciences catalog section, have prefixes **H**, **S** and **HTA**. The basic courses **HSS1–HSS2** and **HSS3–HSS4** are prerequisites for all higher level courses in the same prefix family. **H** and **S** courses carry three credits each; **HTA** courses carry two credits. Engineering students should consult with the dean of Humanities and Social Sciences about choice of courses to satisfy particular interests.

Transfer credits for liberal arts courses must be approved by the dean of Humanities and Social Sciences. Courses that cannot be used to satisfy the Humanities and Social Sciences requirement are:

- language skills courses such as introductory foreign language, public speaking, report writing;
- craft and performance courses unless accompanied by theory or history;
- subjects such as accounting, finance, engineering economy, industrial management, personnel administration.

Some programs require "free electives or non-technical electives." For transfer credit for particular courses, the School of Art or the School of Architecture may be a more appropriate authority to sanction the transfer. Students who are uncertain should approach the Office of the Dean of Engineering in the first instance and be directed to the correct group of faculty.

Program Requirements The specific programs for entering students are shown in detail in the curriculum tables.

Course Substitutions and Credits A student may request to substitute for a required course or courses given in the School of Engineering provided that:

- the substitution is limited to 12 credits maximum toward the total number of credits required for graduation,
- the substitution is approved by the dean/associate dean and program adviser(s) and
- ABET accreditation requirements are not violated.

The number of academic credits for each course generally is based on the following relationship:

- 1 credit per contact hour in class
- 1/2 credit per contact hour of laboratory

This relationship was established on the basis that generally two hours of preparation are expected of the student for every contact hour in class or project activities and generally one hour of preparation is expected for every contact hour of laboratory. (The Chemical Engineering Department does not permit the substitution of any courses for required courses.)

Residence Study Requirement A candidate for a bachelor's degree must be enrolled during the entire academic year immediately preceding the granting of the degree and must carry at least 12 credits per semester during that period. Also, the candidate must have been enrolled for a minimum of four semesters at The Cooper Union as a full-time student for the bachelor's degree.

Honors and Special Programs

Dean's List The Office of Admissions and Records determines a Dean's List twice a year, at the end of each semester, on the basis of the record of the completed grade in every subject at the official end of the grading period. To qualify, a student must have a 3.5 or better semester grade point average for a study program of at least 12 credits during that semester with no grade lower than **C** and no grades of Incomplete (**I**).²

Course Overload A student having a grade point average of 3.0 or better may elect to take an overload of one course in any given semester. In all other cases of overload, approval of the student's academic adviser(s) and the written approval of the dean/associate dean of engineering must be obtained. Overload beyond 21 credits requires the written permission of the dean/associate dean and no overload is permitted for students with a prior semester G.P.A. of less than 3.0 or a cumulative G.P.A. of less than 3.0.

Graduation with Honors Each graduating senior in the School of Engineering who has achieved an overall cumulative rating of 3.8 or higher is awarded the degree with the notation summa cum laude. Magna cum laude requires a G.P.A. of 3.7 or higher and cum laude requires at least a 3.5 G.P.A.

Faculty Advisers All first-year students have the same faculty adviser. For subsequent years, students will be assigned one, two or more advisers each, appropriate to their field of study. Each student's program is established in consultation with his or her adviser(s); changes may be made only with the adviser(s)'s approval. Advisers for IDE and BSE students will be assigned according to the student's educational interests and goals.

Curricular Transfers Students wishing to change their course of study should first discuss their interests with the current adviser(s) in both the current and the new speciality areas. Transfer is at the discretion of the dean's office and the receiving department or the BSE committee. It may be affected by the student's grades and availability of program resources. It becomes effective when the required petition form, approved the dean or associate dean of engineering, has been delivered to the Office of Admissions and Records. First-year students may not change their area of study until the end of the year when two semesters' grades are available. A G.P.A. of 3.0 or better is required for approval to transfer curriculum.

Transfer Credit Students, at their own expense, desiring to register for courses at another institution for transfer credit to The Cooper Union must have appropriate advance approval. For courses in

mathematics, sciences or engineering, this approval is to be obtained from:

- the department responsible for the course at The Cooper Union and
- the dean or associate dean of engineering.

For liberal arts courses, approval is to be obtained from the dean of Humanities and Social Sciences. In order that transfer credits from another school be accepted, a grade of **B**³ or better is required. An exception may be granted in special circumstances only upon formal appeal to the Committee on Academic Standards.

Transfer credit is never granted for paid summer internships or work experience or paid or unpaid research.

Pre-Medical, Pre-Law or Pre-Business Studies Upon completion of the engineering degree, some graduates may decide to attend medical, dental, business or law school. Most of the prerequisites for such a course of action are offered at The Cooper Union. For medical school or dentistry, students are advised to take one year of organic chemistry and one year of biology. For law or business, additional economics, political science and professional ethics courses are useful. Students should consult their adviser(s).

Study Abroad The Cooper Union offers suitably qualified, approved students the opportunity to participate in research programs at various foreign universities during the summer. For example, students have attended universities in England, Ireland, Scotland, Australia, Hong Kong, Germany, China, Japan, Italy, Spain, Ghana and France. Cooper Union credit (up to six credits at the 300 level) is granted upon successful completion of the research work, presentation of a written report and its approval by the Office of the Dean. Applications are available in the dean's office in mid-January. (Students on probation are ineligible for this program). Credit is only allowable for exchange programs authorized by The Cooper Union School of Engineering.

Professional Development Mastering the technical aspects of an engineering field is only part of being a successful engineer. There are many other areas that go toward building and continuing a professional career.

The School of Engineering has established the **Aba and Leja Lefkowitz Program for Professional Development** to strengthen the non-technical attributes required of its engineering undergraduates. Under this umbrella, a number of successful Cooper Union initiatives have been consolidated to provide a comprehensive program of experiences and training for all engineering undergraduates.

² Students may petition the dean/associate for reconsideration in the Dean's List after the Incomplete (I) has been made up.

³ A grade of B- cannot be transferred

This training is provided through zero-credit courses of seminars and workshops that span a student's career at The Cooper Union. Attendance at the seminars and workshops is mandatory for engineering freshmen and sophomores. The courses are designed to introduce students to the profession of engineering, as well as deal with their professional development. The Cooper Union's **CONNECT (Cooper's Own No Nonsense Engineering Communication Training)** program is an integral part of these courses and provides intensive, regular training in effective communication. A wide range of topics are covered (in addition to communication skills) including ethics, environmental awareness, life-long learning, career development, conflict resolution, entrepreneurship, marketing, workplace issues, professional societies, professional licensure, organizational psychology, teamwork skills, etc. These topics are dealt with using methods such as case studies, role playing and interactive activities—"learning by doing." In addition, guest professionals, experts and alumni participate where appropriate.

These experiences make students aware of the importance of the non-technical skills needed for professional success. Through this program students are given significant help in easing the transition into the workplace and ensuring success there.

Engineering Advisory Council

The School of Engineering is advised in key engineering issues, such as leadership, ethics, communication skills, entrepreneurship and corporate responsibility, by its Advisory Council, which is comprised of company presidents, C.E.O.s, Nobel Laureates, engineers, physicians, attorneys and other business and professional experts. The Council meets annually with faculty and students to discuss important issues in engineering education. In addition, the Technology Transfer Advisory Committee is made up of appropriate individuals to advise students and faculty about issues such as patents, commercialization of inventions, entrepreneurship, etc.

Gateway Engineering Education Coalition

The Cooper Union participated in the National Science Foundation (NSF)–sponsored Gateway Engineering Education Coalition with Columbia University, Polytechnic University, New Jersey Institute of Technology, Drexel University, Ohio State University and the University of South Carolina. The object of the coalition was curricular innovation and exploration of new pedagogical methods. Participation has had a strong influence on teaching, learning and assessment methodologies at the School of Engineering. A process of continuous quality improvement is in place.

ACADEMIC STANDARDS

Academic Integrity

Plagiarism is the presentation of another person's "work product" (ideas, words, equations, computer code, graphics, lab data, etc.) as one's own. Whether done intentionally or unintentionally, plagiarism will not be tolerated in the School of Engineering.

There are many types of plagiarism, some of which are listed below. (The list is not exhaustive. Speak with the appropriate faculty member or the dean or associate dean of engineering if you are uncertain as to what constitutes ethical conduct in a particular situation.)

You are plagiarizing if:

- You present as your own work product a homework assignment, a take-home exam or a class project that includes the efforts of other individuals. The contributions of other individuals (if permitted by your instructor) must be acknowledged in writing on the submitted assignment, exam or project.
- You copy the work of other students on an in-class examination or communicate with other individuals in any fashion during an exam.
- You submit as part of a homework assignment, take-home exam or class project material that has been copied from any source (including, but not limited to, a textbook, a periodical, an encyclopedia, the internet) without properly citing the source, and/or without using quotation marks. It is also prohibited to submit such materials in a minimally altered form without proper attribution. Improperly copied material might include text, graphics (computer or otherwise), computer source code, etc.

Other prohibited acts of academic dishonesty include (but are not limited to):

- Attempting to obtain a copy of an examination before it is administered.
- Dishonesty in dealing with a faculty member or a dean, such as misrepresenting the statements of another faculty member.
- Bringing notes into an examination when forbidden to do so.
- Bringing any device into an examination (computer/ PDA/calculator), which permits the retrieval of examination-related materials unless expressly permitted by the instructor.
- Bringing any device into an examination that allows communication with other individuals or computers or computer databases unless expressly permitted by the instructor.

Faculty members may not unilaterally resolve incidents of academic dishonesty. Each faculty member is required to report all cases of plagiarism or academic dishonesty to the engineering dean's office on an Academic Integrity Incident form. If documen-

tary evidence of the incident exists, it should be attached to the form. The dean's office, in consultation with the faculty member and the student, will select from the following sanctions: a grade of **F** for the assignment, a grade of **F** for the course or dismissal of the student from the school. A record of all incident forms will be kept in the dean's office and second-time offenders are candidates for dismissal from the school. Students who are dismissed because of academic dishonesty should be aware that incident reports and any responsive actions by the dean's office or Academic Standards Committee become part of their permanent record.

Sexual or Racial Harassment

Such behavior will not be tolerated. Incidents should be reported immediately. Students should see the dean or associate dean, and also the dean of students as soon as possible.

Code of Conduct

Students are required to read and abide by the code of conduct published by the Office of Student Services.

GRADES OF RECORD

The definitions below deal with the student's attainment in the formal work of the subject. Nevertheless, it should be understood that such essential qualities as integrity, adherence to class regulations, enthusiasm, motivation, clarity in presentation of work and sense of obligation, together with ability to use the English language correctly and intelligibly, are reflected in the grade. The course grade is assigned by the instructor in conformity with definitions indicated in this section.

The grade **A** indicates a superior and comprehensive grasp of the principles of the subject. It denotes an ability to think quickly and with originality toward the solution of difficult problems.

The grade **B** indicates evidence of a good degree of familiarity with the principles involved in the subject. It implies less originality and a tendency to hold to patterns of thought presented in the formal subject matter.

The grade **C** indicates an average knowledge of the principles involved in the subject and a fair performance in solving problems involving these principles. This grade implies average ability to apply the principles to original problems.

The grade **D** indicates a minimum workable knowledge of the principles involved in the subject. This grade denotes low achievement and therefore the number of such grades permitted any student is limited in a manner prescribed by the section on Scholastic Standards.

The grade **F** indicates unsatisfactory understanding of the subject matter involved. A grade of **F** may be made up only by repeating the subject in class; both the new grade and the new credits and the original grade and credits are included in the permanent record and in the grade point average. A student who receives an **F** grade in a repeated course is a candidate for dismissal by the school's Academic Standards Committee.

The Incomplete (I) Grade

The designation of **I** indicates that the work of the course has not been completed and that assignment of a grade and credit has been postponed. This designation will be given only in cases of illness (confirmed by authorized physician's letter) or of other documented extraordinary circumstances beyond the student's control. The **I** designation will be given only with the approval of the dean or associate dean of engineering. At the time of submission of an **I** designation, the instructor will indicate whether the student's progress to that point has been satisfactory or unsatisfactory, offering an estimation of grades whenever possible as a means of assisting the Committee on Academic Standards in their deliberations.

The deadline for removal of an **I** designation will be determined by the instructor, but will not be later than six weeks after the start of the spring semester for students who receive such a designation in the fall semester and not later than two weeks after the start of the fall semester for students who receive such a designation in the spring semester. If the **I** is not removed within the set time limit, either by completing the work in the subject or by passing a re-examination, the **I** will automatically and irrevocably become an **F** unless the dean or associate dean of engineering, in consultation with the instructor, extends the time or the student withdraws from the school.

Dropped Courses and Withdrawals

Change of Program, 1st and 2nd week See General Regulations, page 15. Dropping a course during this period of classes constitutes a program adjustment. The course will not be entered on the transcript.

Adding Courses, including independent study, may not be added after the second week.

Dropping Courses, weeks 3–8. A student anticipating inability to continue an assigned program should immediately seek counseling. A student's program may be adjusted at the discretion of and after conference with the adviser(s) and the dean or associate dean of engineering, but only in cases where scholastic performance is handicapped by conditions beyond the control of the student, such as health or home conditions. This should be done during the first eight weeks of the term.

The designation **W** indicates that the student has withdrawn from the course. For credit, the course must be repeated.

Dropping Courses after the 8th week A student may lighten his or her academic load and receive a **W** grade after the eighth week of classes only with the approval of the course instructor, the adviser(s) and the dean/associate dean. It is the policy of the faculty and the Office of the Dean of Engineering not to approve any withdrawal after the eighth week of classes except under extreme, extenuating circumstances. The designation **WU** indicates that the student has withdrawn from a course without permission of the dean or associate dean of engineering and notification of the dean of Admissions and Records. However, the instructor is free to record an **F** grade in such cases; the **W** grade is not applicable.

Repeating a Course When a course is repeated (due to failure or any other reason), the grade earned each time the course was repeated is calculated into the G.P.A.

Grade Point Average or Ratings To determine academic ratings, numerical equivalents are assigned to grades as follows: A is represented by 4, B by 3, C by 2, D by 1 and F by 0. The sum of the products of credits attempted and grade equivalents earned in a period at The Cooper Union, divided by the sum of credits for that period, is the rating for that period.

Only Cooper Union grades of **A, B, C, D** and **F** will be used in determining ratings. Grades from other colleges and other designations such as **I** and **W** are not used in Cooper Union ratings.

Grade Changes A change in an official grade of record, other than the designation **I**, cannot be made by the dean of Admissions and Records without the express consent of the dean or associate dean of engineering. Grade changes will not be accepted after one year has elapsed from the completion of the course.

Final Examinations Final examinations are held in most subjects. They sometimes are not held in subjects whose content does not readily lend itself to formal examination, such as laboratory or project work. In certain other subjects, the class record may be ample for determining student standing. The decision on giving a final examination in a given subject is made by the instructor.

Academic Probation, Withdrawal, Dismissal Probation is the consequence of unsatisfactory scholarship. It is a warning that may involve a compulsory reduction of academic load, interviews with an assigned adviser and additional academic counseling. A student on academic probation must fulfill conditions as prescribed by the Committee on Academic Standards.

- A student whose semester grade point average is 1.5 and below is on automatic probation and is a candidate for dismissal by the Committee.
- A student whose semester grade point average falls between 1.6 and 2.0 is on automatic probation. Two semesters of automatic probation may cause the student to be a candidate for dismissal by the Committee.
- Estimates of grades in subjects with **I** designations may be included in all Committee deliberations.
- Students who fail to register will have their records annotated: "Dropped: Failure to Register."
- A student who is obliged to leave school for one semester or one year must petition the dean or associate dean of engineering for permission to withdraw. If a medical situation is a factor, consultation with the dean of students may be required. A student who has withdrawn may apply for readmission to the appropriate department and to the dean or associate dean of engineering. A change

in circumstances that indicates that the educational program may be resumed with a probability of success must be demonstrated. If a medical situation existed, consultation with the dean of students is also required.) Furthermore, medical certification of fitness to resume study will probably be required by the Office of the Dean of Engineering.

- A student who wishes to return after an absence of more than two semesters must apply for readmission to the Committee on Academic Standards.
- The records of all first- and second-year students will be reviewed by the associate dean of engineering for recommendations to the Committee on Academic Standards for appropriate action. Students who have not completed satisfactory progress toward their degree may be excluded from the third year and may be required to withdraw from The Cooper Union in order to complete course work elsewhere at their own expense.
- The Committee on Academic Standards reserves the right to determine probation and/or dismissal at any point in a student's career for appropriate academic reasons.
- Students who believe that a modification of their status should be made because of extenuating circumstances may petition, in writing, to the Committee on Academic Standards.

MASTER OF ENGINEERING CURRICULUM

The integrated bachelor/master of engineering program is intended to integrate work at the undergraduate and graduate levels and prepare graduates for entry into the engineering profession at an advanced level or for further graduate study. It affords diversification and versatility by requiring a student to elect a field of study—the major—offered in the School of Engineering, and a minor in a different field of engineering or science; this provides depth and breadth. The school offers master's degrees in chemical engineering, civil engineering, electrical engineering and mechanical engineering. An interdisciplinary master's degree program is being developed.

The faculty have determined that IDE and BSE graduates are eligible for admission to the graduate program. Such graduating students must join the chemical, civil, electrical or mechanical programs, and may be required to “make up” fundamental courses by the department.

Admission Procedure Please refer to the “Application and Admission Information” section, page 8.

General Requirements

Applicants are expected to have a superior undergraduate record and to have given evidence of ability for independent work. Students are accepted on an academically competitive basis subject to the availability of an adviser and of suitable available facilities.

Cooper Union Undergraduates To be eligible for admission to the integrated bachelor/master program, one must be a currently enrolled Cooper Union undergraduate, with a minimum 3.0 grade point average according to the major. For BSE students, a 3.0 grade point average is required in all engineering courses. Consult with the program faculty. Generally, students entering The Cooper Union undergraduate programs as first-year students require four, five or six years to complete the integrated bachelor/master of engineering program.

Specific admission requirements may be waived upon recommendation of the faculty in the area of the student's major interest.

It is planned that, in the future, all master's students not in the integrated bachelor/master program will be admitted on a tuition-paying basis. This includes former graduates of The Cooper Union as well as graduates from other ABET-accredited programs. Admitted students may be required to register for advanced engineering courses to make up for any deficiencies in their preparation.

Certificate Programs The School of Engineering is developing packages to be offered to practicing professionals in various areas upon completion of 12 graduate credits. All students in certificate programs will be required to pay tuition.

COURSE DESIGNATION

The designation of a course offered in the School of Engineering uses an alphabetical prefix and a three-digit numbering system. The first digit usually denotes:

- (1, 2)** lower level undergraduate courses,
- (3)** advanced undergraduate courses and
- (4)** graduate courses.

Course Prefix

Biology	Bio
Chemical Engineering	ChE
Chemistry	Ch
Civil Engineering	CE
Computer Science	CS
Electrical Engineering	EE, ECE
Engineering Sciences	ESC
Interdisciplinary Engineering	EID
Mathematics	Ma
Mechanical Engineering	ME
Physics	Ph

Students should consult official class schedules for courses offered in a given semester. There is no assurance that a course listed in this catalog will be given every year.

Be advised that each school at The Cooper Union offers certain electives that are open to all students; consult each school's course listing.

Unless otherwise indicated, credit listings are for single semesters.

Courses are not generally offered in the summer.

Definitions

- A *free elective* is any course for which a student is qualified given within The Cooper Union. Foreign language courses do not count as free electives.
- The status *advanced engineering elective* is to be determined by the adviser(s) and the Office of the Dean. Normally, such courses will require prerequisites and are usually taken by juniors, seniors or graduate students.
- A *core elective* is defined as any course required in either the first, second or third year of the CE, ChE, EE or ME programs.
- A minimum of 12 credits of engineering electives must be at an advanced level.

CHEMICAL ENGINEERING DEPARTMENT AND PROGRAM

FACULTY

Brazinsky (chair), Davis, Lepek, Okorafor, Stock

MISSION STATEMENT

The Cooper Union's Department of Chemical Engineering is committed to the development and graduation of engineering professionals. The department will promote student learning and understanding of science and engineering fundamentals and guide and encourage the application of this knowledge to the ethical, professional practice of chemical engineering. This will be undertaken in an environment that is responsive to new technologies, and that encourages life-long learning and research.

Program Objectives

- Our chemical engineering graduates will understand the fundamentals of science and engineering and their use in the application of chemical engineering.
- Our graduates will have an understanding and awareness of the professional, ethical and safe application of their knowledge.
- Our graduates will grasp the concept of life-long learning and appreciate the continuing development of new technologies and issues in the professional field.
- Our graduates will transition easily into their professional careers and demonstrate success in that role.
- Those graduates who pursue graduate studies and research at The Cooper Union and/or other institutions will have the necessary technical background, support and preparation to succeed.

The education of the chemical engineer requires a strong foundation in chemistry and physics, which must be applied through the medium of mathematics to the solution of design problems. A thorough knowledge is required of chemical structures, together with energy and kinetic relationships of chemical reactions and molecular transfer. The chemical engineer deals with the application of these principles to processes carried out on a variety of scales from micro-reactors to an industrial scale, in which matter undergoes changes in physical state, chemical composition or energy content. Emphasis is placed on developing creative ability. Facts and theories are presented primarily to stimulate further thought and study in all fields of chemical engineering.

Formal instruction is supplemented by visits to several plants and companies where the contribution of engineers can be observed

and understood with respect to equipment, utilities, safety, costs, environmental impact, labor and supervision. The students get first-hand experience in the chemical engineering laboratory in applying engineering analysis to equipment performance, and in learning limitations of theoretical concepts. In the senior year, the student learns how to design chemical plants from fundamental data on new processes and to recognize areas of limited knowledge from the results of the design, and thus recommend pilot plant studies, if necessary.

Chemical engineering graduates find employment in a wide variety of areas. In addition to the chemical and petroleum industries, chemical engineers are involved heavily in the biomedical, materials and environmental fields. A chemical engineering education can also be easily applied to other interdisciplinary areas such as biochemical and biomedical engineering, energy resources, environmental engineering and materials resources. As a result, chemical engineers are also finding employment in non-industrial institutions such as government, research think-tanks, policy study groups and even publishing companies.

Note that the chemical engineering department does not make use of the 12-credit rule.

Minors

A minor can be obtained by a student in chemical engineering taking any four (4) classes in one of the fields below. The courses listed are examples of courses currently in the Cooper Union catalog. Note that some may require prerequisites or permission of the instructor. Additionally, note that it will not be necessary to obtain a minor in any field in order to graduate with a bachelor of engineering in chemical engineering.

Environmental Engineering

ChE 340/Industrial Waste Treatment, CE 141/Environmental Systems Engineering, CE 142/Water Resources Engineering (also EID 142), CE 346/Hydraulic Engineering, EID 141/Air Pollution Control Systems, CE 414/Solid Waste Management, CE 435/Geo-Environmental Engineering (also EID 435), CE 440/Industrial Waste Treatment Design, CE 441/Water and Wastewater Technology, CE 446/Pollution Prevention or Minimization, CE 447/Stream and Estuary Pollution, CE 449/Hazardous Waste Management.

Biomedical Engineering

ECE 343/Bio-instrumentation and Sensing, EID 121/Biotransport Phenomena, EID 122/Biomaterials, EID 123/Biosystems and Instrumentation, EID 124/Bioengineering in Safety Design and Injury Analysis and Prevention, EID 125/Biomechanics, EID 320/

Special Topics in Bioengineering, EID 325/Science and Application of Bioengineering Technology, EID 326/Ergonomics, EID327/Tissue Engineering, Ch 340/Biochemistry (also Bio 102), Bio 101/Molecular and Cellular Biology, ECE 422/ Selected Topics in Embedded Systems, ME 421/Rehabilitation Engineering (also EID 421), ME 423/Measurement of Human Performance (also EID 423), EID 424/Bioengineering Applications in Sports Medicine, Ch 440/Biochemistry II.

Energy Engineering

ME 131/Energetics (also EID 131), ME 133/Air-Conditioning, Heating and Refrigeration (also EID 133), ME 330/ Advanced Engine Concepts, ME 334/Combustion (also EID 334), ChE 421/Advanced Chemical Reaction Engineering, ChE 434/Special Topics in Combustion (also ME 434), ChE 435/Transport Processes in Internal Combustion Engines (also ME 435), ECE 422/Selected topics in Embedded Systems, Ph 462/Nuclear Physics.

Applied Chemical Technology

ChE 311/Introduction to Polymer Technology, ME 313/ Science of Materials for Engineering Design (also EID 313), ME 314/Introduction to Composite Materials (also EID 314), Ch 364/Solid State Chemistry, Ph 319/Introductory Quantum and Solid State Physics, ChE 411/Polymer Technology and Engineering, ME 410/Materials, Manufacturing Process (also EID 410).

Note: You will be given a letter by the chemical engineering Department certifying that you have completed a minor.

Graduate Program

In addition to advanced courses in chemical engineering and other areas, the student must complete a thesis for the M.E. degree. The candidate must choose a full-time Cooper Union faculty member from either the chemistry or chemical engineering department as one of his or her thesis advisers. Before choosing a thesis topic, however, the student should explore various professors' research interests. Research interests of chemical engineering faculty members include non-Newtonian flow, crystal growth from high-temperature melts, polymer extrusion, heat and mass transfer with change of phase, drag coefficients in dense phase transport, construction of a database of engineering materials, mathematical modeling of bio-heat transfer in micro-circulation, mathematical modeling of whole-body heat transfer, analysis of oxygen transport in the cardiovascular system and an integrated gasification process for the simultaneous disposal of sludge and garbage with concomitant production of steam and electricity, biochemical separation, protein-purification, environmental engineering and mathematical modeling, evaluation of sustainability, batch

process design and optimization, pollution prevention and mitigation, infinite linear programming, nano-materials and energy systems and processes.

Chemical Engineering Program

Freshman Year	Credits
<i>Fall Semester:</i>	
ESC000.1 Professional Development Seminar	0
Ma 110 Introduction to Linear Algebra	2
Ma 111 Calculus I	4
Ch 110 General Chemistry	3
EID 101 Engineering Design and Problem Solving	3
CS 102 Introduction to Computer Science	3
HSS 1 Literary Forms and Expressions	3
Total Credits Fall Semester	18

<i>Spring Semester:</i>	
ESC000.2 Professional Development Seminar	0
Ma 113 Calculus II	4
Ph 112 Physics I: Mechanics	4
Ch 111 General Chemistry Laboratory	1.5
Ch 160 Physical Principles of Chemistry	3
HSS 2 Texts and Contexts: Old Worlds and New	3
Total Credits Spring Semester	15.5

Sophomore Year	Credits
<i>Fall Semester:</i>	
ESC000.3 Professional Development Seminar	0
ESC 170 Energy and Material Balances	3
Ma 223 Vector Calculus	2
Ma 224 Probability	2
Ph 213 Physics II: Electromagnetic Phenomena	4
Ph 291 Introductory Physics Laboratory	1.5
Ch 231 Organic Chemistry I	3
HSS 3 The Making of Modern Society	3
Total Credits Fall Semester	18.5

<i>Spring Semester:</i>	
ESC000.4 Professional Development Seminar	0
Ma 240 Ordinary and Partial Differential Equations	3
Ph 214 Physics III: Optics and Modern Physics	3
Ch 232 Organic Chemistry II	2
Ch 233 Organic Chemistry Laboratory	2
ESC 130.1 Chemical Engineering Thermodynamics	3
HSS 4 The Modern Context: Figures and Topics	3
Total Credits Spring Semester	16

Junior Year	Credits
<i>Fall Semester:</i>	
EE 121 Basic Principles of Electrical Engineering	2
Ch 251 Instrumental Analysis Laboratory	2
Ch 261 Physical Chemistry I	3
ChE 131 Advanced Chemical Engineering Thermodynamics	3
ESC 140 Fluid Mechanics and Flow Systems	3
Engineering or Science Elective	3
Total Credits Fall Semester	16
<i>Spring Semester:</i>	
Ch 262 Physical Chemistry II	2
ChE 121 Chemical Reaction Engineering	3
ChE 141 Heat Transmission	3
ChE 151 Process Simulation and Mathematical Techniques for Chemical Engineers	3
Engineering or Science Elective	3
Free Elective	3
Total Credits Spring Semester	17
Senior Year	
Credits	
<i>Fall Semester:</i>	
ChE 162.1 Chemical Engineering Laboratory I	1.5
ChE 161.1 Process Evaluation and Chemical Systems Design I	3
ChE 142 Mass Transfer Processes	4
ChE 152 Chemical Process Dynamics and Control	3
Engineering or Science Elective	3
Humanities/Social Sciences Elective	3
Total Credits Fall Semester	17.5
<i>Spring Semester:</i>	
ChE 162.2 Chemical Engineering Laboratory II	1.5
ChE 161.2 Process Evaluation and Chemical Systems Design II	3
ESC 110.1 Materials Science for Chemical Engineers	3
Engineering or Science Elective	3
Free Elective	6
Total Credits Spring Semester	16.5
Total credits required for degree	135

CIVIL ENGINEERING DEPARTMENT AND PROGRAM

FACULTY

J. Ahmad (Chair), Cataldo, Guido, Tzavelis, Yapijakis

MISSION STATEMENT

To prepare our students as civil engineering professionals who will have the depth and breadth of knowledge, sense of social and ethical responsibility, commitment to a safe environment and a desire to serve the society in leadership positions.

Program Objectives

- Our civil engineering graduates will engage in life-long learning to stay abreast of the latest body of knowledge and professional practices in civil engineering and allied disciplines throughout their careers.
- Our graduates will excel in teamwork, interdisciplinary concepts, organizational skills and problem-solving methodologies in their professional careers.
- Our graduates will attain positions of leadership as professional practitioners, government officials, academicians, inventors, researchers, etc. during their professional careers.
- Our graduates will have a strong sense of commitment to excellence, independent thinking, innovation and modern professional practices throughout their careers.

Program description

Civil engineering, earliest of the engineering professions, has evolved into a broad spectrum of specialities: structural, geotechnical, hydraulic, environmental, transportation, urban planning, construction management, sustainable design, urban security and infrastructure rehabilitation. Depending on his or her interests and abilities, the modern civil engineer also may become involved in research, design and development related to projects in alternative energy sources, space structures, protection against natural and man-made disasters, etc. The civil engineer also studies and develops new materials, new structural systems and new strategies for optimizing design. Basic research, especially in the areas of applied and experimental mechanics, often arises either as a preliminary or adjunct requisite to these studies.

The civil engineer who wishes to practice creatively in any of these fields must be thoroughly grounded in the basic sciences, mathematics and applied mechanics, structures and structural mechanics, engineering sciences and computer applications.

The members of the civil engineering faculty are actively engaged in research in their specialities, which include modern advances in structural engineering and materials, geotechnical engineering, alternative energy sources, green design of buildings, water pollution control technologies, water resources engineering and urban security.

Within the civil engineering program, students may elect to pursue specialized study through an appropriate choice of electives in two areas:

- Structural and Geotechnical Engineering
- Water Resources and Environmental

Graduate level courses in these areas are available to seniors with superior academic records as indicated in the following lists:

Structures and Geotechnical Engineering: CE 422, CE 425, CE 426, CE 427, CE 428, CE 431, CE 432, CE 433, CE 434, CE 450, CE 470.

Water Resources and Environmental Engineering: CE 414, CE 440, CE 441, CE 442, CE 443, CE 444, CE 445, CE 446, CE 447, CE 448, CE 449.

Graduate Program

Completion of the master of engineering degree program in civil engineering is important for entry into the profession in any of the specialized areas discussed above. The civil engineering department offers many graduate level courses in the cited areas, such as structural engineering and environmental engineering. Graduate minors may include computer engineering, civil engineering management and others. Also recognized are minors in interdisciplinary areas of engineering.

Civil Engineering Program

Freshman Year	Credits
<i>Fall Semester:</i>	
ESC000.1 Professional Development Seminar	0
Ma 110 Introduction to Linear Algebra	2
Ma 111 Calculus I	4
Ch 110 General Chemistry	3
EID 101 Engineering Design and Problem Solving	3
CS 102 Introduction to Computer Science	3
HSS 1 Literary Forms and Expressions	3
Total credits fall semester	18
<i>Spring Semester:</i>	
ESC000.2 Professional Development Seminar	0
Ma 113 Calculus II	4
Ph 112 Physics I: Mechanics	4
Ch 111 General Chemistry Laboratory	1.5
Ch 160 Physical Principles of Chemistry	3
HSS 2 Texts and Contexts: Old Worlds and New	3
Total credits spring semester	15.5

Sophomore Year	Credits
<i>Fall Semester:</i>	
ESC000.3 Professional Development Seminar	0
Ma 223 Vector Calculus	2
Ma 224 Probability	2
Ph 213 Physics II: Electromagnetic Phenomena	4
Ph 291 Introductory Physics Laboratory	1.5
ESC 100 Engineering Mechanics	3
ESC 110 Materials Science	3
HSS 3 The Making of Modern Society	3
Total credits fall semester	18.5
<i>Spring Semester:</i>	
ESC000.4 Professional Development Seminar	0
ESC 120 Principles of Electrical Engineering	3
Ma 240 Ordinary and Partial Differential Equations	3
Ph 214 Physics III: Optics and Modern Physics	3
ESC 101 Solid Mechanics	3
CE 120 Fundamentals of Civil Engineering	3
HSS 4 The Modern Context: Figures and Topics	3
Total credits spring semester	18

Junior Year	Credits
<i>Fall Semester:</i>	
CE 121 Structural Engineering	4.5
CE 141 Environmental Systems Engineering	4.5
ESC 130 Engineering Thermodynamics	3
ESC 140 Fluid Mechanics and Flow Systems	3
Humanities/Social Sciences Elective	3
Total credits fall semester	18
<i>Spring Semester:</i>	
CE 122 Structural Engineering II	3
CE 131 Introduction to Geotechnical Engineering	4.5
CE 142 Water Resources Engineering	4.5
CE 341 Design of Steel Structures	3
Humanities/Social Sciences Elective	3
Total credits spring semester	18

Senior Year	Credits
<i>Fall Semester:</i>	
CE 342 Design of Reinforced Concrete Structures	3
CE 351 Urban Transportation Planning	3
CE 363 Civil Engineering Design I	3
Engineering or Science Electives	6
Total credits fall semester	15
<i>Spring Semester:</i>	
CE 361 Civil Engineering Experimental Projects	2
CE 364 Civil Engineering Design II	3
Engineering or Science Electives	9
Total credits spring semester	14

Total credits required for degree **135**

ELECTRICAL ENGINEERING DEPARTMENT AND PROGRAM

FACULTY

H. Ahmad, Baum (Dean), Ben-Avi (Associate Dean), Chatterjee, Cumberbatch, Fontaine (Chair), Keene, Kirtman, Sable

MISSION STATEMENT

To develop a highly trained, consummate engineer: able to lead, to practice in a professional manner, to grow with technological advances, to express himself or herself in written and in oral form, to function as a project engineer immediately upon graduation and to pursue graduate studies in a variety of professional fields.

Program Objectives

Each of our electrical engineering graduates:

- will be capable of functioning as a first-class project engineer,
- will have exceptional technical knowledge and professional design skills,
- will be capable of professional-level written and oral expression.
- will be capable of demonstrating leadership skills and
- will be open-minded and receptive to new ideas and viewpoints, with a commitment to excellence, independent thinking, research, life-long learning, innovation and the use of the latest technologies and modern professional practices throughout his or her career.

Program description

Basic courses in electrical circuits and signal processing (or computer systems or computer engineering), along with core mathematics, science and humanities courses, are taken in the freshman and sophomore years. Students may then elect to pursue study through an appropriate choice of electives in three areas:

- Electronic Systems and Materials
- Signal Processing and Communications
- Computer Engineering

Students plan their electives with the assistance of a faculty adviser to specialize in areas of interest and to obtain a well-rounded and diverse educational experience. By the senior year, strong students are encouraged to take graduate-level electives beyond the requirements of the bachelor's degree as part of an integrated five-year master's program.

The curriculum interweaves strong theory, grounded in mathematics and science, with extensive use of CAD tools and practical projects. Team and individual projects begin in the freshman year and culminate with year-long senior projects.

All laboratory courses, and many recitation courses, are project based. By the time students commence their senior projects, they perform open-ended system design, implementation and testing, cost analysis and prepare written and oral presentations. They act as project managers under the guidance of a faculty adviser.

There are numerous research and independent study opportunities involving close work with faculty and practicing professionals on cutting-edge problems.

Graduate Program

The candidate must choose a full-time Cooper Union faculty member from the electrical engineering department as one of his or her advisers. Possible areas of concentration or thesis topics are numerous and reflect the diverse interests of the faculty. Some examples are digital signal processing, image and video processing, biomedical engineering, wireless communications, computer networks, machine learning, mapping algorithms to architecture, advanced computing and simulation methodology, electronic materials, integrated circuit engineering and sustainable engineering. Thesis topics that are research-oriented or targeted towards commercial application are particularly encouraged.

Web Site

The Electrical Engineering program maintains a web site at www.ee.cooper.edu.

Electronic Systems and Materials Track in Electrical Engineering

Freshman Year	Credits
<i>Fall Semester:</i>	
ESC000.1 Professional Development Seminar	0
Ma 110 Introduction to Linear Algebra	2
Ma 111 Calculus I	4
Ch 110 General Chemistry	3
EID 101 Engineering Design and Problem Solving	3
CS 102 Introduction to Computer Science	3
HSS 1 Literary Forms and Expressions	3
Total Credits Fall Semester	18
<i>Spring Semester:</i>	
ESC000.2 Professional Development Seminar	0
Ma 113 Calculus II	4
Ph 112 Physics I: Mechanics	4
ECE 150 Digital Logic Design	3
Ch 111 General Chemistry Laboratory	1.5
Ch 160 Physical Principles of Chemistry	3
HSS 2 Texts and Contexts: Old Worlds and New	3
Total Credits Spring Semester	18.5
Sophomore Year	
<i>Fall Semester:</i>	
ESC000.3 Professional Development Seminar	0
ECE 141 Circuits & Electronics I	3
Ma 223 Vector Calculus	2
Ma 240 Ordinary and Partial Differential Equations	3
Ph 213 Physics II: Electromagnetic Phenomena	4
Ph 291 Introductory Physics Laboratory	1.5
HSS 3 The Making of Modern Society	3
Total Credits Fall Semester	16.5
<i>Spring Semester:</i>	
ESC000.4 Professional Development Seminar	0
ECE 110 MATLAB Seminar: Signals and Systems	0
ECE 111 Signal Processing & Systems Analysis	3
ECE 131 Solid State Materials	3
ECE 151 Computer Architecture	3
Ma 224 Probability	2
Ph 214 Physics III: Modern Physics	3
HSS 4 The Modern Context: Figures and Topics	3
Total Credits Spring Semester	17

Junior Year	Credits
<i>Fall Semester:</i>	
ECE 101 Communication Theory	3
ECE 114 Digital Signal Processing	3
ECE 121 Control Systems	3
ECE 142 Circuits and Electronics II	3
ECE 193 Electrical & Computer Engineering Projects I	1.5
Ma 326 Linear Algebra	3
Humanities/Social Sciences Elective	3
Total Credits Fall Semester	19.5
<i>Spring Semester:</i>	
ECE 103 Communication Networks	3
ECE 135 Engineering Electromagnetics	4
ECE 194 Electrical & Computer Engineering Projects II	4
ECE 341 Integrated Circuit Design	3
Humanities/Social Sciences Elective	3
Total Credits Spring Semester	17
Senior Year	
<i>Fall Semester:</i>	
ECE 195 Electrical & Computer Engineering Projects III	4
Non-technical Elective	3
Engineering or Science Electives	7
Total Credits Fall Semester	13
<i>Spring Semester:</i>	
ECE 196 Electrical & Computer Engineering Projects IV	3
Non-technical Elective	3
Engineering or Science Electives	8.5
Total Credits Spring Semester	14.5
Total credits required for degree	135

Signal Processing and Communications Track in Electrical Engineering

Freshman Year	Credits
<i>Fall Semester:</i>	
ESC000.1 Professional Development Seminar	0
Ma 110 Introduction to Linear Algebra	2
Ma 111 Calculus I	4
Ch 110 General Chemistry	3
EID 101 Engineering Design and Problem Solving	3
CS 102 Introduction to Computer Science	3
HSS 1 Literary Forms and Expressions	3
Total Credits Fall Semester	18
<i>Spring Semester:</i>	
ESC000.2 Professional Development Seminar	0
Ma 113 Calculus II	4
Ph 112 Physics I: Mechanics	4
ECE 150 Digital Logic Design	3
Ch 111 General Chemistry Laboratory	1.5
Ch 160 Physical Principles of Chemistry	3
HSS 2 Texts and Contexts: Old Worlds and New	3
Total Credits Spring Semester	18.5
Sophomore Year	
<i>Fall Semester:</i>	
ESC000.3 Professional Development Seminar	0
ECE 141 Circuits & Electronics I	3
Ma 223 Vector Calculus	2
Ma 240 Ordinary and Partial Differential Equations	3
Ph 213 Physics II: Electromagnetic Phenomena	4
Ph 291 Introductory Physics Laboratory	1.5
HSS 3 The Making of Modern Society	3
Total Credits Fall Semester	16.5
<i>Spring Semester:</i>	
ESC000.4 Professional Development Seminar	0
ECE 110 MATLAB Seminar: Signals and Systems	0
ECE 111 Signal Processing & Systems Analysis	3
ECE 131 Solid State Materials	3
ECE 151 Computer Architecture	3
Ma 224 Probability	2
Ph 214 Physics III: Modern Physics	3
HSS 4 The Modern Context: Figures and Topics	3
Total Credits Spring Semester	17

Junior Year	Credits
<i>Fall Semester:</i>	
ECE 101 Communication Theory	3
ECE 114 Digital Signal Processing	3
ECE 121 Control Systems	3
ECE 142 Circuits and Electronics II	3
ECE 193 Electrical & Computer Engineering Projects I	1.5
Ma 326 Linear Algebra	3
Humanities/Social Sciences Elective	3
Total Credits Fall Semester	19.5
<i>Spring Semester:</i>	
ECE 103 Communication Networks	3
ECE 135 Engineering Electromagnetics	4
ECE 194 Electrical & Computer Engineering Projects II	4
ECE 302 Probability Models & Stochastic Processes	3
Humanities/Social Sciences Elective	3
Total Credits Spring Semester	17
Senior Year	
<i>Fall Semester:</i>	
ECE 195 Electrical & Computer Engineering Projects III	4
Non-technical Elective	3
Engineering or Science Electives	7
Total Credits Fall Semester	13
<i>Spring Semester:</i>	
ECE 196 Electrical & Computer Engineering Projects IV	3
Non-technical Elective	3
Engineering or Science Electives	8.5
Total Credits Spring Semester	14.5
Total credits required for degree	135

Computer Engineering Track in Electrical Engineering

First Year	Credits
<i>Fall Semester:</i>	
ESC000.1 Professional Development Seminar	0
Ma 110 Introduction to Linear Algebra	2
Ma 111 Calculus I	4
Ch 110 General Chemistry	3
EID 101 Engineering Design and Problem Solving	3
CS 102 Introduction to Computer Science	3
HSS 1 Literary Forms and Expressions	3
Total Credits Fall Semester	18

<i>Spring Semester:</i>	
ESC000.2 Professional Development Seminar	0
Ma 113 Calculus II	4
Ph 112 Physics I: Mechanics	4
ECE 150 Digital Logic Design	3
Ch 111 General Chemistry Laboratory	1.5
Ch 160 Physical Principles of Chemistry	3
HSS 2 Texts and Contexts: Old Worlds and New	3
Total Credits Spring Semester	18.5

Sophomore Year	Credits
<i>Fall Semester:</i>	
ESC000.3 Professional Development Seminar	0
ECE 141 Circuits & Electronics I	3
ECE 161 Programming Languages	3
Ma 223 Vector Calculus	2
Ma 240 Ordinary and Partial Differential Equations	3
Ph 213 Physics II: Electromagnetic Phenomena	4
Ph 291 Introductory Physics Laboratory	1.5
HSS 3 The Making of Modern Society	3
Total Credits Fall Semester	19.5

<i>Spring Semester:</i>	
ESC000.4 Professional Development Seminar	0
ECE 110 MATLAB Seminar: Signals and Systems	0
ECE 111 Signal Processing & Systems Analysis	3
ECE 131 Solid State Materials	3
ECE 151 Computer Architecture	3
ECE 164 Data Structures and Algorithms I	2
Ma 224 Probability	2
Ph 214 Physics III: Modern Physics	3
HSS 4 The Modern Context: Figures and Topics	3
Total Credits Spring Semester	19

Junior Year	Credits
<i>Fall Semester:</i>	
ECE 101 Communication Theory	3
ECE 114 Digital Signal Processing	3
ECE 142 Circuits and Electronics II	3
ECE 165 Data Structures and Algorithms II	2
ECE 193 Electrical & Computer Engineering Projects I	1.5
Ma 352 Discrete Mathematics	3
Humanities/Social Sciences Elective	3
Total Credits Fall Semester	18.5

<i>Spring Semester:</i>	
ECE 103 Communication Networks	3
ECE 194 Electrical & Computer Engineering Projects II	4
ECE 302 Probability Models & Stochastic Processes	3
ECE 361 Software Engineering & Large System Design	3
Humanities/Social Sciences Elective	3
Total Credits Spring Semester	16

Senior Year	Credits
<i>Fall Semester:</i>	
ECE 195 Electrical & Computer Engineering Projects III	4
Non-technical Elective	3
Engineering or Science Electives	6
Total Credits Fall Semester	13

<i>Spring Semester:</i>	
ECE 196 Electrical & Computer Engineering Projects IV	3
Non-technical Elective	3
Engineering or Science Electives	6.5
Total Credits Spring Semester	12.5

Total credits required for degree 135

MECHANICAL ENGINEERING DEPARTMENT AND PROGRAM

FACULTY

Baglione, Delagrammatikas, Lima, Sidebotham,
Wei (chair), Wootton

MISSION STATEMENT

The Cooper Union's Department of Mechanical Engineering will produce broadly- and rigorously-educated graduates, able to practice professionally, pursue advanced studies and innovate in a wide range of fields. Together with our faculty and staff, our students will develop a commitment toward lifelong interdisciplinary learning, fulfill their potential for responsible leadership and inspire others to continuously pursue excellence by example.

Program Objectives

- Our graduates will apply their broad and rigorous education to responsible, interdisciplinary problem solving,
- communicate clearly and effectively in their chosen professions
- continue to learn and educate themselves in their fields of pursuit.

Program description

Mechanical engineering is concerned with the devices and phenomena related to the generation, transmission, application and control of power. Mechanical engineering grew up with the Industrial Revolution and is today the broadest of the engineering disciplines, encompassing many activities and fields of interest. Mechanical engineers may be involved with research and development, design, manufacturing, sales, application and service, administration and management, as well as teaching and consulting. Fields of interest include solid mechanics, materials, fluid mechanics, acoustics, heat transfer and thermodynamics, combustion, control systems, manufacturing, CAD/CAM and robotics or combinations of these as is often the case in the design and development work of complex projects. (Examples: the space shuttle, the investigation of alternate energy from renewable resources, the development of completely automated factories through robotics and human joint replacements.) At the Albert Nerken School of Engineering, the mechanical engineering faculty and students have been, and continue to be, involved in these and other exciting new developments through their project work, research work or consulting.

Mechanical engineering is an ideal foundation for careers in the aerospace industry, ocean engineering, marine engineering, biomedical engineering, the automobile industry, the power and utility industries and virtually any area of activity that requires analytical abilities combined with a strong background in design practice.

The sequences of courses shown in the undergraduate curriculum table emphasize the fundamental engineering sciences as well as their applications in a computer environment and professional design practice. By the selection of electives and of their design and research projects, students have a large degree of flexibility in exploring their own interests.

Graduate Program

Areas of research include computer-aided design and engineering, robotics, biomedical engineering, automotive systems, mechatronics, thermoelectric power generation, acoustics, combustion and other interdisciplinary areas of engineering.

Mechanical Engineering Program**Freshman Year****Credits***Fall Semester:*

ESC000.1 Professional Development Seminar	0
Ma 110 Introduction to Linear Algebra	2
Ma 111 Calculus I	4
Ch 110 General Chemistry	3
EID 101 Engineering Design and Problem Solving	3
CS 102 Introduction to Computer Science	3
HSS 1 Literary Forms and Expressions	3
Total Credits Fall Semester	18

Spring Semester:

ESC000.2 Professional Development Seminar	0
Ma 113 Calculus II	4
Ph 112 Physics I: Mechanics	4
EID 103 Principles of Design	3
or	
EID 110 Engineering Design Graphics	1.5
Ch 111 General Chemistry Laboratory	3
Ch 160 Physical Principles of Chemistry	3
HSS 2 Texts and Contexts: Old Worlds and New	3
Total Credits Spring Semester	18.5

Sophomore Year**Credits***Fall Semester:*

ESC000.3 Professional Development Seminar	0
Ma 223 Vector Calculus	2
Ma 224 Probability	2
Ph 213 Physics II: Electromagnetic Phenomena	4
Ph 291 Introductory Physics Laboratory	1.5
ESC 100 Engineering Mechanics	3
ESC 110 Materials Science	3
HSS 3 The Making of Modern Society	3
Total Credits Fall Semester	18.5

Spring Semester:

ESC000.4 Professional Development Seminar	0
ESC 121 Basic Principles of Electrical Engineering	2
Ma 240 Ordinary and Partial Differential Equations	3
Ph 214 Physics III: Optics and Modern Physics	3
ESC 101 Mechanics of Materials	3
ESC 161 Systems Engineering	3
ME 155 Design and Prototyping	2
HSS 4 The Modern Context: Figures and Topics	3
Total Credits Spring Semester	19

Junior Year**Credits***Fall Semester:*

ESC 130 Engineering Thermodynamics	3
ESC 140 Fluid Mechanics & Flow Systems	3
ME 100 Stress and Applied Elasticity	3
ME 151 Feedback Control Systems	3
Engineering or Science Elective	3
Humanities/Social Sciences Elective	3
Total Credits Fall Semester	18

Spring Semester:

ME 101 Mechanical Vibrations	3
ME 130 Advanced Thermodynamics	3
ME 142 Heat Transfer	3
ME 160 Engineering Experimentation	3
Engineering or Science Elective	3
Humanities/Social Sciences Elective	3
Total Credits Spring Semester	18

Senior Year**Credits***Fall Semester:*

ME 120 Design Elements	3
or	
ME 141 Fundamentals of Aerodynamics	
ME 163 Mechanical Engineering Projects	3
ME 312 Manufacturing Engineering	3
Free Electives	4
Total Credits Fall Semester	13

Spring Semester:

ME 164 Capstone Senior Mechanical Engineering Design	3
ME 320 Mechanical Design	3
or	
ME 300 Space Dynamics	
Free Electives	6
Total Credits Spring Semester	12

Total credits required for degree**135**

BACHELOR OF SCIENCE IN ENGINEERING CURRICULUM

General Engineering

The School of Engineering offers a program in General Engineering leading to the degree of bachelor of science in engineering (B.S.E.). It is Intended for students who have a clear Idea of their educational objectives. These may require a more flexible Inter-disciplinary course of study. This program Is also suitable for students who desire a strong, broad-based, rigorous engineering background as preparation for graduate study in mathematics, science or other disciplines.

Curriculum

While details of programs will vary according to educational goals and advisor's requirements, the core is as follows:

	Credits
Core Courses	55
Humanities and Social Sciences (over and above the core courses)	minimum 6
Engineering and Engineering Sciences ¹ (over and above the core courses)*	minimum 44
Free Electives ²	30
Total credits	135

The program is administered by an interdepartmental committee. Approximately 10 percent of the engineering undergraduates currently undertake this program.

Each student is assigned an adviser from the committee; other faculty may also act as co-advisors. Choice of electives Is closely monitored for academic rigor and coherence by the inter-departmental committee.

Students who are considering applying to medical or dental school after completing the program are advised to take one year of biology. Law schools may require additional courses in the social sciences.

The program is not suitable for students who wish licensure.

Core Curriculum of the School of Engineering

Freshman Year	Credits
<i>Fall Semester:</i>	
ESC 000.1 Professional Development Seminar	0
Ma 110 Introduction to Linear Algebra	2
Ma 111 Calculus I	4
Ch 110 General Chemistry	3
EID 101 Engineering Design and Problem Solving	3
CS 102 Computer Programming for Engineers	3
HSS 1 Literary Forms and Expressions	3
Total credits fall semester	18

<i>Spring Semester:</i>	
ESC 000.2 Professional Development Seminar	0
Ma 113 Calculus II	4
Ch 111 General Chemistry Laboratory	1.5
Ch 160 Physical Principles of Chemistry	3
Ph 112 Physics I: Mechanics	4
HSS 2 Texts and Contexts: Old Worlds and New	3
Total credits spring semester	15.5

Sophomore Year	Credits
<i>Fall Semester:</i>	
ESC 000.3 Professional Development Seminar	0
Ma 223 Vector Calculus	2
Ma 224 Probability	2
Ph 213 Physics II: Electromagnetic Phenomena	4
Ph 291 Introductory Physics Lab	1.5
HSS 3 The Making of Modern Society	3
Electives	6
Total credits fall semester	18.5

<i>Spring Semester:</i>	
ESC 000.4 Professional Development Seminar	0
Ma 240 Ordinary and Partial Differential Equations	3
Ph 214 Physics III: Optics and Modern Physics	3
HSS 4 The Modern Context: Figures and Topics	3
Electives	10
Total credits spring semester	19

¹ Courses with prefix BIO, ChE, CE, CS, EE/ECE, ME, EID, ESC

² Any course offered at The Cooper Union

MASTER'S PROGRAM DEGREE REQUIREMENTS

For Cooper Union integrated bachelor/master's program students

Credit Requirements

A minimum of 30 credits beyond the baccalaureate degree must be completed at The Cooper Union (in addition to possible undergraduate deficiencies). Of these, not more than six credits may be undergraduate-level courses. The 30 credits offered for the degree must satisfy the following distribution:

	Credits
The major	minimum 12
A coherent concentration of graduate-level courses in the chosen field, which must include courses approved by the adviser(s). (A planned course of study must be submitted for approval by the dean's office.)	
The minor	minimum 12
A concentration in an area of engineering other than the chosen major.	
Thesis project	65
Total Credits	30

Grade Requirement

A minimum grade point average of 3.0 is needed in all courses to satisfy the master's degree requirement.

Appropriate Excess Credits Taken as an Undergraduate

For Cooper Union baccalaureate holders, any credits of appropriate level, taken as undergraduates in excess of their bachelor's degree requirement, may be applied to the master's degree, subject to the above requirements and advisory approval.

Time Limitation

The requirements for the master of engineering program must be completed within two years of admission except for extraordinary circumstances that require the express consent of the dean or associate dean of engineering. Requests for such extension must be presented in writing to the Office of the Dean in the final semester of the second year. Thesis adviser(s)'s approval is also required. Master's students who receive approval to extend their studies beyond two years will be assessed a maintenance of matriculation fee of \$1,000 per semester.

Program of Study

A complete program of study, major as well as minor, is designed by the student with the assistance and approval of the academic adviser(s) and approved by the Office of the Dean of Engineering.

Minors

Minor concentrations are offered in accordance with faculty interests and school resources. Courses in engineering and science are chosen to form an innovative and coherent program of study for a minor with the approval of the department and faculty adviser(s).

Thesis/Project

- Each student is required to submit a thesis or project in the major or the minor area of study, equivalent to a maximum of six credits (400 level), for partial fulfillment of the master of engineering requirements. This project must be discussed with and approved by an adviser prior to being started.
- The thesis or project must be successfully defended orally by the student and submitted in written form.

Fellowships

One source of funding available to students wishing to pursue graduate study in engineering is the Enders Fund, governed by the will of Henry C. Enders and administered by the New York Community Trust. This fellowship is available to engineering graduates of The Cooper Union who plan to do graduate work in either chemistry, chemical engineering, chemistry-based environmental engineering or chemistry-based bioengineering and, who have satisfactorily completed all of the chemistry courses required of Cooper Union chemical engineering graduates. Recipients are selected by the joint faculties of chemistry and chemical engineering.

DEPARTMENTS

Chemistry

Faculty: Bové (chair), Newmark, Savizky, Topper

The Department of Chemistry offers a wide range of courses that are necessary for the understanding of the various engineering disciplines. First-year engineering students enroll in the following courses: General Chemistry (a general quantitative and descriptive overview of chemistry), Physical Principles of Chemistry (a quantitative discussion of chemical thermodynamics, electrochemistry and chemical kinetics) and General Chemistry Laboratory (chemical experimentation with emphasis on data recording, report writing and safety).

Sophomore and junior level courses required for chemical engineering majors can also be taken as electives by those wishing to further their knowledge in the environmental, biomedical, instrumental and physical areas.

In addition, elective courses, suitable for students interested in bioengineering or students intending to go to medical school, are available.

Research at the undergraduate and master's levels can be conducted under the supervision of the chemistry faculty.

Interested students should meet with the chemistry chair to discuss possible research areas.

The department operates laboratories in general chemistry, organic chemistry and instrumental analysis and for research projects.

Mathematics

Faculty: Agrawal (chair), Bailyn, Casti, Hopkins, Smyth, Vulakh

Visiting: Mintchev

The primary responsibility of the Department of Mathematics is the maintenance and delivery of the core mathematics curriculum for the School of Engineering. This consists of a sequence of required courses given in the first two years covering calculus, linear algebra, probability, vector calculus and differential equations. In addition to the core courses, there are a variety of elective mathematics courses, some of which are computer related. The mathematics curriculum will more than adequately prepare the student for professional work as well as graduate study in engineering and applied mathematics.

The faculty of mathematics strives to develop in the student a firm foundation in, and an appreciation of, the structure and methods of mathematics. Students interested in mathematics research should consult the chair for specific areas of expertise.

Mathematics Minor

The department of mathematics offers a minor in mathematics. Students seeking a minor in mathematics must complete at least 15 credits of mathematics coursework in addition to the 17 credits required by every engineering department. These additional credits must include Advanced Calculus I and II (Ma 350, 351), Linear Algebra (Ma 326), Modern Algebra (Ma 347) and an elective course in mathematics at or above the 300 level. An overall G.P.A., at graduation, of at least 3.0 among the mathematics portion (32 credits) of the program is required to obtain a minor in mathematics.

Physics

Faculty: A. Wolf (chair), Uglesich

The physics program at The Cooper Union provides a sequence of introductory courses devised to introduce students in engineering to fundamental physical concepts that underlie all the engineering disciplines. Additionally, the Physics Department offers elective courses that are crafted to provide an enhanced understanding of specially selected fields of interest in engineering science.

COURSE RENUMBERING

In the process of curriculum development, courses have been renumbered. This chart shows the new and old numbers for convenience. You may find an old number listed in the prerequisites for a course.

CS 102	EID102	Introduction to Computer Science
ECE 101	EE101	Communication Theory
ECE 103	EE103	Communications Networks
ECE 110	EE000.1	MATLAB seminar
ECE 114	EE114	Digital Signal Processing
ECE 116	EE211	Music & Engineering
ECE 121	EE171	Control Systems
ECE 131	ESC310	Solid State Materials
ECE 132	EE132	Electro-mechanical Energy Conversion
ECE 150	EE150	Digital Logic Design
ECE 151	EE151	Computer Architecture
ECE 161	EID151	Programming Languages
ECE 163	EE153	Data Structures
ECE 193	EE160	EE projects I
ECE 194	EE161	EE projects II
ECE 195	EE162	EE projects III
ECE 196	EE163	EE projects IV
ECE 301	EE301	Communications Systems
ECE 309	EE360	Intro to Cryptography
ECE 321	EE372	Control System Design
ECE 323	EE381	Embedded System Design
ECE 341	EE143	Integrated Circuit Engineering
ECE 343	EE391	Bio-instrumentation and Sensing
ECE 344	EID123	Bio-systems and Instrumentation
ECE 361	EE352	Software Engineering and Large Systems Design
ECE 399	EE399	Selected topics in Electrical Engineering
ECE 401	EE401	Selected Topics in Communication Theory
ECE 402	EE402	Selected Topics in Probability and Stochastic Processes
ECE 403	EE407	High-speed Networks
ECE 404	EE404	Communication Coding
ECE 405	EE405	Advanced Digital Communications
ECE 408	EE408	Wireless Communications
ECE 409	EE460	Advanced Cryptography
ECE 413	EE413	Robust Signal Processing
ECE 415	EE415	Wavelets & Multi-resolution Imaging
ECE 416	EE416	Adaptive Filters
ECE 417	EE417	DSP System Design
ECE 418	EE418	Digital Video
ECE 421	EE471	Advanced Control System Design

ECE 422	EE482	Selected Topics in Embedded Systems
ECE 423	EE464	Digital & Microprocessor Control
ECE 431	EE421	Microwave Engineering
ECE 433	EE406	Optical Communication Devices & Systems
ECE 441	EE414	Digital Integrated Circuit Engineering
ECE 443	EE440	Thin Film Electronics
ECE 453	EE453	Advanced Computer Architecture
ECE 457	EE457	Computer Operating Systems
ECE 461	EE451	Advanced Programming Methods
ECE 462	EE452	Interactive Engineering Graphics
ECE 464	EE454	Databases
ECE 466	EE456	Compiling Techniques
ECE 468	EE458	Computer Vision
ECE 469	EE459	Artificial Intelligence
ECE 491	EE491	Selected Topics in Electrical & Computer Engineering
ECE 499	EE499	Master's Thesis

Chemical Engineering Courses

Undergraduate

ChE 121 Chemical Reaction Engineering After consideration of chemical reaction kinetics and thermodynamics, the course focuses on the design relationships for batch, semi-batch, plug-flow and mixed reactors. The application of these design relationships is explored in ideal, isothermal, non-isothermal, adiabatic reactors. Homogeneous, heterogeneous and biological systems are discussed including the effect of transport phenomena on reaction rates and reactor design.
3 credits. Prerequisites: ESC 170 and ESC 140

ChE 131 Advanced Chemical Engineering Thermodynamics Concept of fugacity in imperfect gases; chemical potential and partial molal properties in mixtures; Gibbs-Duhem Equation; ideal solutions of imperfect gas mixtures; the Lewis and Randall Rule; methods of calculating activity coefficients in non-ideal mixtures; vapor-liquid equilibria; checking thermodynamic consistency of vapor-liquid equilibrium data; equilibrium constant, enthalpy change and Gibbs free energy of formation in chemical reactions.
3 credits. Prerequisite: ESC 130.1

ChE 141 Heat Transmission Thermal conductivity; steady state conduction in solids and heterogeneous materials; transient conduction; convective heat transfer; heat transfer during boiling and during condensation; design of heat-exchange equipment; radiation heat transfer.
3 credits. Prerequisite: ESC 140

ChE 142 Mass Transfer Operations Diffusion mechanisms and phenomena; estimation of diffusivity. Fick's law of diffusion; concentration distributions in solid and fluid flow with or without chemical reaction. Application of thermodynamic and transport concepts to the design of continuous-contact and staged mass transfer processes. Distillation, gas absorption and drying. Examination of the limitations of theory and empiricism in design practice.
4 credits Prerequisites: ChE 131, ChE 141 and ESC 140

ChE 151 Process Simulation and Mathematical Techniques for Chemical Engineers In this course computer-aided design is applied to chemical engineering problems in fluid flow, heat transfer, mass transfer and chemical reactor analysis. Topics include: matrices and determinants properties and special matrices, systems of linear equations and methods of solution by matrices, eigenvalues, eigenvectors and applications to least squares and stage processes. Steady and unsteady general diffusion equation, one- and two-dimensional heat transfer equation, Fourier series, Laplace and Z transforms and applications. Series and numerical solutions, Power, Bessel, Euler, Runge-Kutta, Milne, Finite differences approximations and Crank-Nicholson. Applications.
3 credits

ChE 152 Chemical Process Dynamics and Control Introduction to logic of process dynamics and principles of control in chemical engineering applications; block diagram notation, input disturbance, frequency response and stability criteria for chemical equipment and chemical reaction systems; single- and multiple-loop systems; phase plane analysis of reaction systems; application of analog computer in solution of problems.
3 credits. Prerequisite: ChE 151

ChE 161.1 Process Evaluation and Design I The course uses design projects to explore process flow diagrams and initial equipment design estimates based on process and unit operation material and heat balances. Studies include equipment cost estimation methods that are developed into process economic evaluations and profitability analysis. The course concludes with process and equipment design using Simulation Science's PRO-vision/PRO-II and an examination of optimization techniques.
3 credits each. Prerequisites: ChE 141 and ChE 121

ChE 161.2 Process Evaluation and Design II This is a continuation of ChE 161.1, and is the "capstone design course" in chemical engineering. All aspects of chemical engineering are integrated in the design of a chemical process plant. The design process consists of flow-sheet development, equipment selection and sizing, utility requirements, instrumentation and control, economic analysis and formulation of safety procedures. The plant design is carried out in class and includes the use of professional

simulation packages. The AIChE project is included in this course.
3 credits. Prerequisite: ChE 161.1

ChE 162.1-162.2 Chemical Engineering Laboratory I & II This laboratory course emphasizes the application of fundamentals and engineering to processing and unit operations. The experiments range from traditional engineering applications to new technologies and are designed to provide hands-on experiences that complement the theories and principles discussed in the classroom. Preparation of detailed project reports and oral presentations are important components of this course.
1.5 credits each. Prerequisite: ChE 121, ChE 141; co-requisite: ChE 142

ChE 311 Introduction to Polymer Technology Introduction to the chemistry and physical status of polymer materials. Discussion on formation of polymers from corresponding monomers, emphasizing mechanisms and kinetics of various polymerization techniques. Measurements of average molecular weights and molecular weight distribution of polymers. Viscosity and rheology of polymer solutions and melts.
3 credits

ChE 321 Chemical Reactor Design Design and analysis of chemical reactor systems; transport phenomena; reactor dynamics; design optimization; experimental techniques.
3 credits. Prerequisite: ChE 121

ChE 340 Industrial Waste Treatment This course deals with the treatment of industrial waste streams. Topics include: sources of wastewater, characterization of industrial wastewater, BOD, COD, TOC, The OD, primary treatment by physical unit operations (coagulation and flocculation, sedimentation, flotation, thickeners, filtration, absorption, ...), secondary treatment by unit processes (ion exchange, chlorination, de-chlorination, ...); biological treatments (kinetics and reactor design, aerobic, anaerobic, ...); industrial applications and municipal and government regulations. This course is 50 percent engineering science, 50 percent engineering design. The course also includes a research paper on an environmental topic.
3 credits. Prerequisite: Ch 160

ChE 342 Separation Processes Advanced study of the theory and design of multi-component distillation, gas absorption and extraction operations. Thermal diffusion, foam

fractionation, parametric pumping, reverse osmosis and chromatographic separations are examples of less conventional operations discussed. Thermodynamics of phase-equilibrium; diffusion and low- and high-flux mass transport theory.
3 credits. Prerequisite: ChE 151

ChE 391 Research Problem I An elective course available to qualified and interested students recommended by the faculty. Students may select problems of particular interest in some aspect of theoretical or applied chemical engineering. Topics range from highly theoretical to completely practical, and each student is encouraged to do creative work on his or her own with faculty guidance.
3 credits. Prerequisite: senior standing.

ChE 392 Research Problem II Continuation of ChE 391.
3 credits. Prerequisite: ChE 391

ChE 393 Research Problem 111 Continuation of ChE 392.
3 credits. Prerequisite: ChE 392

ChE 394 Research Problem IV Continuation of ChE 393.
3 credits. Prerequisite: ChE 393

Graduate

ChE 411 Polymer Technology and Engineering Structures and synthesis of Carbon-Carbon and heterogeneous chain polymers, mechanisms and kinetics of emulsion, condensation, ionic stereo-specific polymerizations. Rubber elasticity, Rheological and viscoelastic properties of polymers and polymer solutions. Survey and investigations of advanced topics are required.
3 credits. Prerequisite: permission of instructor

ChE 421 Advanced Chemical Reaction Engineering Principles and practices of chemical reaction systems emphasizing heterogeneous chemical kinetics, coupled heat and mass transfer in reacting systems and reactor dynamics. Modeling and simulation of systems are extensively applied.
3 credits. Prerequisite: ChE 121

ChE 430 Thermodynamics of Special Systems (same as EID and ME 430)
3 credits. Prerequisite: ChE 131

ChE 431 Advanced Chemical Engineering Thermodynamics and Molecular Theory

Modern methods of applying thermodynamics and molecular physics to phase behavior of fluid mixtures, intermolecular forces and thermodynamic properties, molecular dynamic properties, molecular theory of gases and liquids, theories of liquid solutions and fluid mixtures at high pressures.

3 credits. Prerequisite: ChE 131

ChE 434 Special Topics in Combustion (same as ME 434)

3 credits. Prerequisite: ME334 or permission of instructor

ChE 435 Transport Processes in Internal Combustion Engines (same as ME 435).

3 credits. Prerequisite: permission of instructor

ChE 440 Advanced Fluid Mechanics (same as EID and ME 440).

3 credits. Prerequisites: ESC 140 and permission of instructor

ChE 441 Advanced Heat and Mass Transfer (same as EID 441).

3 credits. Prerequisite: ESC 141

ChE 442 Multi-Component Distillation

Various methods for vapor-liquid equilibrium calculations, including the Wilson parameter approach, are reviewed. Distillation tower design based on steady-state approach includes analytical method using matrix operation and various convergence methods are discussed in detail. Introduction to unsteady-state approach for tower design and dynamics evaluation. Students are encouraged to apply existing techniques to complex towers and to improve the state of the art.

3 credits. Prerequisite: ChE 142

ChE 444 Boundary Layer Theory

Study of heat, mass and momentum transfer in the boundary layer region of a submerged body; emphasis on continuum fluid systems, with introduction to rarified and non-continuum gaseous systems; analytical, numerical and analog methods of solutions.

3 credits. Prerequisite: ESC 141

ChE 451 Digital Simulation

Principles of digital simulation for chemical processes and other engineering problems are introduced. Groups of subroutines as essential tools for dynamic simulation and evaluation are developed. Projects

involving advanced dynamic simulations of chemical engineering systems are required.

3 credits. Prerequisite: permission of instructor

ChE 452 Chemical Process Optimization

Various algorithms of optimization techniques are introduced. Methods covered include both analytical and numerical approaches. Applications to optimal reactor design. Optimal control of chemical process equipment performance is demonstrated. Solution by students of assigned optimization problems in chemical engineering on digital or analog computers is required.

3 credits. Prerequisite: ChE 451

ChE 453 Digital Computer Process Control

An introductory course in digital computer control. Topics discussed include basic mathematics of sampling data systems; control algorithms using transformation, direct digital control, supervisory control, application of the digital computer to advanced control and optimal control. Analog to digital and digital to analog conversions, acquisition of laboratory data and remote control of experimental equipment are also covered.

3 credits. Prerequisite: ChE 152

ChE 454 Advanced Experimental Process Control

Advanced experimental process control concepts and advanced digital computer control. Three-mode feed forward control of process variables including temperature, pressure, level and pH value. Feed forward, proportional and cascade controls of various process variables. Logic programmable control. Series communication control. Computer controls step change, single-in, single-out and transfer function evaluation. Computer data acquisition.

3 credits. Prerequisite: ChE 152

ChE 460 Chemical Engineering Equipment Design

The chemical engineer must develop, design and engineer both the complete process and the equipment used; choose the proper raw materials; operate the plant efficiently, safely and economically; and see to it that products meet the requirements set by the customer. Chemical engineering is both an art and a science. Whenever science helps the engineer to solve a problem, science should be used. When, as usually the case, science does not give a complete answer, it is necessary to use experience and judgement. The professional stature of an engineer depends on skill in utilizing all sources of information to reach practical

solutions to processing problems. This course will concentrate specifically on the theoretical and practical principles of detailed equipment design for mass transfer, heat transfer and reaction operations. Attempts will be made to emphasize modern technologies used in these operations. Equipment covered will vary from year to year.

3 credits

ChE 490 Process Synthesis

This course provides a new basis for the design of integrated chemical processes. The ability to predict, at the outset, achievable design targets that have a sound scientific basis is fundamental to the approach. These targets relate to energy, capital and raw materials, costs and flexibility. Topics will include review of basic thermodynamic concepts, capital/energy trade-off, process integration—multiple utilities, process/utility interface, reactors and separators in the context of overall process—power optimization, design for flexibility, total sites layout, batch processes and process plant retrofit.

3 credits. Prerequisites: ChE 161.1 and ChE 161.2 or permission of instructor

ChE 499 Thesis/Project

Master's candidates are required to conduct, under the guidance of a faculty adviser, an original investigation of a problem in chemical engineering, individually or in a group, and to submit a written thesis describing the results of the work.

6 credits for full year

Civil Engineering Courses

Undergraduate

CE 120 Civil Engineering Fundamentals

Planning, execution and interpretation of drawings and specifications for civil engineering projects. Sample drawings and specifications. Contractual requirements. Sample contracts. Permitting, scheduling and cost estimation. Basic operations of design and construction firms. Interface with other disciplines on civil engineering projects.

3 credits. Prerequisite: EID 101

CE 121 Structural Engineering I

Discussion of materials, loads and forms of structures. Analysis of determinate structures. Displacements of structures and their importance in applications. Experimental aspects of materials behavior in structural applications. Emphasis is placed on basic experimental techniques, design of experiments, selection and use of appropriate instrumentation and interpretation of results.

4.5 credits (3 hours of lecture, 3 hours of laboratory).

Prerequisite: ESC 101

CE 122 Structural Engineering II

Modern methods of structural analysis of indeterminate structures. Discussion of energy methods, force methods and displacement methods. Formulation of elementary matrix stiffness and flexibility methods. Computer applications in structural analysis.

3 credits. Prerequisite: CE 121

CE 131 Introduction to Geotechnical Engineering

Introduction to various indexing tests of soils, clay mineralogy, permeability, seepage and flow nets, stress distribution in soil masses, one-dimensional consolidation theory, strength characteristics of soils, application of Mohr's Circle to soil mechanics, stability of slopes.

4.5 credits (3 hours of lecture, 3 hours of laboratory). Prerequisite: ESC 101; prerequisite or co-requisite. ESC 140

CE 141 Environmental Systems Engineering

Qualitative and quantitative treatment of water and wastewater systems as related to domestic and industrial needs and their effect on the environment. Introduction to air pollution sources and control and solid/hazardous waste engineering. Design of water and wastewater treatment plants. Field and laboratory techniques for measurement of water quality parameters. Laboratory analysis of representative waters and wastewaters for commonly determined parameters as related to applications in water environment.

4.5 credits (3 hours of lecture, 3 hours of laboratory). Prerequisite: ESC 140

CE 142 Water Resources Engineering (same as EID 142)

Problems in conservation and utilization of water. Hydrologic techniques. Surface water and ground water supplies. Water transmission and distribution. Flood control, navigation and irrigation. Introduction to open channel flow and pipe networks. Design of hydraulic structures. Experimental aspects of hydraulic phenomenon. Emphasis is placed on basic experimental techniques, design of experiments, selection and use of appropriate instrumentation and interpretation of results.

4.5 credits (3 hours of lecture, 3 hours of laboratory). Prerequisite: ESC 140

CE 331 Foundation Engineering

Layout of subsurface investigation program, SPT (Standard Penetration Test), Dutch-cone penetrometer. Analysis and design of spread footings on cohesive and cohesionless soil by stability and settlement procedures, combined footings, strap footings, floating foundations and pile foundations. Settlement analysis due to deep-seated consolidation.

3 credits. Prerequisite: CE 131

CE 332 Lateral Earth Pressures and Retaining Structures

Introduction to classical lateral earth pressure theories (Rankine and Coulomb). Analysis and design of cantilever and gravity retaining walls, cantilevered and anchored sheetpile bulkheads, anchorage systems (individual and continuous deadmen, grouted tiebacks) and braced cofferdams. Gravity Wall Systems (Gabion Walls, Criblock Walls and Double Wall).

3 credits. Prerequisite: CE 131

CE 341 Design of Steel Structures

Study of behavior and design of structural steel components and their connections. Understanding and development of design requirements for safety and serviceability, as related to latest structural steel specifications by the American Institute of Steel Construction (A.I.S.C.). Current design emphasizing LRFD, fabrication and construction practices. Composite design.

3 credits. Prerequisite: CE 121; co-requisite: CE 122

CE 342 Design of Reinforced Concrete Structures

Study of the behavior and design of structural concrete components and their connections. Understanding and development of design requirements for safety and serviceability, as related to latest specifications by the American Concrete Institute (A.C.I.). Current design, fabrication and construction practices. Introduction to prestressed concrete.

3 credits. Prerequisite: CE 122

CE 346 Hydraulic Engineering

An integration and application of the principles of fluid mechanics to problems concerned with water supply and distribution. Open channel flow and design of hydraulic structures.

3 credits. Prerequisite: CE 142

CE 351 Urban Transportation Planning

Historical background and evolution of current procedures used in the "urban transportation planning process." Covered are the historical framework, urban development theories, land use, trip generation, trip distribution models, traffic assignment techniques, modal split and introduction to urban transportation systems.

3 credits

CE 352 Elements of Transportation Design

Review of urban transportation planning process. Specific design elements of various highway and public transportation systems. Included are locational design, traffic service, environmental impact analyses, alternatives evaluation, geometric design elements, operations and capacity and level-of-service analysis. Also, selected topics in urban transportation systems.

3 credits

CE 361 Civil Engineering Experimental Projects

Exploratory experimental projects in materials, hydraulics, soils, environmental or other civil engineering specialties. Projects are

conceived, designed and executed by groups of students under faculty supervision.

2 credits. Prerequisite: Permission of instructor. (Students are required to have taken introductory civil engineering subject(s) related to project)

CE 363 Civil Engineering Design I

Individual or group design projects based upon the interests of the students and with the approval of the instructor. Final engineering reports and formal oral presentations are required for all projects. Lectures by faculty and professional practitioners cover the following topics: engineering, environmental and economic feasibility assessment issues; preparation of plans and specifications; cost estimates; progress chart and critical path; interfacing with community, etc. Field visits to major New York City projects under construction.

3 credits. Prerequisite: permission of instructor. (Students are required to have taken introductory CE subject(s) related to project)

CE 364 Civil Engineering Design II Continuation of CE 363.

3 credits. Prerequisite: CE 363

CE 369 Civil Engineering Project

Individual design, research or experimental projects. Open only to well-qualified students.

3 credits. Prerequisite: permission of instructor

CE 380 Fundamentals of Construction Management (same as EID 380)

3 credits

CE/EID 390 Introduction to Sustainable Design

Sustainable design minimizes the impact on the environment by site planning and design, energy and water conservation and interior environmental quality. This course will focus on the design of a prototype structure using sun, light, air, renewable materials, geological systems, hydrological systems and green roofing. Each student will develop a project outlined by the U.S. Green Building Council rating system known as LEED. The six areas that will be developed to design the project are: sustainable sites, water efficiency, energy and atmosphere, material and resources, indoor environmental quality and innovative design process. Class time is separated into a series of lectures, private consultations and student presentations.

3 credits. Prerequisite: permission of instructor and ESC 140; CE 122 or ME 100

Graduate**CE 411 Introduction to Civil Engineering Management**

Overview of the civil engineering profession and the importance of infrastructure to society. The course will emphasize the planning, design, construction and maintenance of public works. New York City will serve as the laboratory for field visits and course projects.

3 credits. Prerequisite: permission of instructor

CE 412 Stochastic Concepts in Civil Engineering

Introduction to probabilistic methods and stochastic concepts in civil engineering. Elements of applied probability and statistics. Engineering applications involving economic decisions under uncertainty. Realistic and common civil engineering examples and problems in transportation, structures, materials, soils and water resources.

3 credits. Prerequisites: Ma 224 and Ma 240

CE 414 Solid Waste Management

Engineering aspects of solid waste collection, transport and disposal, including sanitary landfill design, incineration, composting, recovery and re-utilization of resources. Optimization techniques of facility-siting and collection route selection and economic evaluation of factors affecting selection of disposal methods.

3 credits. Prerequisite: permission of instructor

CE 421 Matrix Methods of Structural Analysis

In-depth treatment of matrix methods. Application to linear as well as nonlinear analysis of plane and space structures. Discussion of current techniques. Computer applications.

3 credits. Prerequisites: CE 122, Ma 240

CE 422 Finite Element Methods (same as EID 422)

Shape functions and generalized displacements. Assemblage of elements. Convergence criteria. Triangular, rectangular and quadrilateral elements in plane stress and plane strain. Isoparametric formulations. General solids. Hexahedral and tetrahedral elements. Flexure in plates. General shells. Natural coordinates. Computer programs.

3 credits. Prerequisite: CE 122 or ME 100

CE 424 Plates and Shells

Discretized grid-work and grillage analysis by matrix techniques. Development of the classical thin plate theory. Mathematical and numerical solutions of the plate equation. Introduction to thin shell theory. Practical applications such as cylindrical shell roofs, spherical shell with an edge ring and various cases of shells of revolution.
3 credits. Prerequisite: CE 122

CE 425/EID 425 Structural

Dynamics Dynamic behavior and design of structures subjected to time-dependent loads. Included in the load systems are earthquakes, blasts, wind and vehicles. Shock spectra and pressure impulse curves. Special applications in blast mitigation design.
3 credits. Prerequisite: CE 122

CE 426 Advanced Structural Design

Discussion of principal design codes (AISC, ACI and AASHTO) as they relate to ASCE Standards, the International Building Code (IBC) and NYC Building codes. Advanced materials behavior. Strength and serviceability requirements. Design of composite girders and slabs. Limit state response and formation of plastic hinges in steel and concrete structures. Structural upgrade and retrofit of existing structures.
3 credits. Prerequisite or co-requisite: CE 341

CE 427 Behavior and Design of Prestressed Concrete Structures

Behavior and design of prestressed members in flexure, shear, bond and torsion; continuous beams; columns; prestressed systems; loss of prestress. Emphasis is placed on ultimate strength design and the background of latest ACI code.
3 credits. Prerequisite: CE 341

CE 428 Plastic Analysis and Design

Limit analysis of beams and frames. Upper and lower bound theorems. Collapse loads and displacements. Applications to steel and concrete structures. Special applications in blast mitigation design.
3 credits. Prerequisite: CE 341

CE 431 Advanced Foundation Engineering

Analysis and design of foundations subjected to vibratory loading, beams on elastic foundation (vertical subgrade modulus), laterally loaded piles (with software applications), Wave Equation Analysis of Piles (with software application of WEAP).
3 credits. Prerequisites: CE 131 and permission of instructor

CE 432 Special Topics in Lateral Earth Pressure and Retaining Structures

Analysis and design of cellular cofferdams, reinforced earth-retaining structures, slurry walls and retaining structures subjected to earthquake loading, soil nailing.
3 credits. Prerequisites: CE 131 and permission of instructor

CE 433 Advanced Topics in Geotechnical Engineering I

Analysis of slopes using translatory slides and available software packages (PCSTABL). Ground improvement technologies: including dynamic compaction, grouting, ground freezing and reinforced earth technologies.
3 credits. Prerequisite: permission of instructor

CE 434 Advanced Topics in Geotechnical Engineering II

Stresses in homogeneous and layered systems due to surface and buried loads. Development of flow network concepts and the Terzaghi one-dimensional consolidation theory, secondary consolidation, site pre-loading, sand drains and prefabricated vertical drains.
3 credits. Prerequisite: permission of instructor

CE 435 GeoEnvironmental Engineering (same as EID 435)

3 credits. Prerequisites: ESC 140, CE 141, CE 131 and permission of instructor

CE 440 Industrial Waste Treatment Design

Integrated lecture and design periods that cover the sources of industrial wastewaters, their quantities and characteristics, and their treatability by physical, chemical and biological processes. Status of regulations involving categorical standards, local and state industrial pretreatment programs, NPDES permits, etc. Problems and solutions involved in combining municipal and industrial waste treatment. Case studies.
3 credits. Prerequisite: permission of instructor

CE 441 Water and Wastewater Technology

Wastewater sources and estimates of domestic, commercial and industrial flows. Integrated lecture and design periods that cover unit processes for water and wastewater treatment. Design projects include hydraulic and process design of oxidation ponds, screening, grit removal, sedimentation tanks, secondary biological treatment, other physicochemical processes and outfall design.
3 credits. Prerequisite: permission of instructor

CE 442 Open Channel Hydraulics

Derivation of the general one-dimensional equations of continuity, momentum and energy used in open channel flow analysis. Steady uniform flow and boundary resistance. Steady nonuniform flows, channel transitions and controls, hydraulic jumps, surges, surface curves for gradually varied flow including the effects of lateral inflow. Unsteady flow in open channels. Dynamic waves, method of characteristics, surge formation. Kinematic waves, flood routing and overland flow. Design of channels and other hydraulic structures.
3 credits. Prerequisite: CE 142

CE 443 Groundwater Hydrology

Physical process of flow in homogeneous and heterogeneous media. Development of governing equations and boundary conditions, analysis by analytical and numerical techniques. Groundwater resources; design of wells and prediction of yield. Analyses of transport of contaminants using deterministic and stochastic methods.
3 credits. Prerequisite: CE 142

CE 444 Hydrology

Hydrology of the water cycle related to air mass movement, precipitations, evaporation, stream flow, floods, infiltration and groundwater including statistical hydrology. Design of irrigation systems.
3 credits. Prerequisite: CE 142

CE 445 Coastal Engineering

Introduction of the hydrodynamics of waves in deep and shallow water. Emphasis on physical interpretation of the results and their engineering application. Wave refraction, diffraction, storm surges and statistical aspects of water waves.
3 credits. Prerequisite: CE 142

CE 446 Pollution Prevention or Minimization

Introduction to the new concept and regulations in the U.S. and Canada of Pollution Prevention or Waste Minimization for managing hazardous pollution and protecting the environment and public health. Methodology of conducting environmental audits and lessons learned from successful pollution prevention programs. Case studies of various programs in industry, etc.
3 credits. Prerequisite: permission of instructor

CE 447 Stream and Estuary

Pollution Application of basic concepts of fluid kinetics and dynamics to the analysis of dispersal and decay of contaminants introduced into lakes, streams, estuaries and oceans. Analysis and modeling of leachate and other contaminants into groundwater.
3 credits. Prerequisite: CE 142

CE 448 Environmental and Sanitary Engineering (same as EID 448)

Topics include types of environmental pollution and their effects; water quality standards and introduction to laboratory analyses of water quality parameters; sources and estimates of water and wastewater flows; physicochemical unit treatment processes. Integrated lecture and design periods cover water supply network, wastewater collection system and water treatment design projects.
3 credits. Prerequisite: permission of instructor

CE 449 Hazardous Waste

Management Definition and characteristics of hazardous wastes. Generation, transport, treatment, storage and disposal of hazardous wastes. Leachate characteristics and management. Treatment technologies. Monitoring and safety considerations. Obligations under Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Field trips.
3 credits. Prerequisite: permission of instructor

CE 450 Civil Engineering

Construction Preparation of plans and specifications. The bidding and award process. Contractual relations between the owner and the contractor.

Preparation of cost estimate for a competitively bid project. Preparation of a progress chart and critical path. Sequencing various job elements. Engineering the actual construction. Management of labor. Interlacing with the community. Environmental requirements. Job safety. Changes and unanticipated conditions. Contract disputes and their resolutions.

3 credits. Prerequisite: CE 341

CE 470 Urban Security

Design of urban systems to protect against terrorism. Analysis of blast loads. Blast mitigation design considerations. Technology transfer: military/defense to civilian sector. Response spectra. Pressure-Impulse Curves. Stand off distances. Blast mitigation measures for buildings, bridges and tunnels. Prevention of progressive collapse in tall buildings. Design of glazing. Retrofit upgrade of existing urban infrastructure. Proposed changes in New York City Building Code to protect against terrorism. Insurance issues for commercial buildings.

3 credits. Prerequisites: CE 122 or ME 101 and permission of instructor

CE 499 Thesis/Project

Master's candidates are required to conduct, under the guidance of a faculty adviser, an original investigation of a problem in civil engineering, individually or in a group, and to submit a written thesis describing the results of the work.

6 credits for full year

Electrical Engineering**Electrical and Computer Engineering (ECE)****Undergraduate****ECE 101 Communication Theory (formerly EE 101)**

Information theory: entropy, information, channel capacity, rate-distortion functions, theoretical limits to data transmission and compression. Error control coding: block, cyclic and convolutional codes, Viterbi algorithm. Baseband and bandpass signals, signal constellations, noise and channel models. Analog and digital modulation formats (amplitude, phase and frequency), MAP and ML receivers, ISI and equalization. Coherent and non-coherent detection, carrier recovery and synchronization. Performance: computation of SNR, BER, power and bandwidth requirements. TDMA, FDMA, CDMA.

3 credits. Prerequisites: Ma 224 and ECE 111

ECE 103 Communication Networks (formerly EE 303)

Analysis and design of communication networks. Network protocols, architecture, security, privacy, routing and congestion control, internet, local area networks, wireless networks, multimedia services. Physical layer, multiple access techniques, transport layer. Introduction to probabilistic and stochastic analytic techniques for communication networks. Simulation techniques.

3 credits. Prerequisites: ECE 150 and Ma 224

ECE 110 MATLAB Seminar: Signals & Systems

A weekly hands-on, interactive seminar that introduces students to MATLAB, in general, and the Signal Processing Toolbox in particular. Students explore scientific computation and scientific visualization with MATLAB. Concepts of signal processing and system analysis that are presented in ECE111 or other introductory courses on the subject are reinforced through a variety of demonstrations and exercises. It is strongly encouraged for students taking a first course in signals and systems, or for students expecting to use MATLAB in projects or courses.

0 credits. 1 hour per week

ECE 111 Signal Processing & Systems Analysis

A presentation of signals and systems that does not rely on prior knowledge of electrical circuits or differential equations. Sine waves, phasors, continuous-time and discrete-time signals, sampling. Starting from elementary discrete-time systems (FIR filters), and moving on to more complex systems (IIR digital filters and analog filters), concepts such as impulse response, convolution, frequency response, transfer functions (z-transform and Laplace transform) are presented. Block and signal-flow diagrams. Linearity, causality, time-invariance, stability. Feedback: open-loop and closed-loop gain. Transient response, poles and zeros. Vector spaces of signals, Fourier analysis, modulated signals, random signals. Examples include speech and audio signals, communication and control systems. Extensive use of MATLAB.

3 credits. Prerequisite: Ma 113, co-requisite: ECE 110

ECE 114 Digital Signal Processing (formerly EE 114)

Review of Laplace and z-transforms. Minimum-phase and all-pass functions. Multidimensional signals, systems and Fourier analysis. Analog filter design, digital IIR and FIR filter design. Sampling, multirate systems and filter banks, A/D and D/A converter models. Discrete-time state-space. Filter structures, quantization effects and design to mitigate quantization effects. DFT and FFT. Spectral analysis of deterministic and random signals. Introduction to adaptive filters. Differential coding, transform coding. Speech, audio and video signals. Extensive use of MATLAB.

3 credits. Prerequisites: Ma 240 and ECE 111

ECE 121 Control Systems (formerly EE 171)

Block and signal-flow diagrams, Mason's theorem. Laplace transform, frequency response, Bode plots, root locus, Routh-Hurwitz array. Analysis of feedback control systems: open-loop and closed-loop gain, Nichols chart, Nyquist diagram, gain and phase margin. Continuous-time state-space analysis, state-variable feedback, canonical forms, observability and controllability. Second-order models, transient and steady-state performance. Emphasis on analog systems, although digital control systems will be discussed as time allows. Extensive use of MATLAB.

3 credits. Prerequisites: Ma 240 and ECE 111

ECE 131 Solid-State Materials

Applied solid-state physics with emphasis on semiconductor materials. Crystals, quantum mechanics, Schrodinger equation, energy bands, Fermi-Dirac statistics, Fermi levels. Semiconductor physics: electrons and holes, doping, diffusion and drift, generation-recombination, mobility. Physics of PN junction and BJT; depletion, carrier injection, minority carrier profiles, Ebers-Moll equations, junction capacitance, hybrid-pi model. Breakdown, metal-semiconductor contacts, heterojunctions, fabrication techniques, temperature effects and additional topics as time allows. Diode circuits; DC analysis of BJTs in active, saturated and cutoff modes; single transistor amplifiers and small-signal models.

3 credits. Prerequisite: ECE141

ECE 132 Electro-Mechanical Energy Conversion (formerly EE 132)

Analysis of energy sources and energy converters. Principles of electro-mechanical energy conversion; singly and multiply excited systems; rotating and linear machines; three-phase circuits; magnetic circuits and transformers; torque and induced voltage from field considerations; synchronous machines; induction motors; DC machines. Introduction to power electronics. Applications including high-speed transportation, energy storage and interconnection of distant generating stations.

3 credits. Prerequisites: ESC120 or ECE 141 and Ph 213

ECE 135 Engineering Electromagnetics

This course emphasizes time-varying fields, with topics presented from electrostatics and magnetostatics as necessary. Maxwell's equations, constitutive relations, phasor vector fields, wave and Helmholtz equations, potentials, boundary conditions. Plane waves in lossless and lossy materials, polarization, incidence. Transmission lines: transient analysis, TDR, phasor analysis, standing wave diagrams, Smith chart, impedance matching. Guided waves: TEM, TE and TM modes, dispersion, evanescence, cavity resonators. Microwave network analysis and device characterization with scattering parameters. Antennas, antenna arrays and Fourier optics. Additional topics from microwaves and optics will be covered as time allows. Students use a vector network analyzer to perform measurements at high frequencies.

4 credits. Prerequisites: Ma 223, Ph 213 and ECE 111

ECE 141 Circuits & Electronics I

Circuit analysis: KVL, KCL, loop and nodal analysis, systematic and "shortcut" solution methods. Transient analysis of first, second and higher order RLC circuits, initial conditions. Introduction to diode and transistor models and circuits.

3 credits. Prerequisite: Ma 113

ECE 142 Circuits & Electronic II

MOS circuits: DC operation and analysis. Single stage MOS amplifiers, circuit design, DC and small signal analysis. Cascode amplifier. Current mirrors, active loads. BJT and MOS differential amplifiers. Monolithic operational amplifiers. Output stages. Frequency response. Introduction to feedback theory, amplifier topologies. Circuit design and analysis are supplemented with industry standard CAD software.

3 credits. Prerequisites: ECE131, ECE141

ECE 150 Digital Logic Design (formerly EE 150)

Theoretical and practical issues concerning design with combinational and sequential logic circuits, and programmable logic devices. Number systems, Boolean algebra, representation and simplification of Boolean functions, universal logic families. Finite-state machines, state tables and state diagrams, flip-flops, counters, registers. Adders, decoders, comparators, multiplexers, memories and applications. Programmable devices: PLA, PLD, etc. Principles of analog circuits are presented in the context of real world problems, such as "glitches," power and ground bounce, contact bounce, tri-state logic and bus interfacing, timing circuits, asynchronous versus synchronous circuit components. Characterization of electronic and logical properties of digital circuits. Course work involves individual and team projects in which: digital circuits are designed and prototypes are constructed and tested on breadboards; designs involving programmable logic devices are developed using CAD tools. The projects, approximately 50 percent of the course grade, are used to assess technical writing, oral presentation, teamwork and project management skills.

3 credits. Prerequisites: none. Non-refundable materials fee: \$40

ECE 151 Computer Architecture (formerly EE 151)

Basic structure of computers based on the von Neumann model. Generic one-bus, two-bus and three-bus architectures. Stack based design. Tri-state logic and interfacing to a bus. Aspects of bus timing and maximum running speeds. Instruction sets: 1,

11/2, 2, 3 and more operand instructions. Operand addressing modes including case studies. Computer subsystems: (a) memory: dynamic and static RAM, refresh cycles, asynchronous data transfers; (b) I/O: interrupts vs. polling, ISRs and program controlled I/O. The control unit: microprogramming vs. hardwired controllers. Horizontal vs. vertical microinstructions. The execution of a program; instruction fetch and execution sequences; PC, IR and other special registers. Computer peripherals and secondary storage. Course work involves the building of advanced digital circuits using VLSI programmable chips provided in a kit of parts. Introduction to parallel and pipelined architectures

ECE 161 Programming Languages

Practical programming languages including C, C++ and Java; optionally Perl or additional languages. Memory, strings, pointers and arrays. Structures and linked lists. Static memory, the stack and the heap. Activation records and function calls. Structured programming. Recursion. Object oriented programming. C++ strings, vectors and maps. Creating classes: data members, member functions, constructors and destructors. Encapsulation and information hiding. Derived classes, inheritance and polymorphism. Operator overloading. An overview of Java.

3 credits. Prerequisite: CS102

ECE 164 Data Structures & Algorithms I

An introduction to fundamental data structures and algorithms, with an emphasis on practical implementation issues and good programming methodology. Topics include lists, stacks, queues, trees, hash tables and sorting algorithms. Also an introduction to analysis of algorithms with big-O notation. Assignments include programming projects and problem sets.

2 credits. Prerequisite: ECE 161

ECE 165 Data Structures & Algorithms II

A continuation of ECE 164, also with an emphasis on practical implementation issues and good programming methodology. Topics include graphs, graph related algorithms and dynamic programming techniques. Also an introduction to some advanced topics such as Turing machines, computability and NP-complete systems. Assignments include programming projects and problem sets.

2 credits. Prerequisite: ECE 164

ECE 193 Electrical & Computer Engineering Projects I (formerly EE 160)

An introduction to laboratory techniques for electrical and computer engineering. Electronic test equipment including: DVM, oscilloscope, curve tracer, spectrum analyzer. Circuit analysis and design, discrete and integrated electronic components and circuits. Several projects of limited scope provide an understanding of the fundamental building blocks employed in the more advanced designs in successive projects courses. Students give weekly oral presentations and demonstrate laboratory proficiency through in-class demonstrations and concise, formal technical reports.

11/2 credits. Prerequisites: ECE 111, ECE 141 and ECE 150. Non-refundable materials fee: \$40

ECE 194 Electrical & Computer Engineering Projects II (formerly EE 161)

Principles learned in ECE 193 are applied to the design, construction and characterization of electrical and computer engineering projects of significant complexity. Assignments typically involve both analog and digital design, and students are free to pursue any solution that satisfies the engineering requirements and meets with the instructor's approval. Formal and informal lectures are given on safety, circuit operation and design, and construction techniques; participation in design reviews and technical reports.

4 credits. Prerequisite: ECE 193. Non-refundable materials fee: \$40

ECE 195 Electrical & Computer Engineering Projects III (formerly EE 162)

ECE 195 and ECE 196 constitute the year-long senior design project. Students work in small groups on projects chosen with the advice and consent of the faculty adviser. Projects may be oriented towards research or product development, and may be in any area of electrical and computer engineering, such as in: computer engineering, signal processing (imaging, sensor arrays, multimedia), telecommunications, computer networks, microwaves, optics, advanced electronics, VLSI chip design, or an interdisciplinary area such as robotics or bioengineering. Students perform all aspects of project management, such as scheduling, budgeting, system design and developing milestones, as well as technical work including hardware and software implementation, testing and performance evaluation. Students also give several spontaneous and rehearsed oral presentations

and prepare written reports. Students attend weekly lectures covering: social, economic, legal and ethical issues; safety and laboratory practice; design methodologies; technical writing; preparation of multimedia presentations and tailoring presentations to target audiences.

3 credits. Prerequisite: ECE 194. Non-refundable materials fee: \$40

ECE 196 Electrical & Computer Engineering Projects IV (formerly EE 163)

This course concludes the senior project begun in ECE 195. Students submit two complete theses, one in short form and the other in long form, and give at least two presentations, one short and one long. The initial goal is to achieve a functioning system. Afterwards, students undertake the completion of the prototyping cycle, which may involve improving the circuit implementation (such as by employing PCBs populated with surface mount chips), adding a user-friendly interface, obtaining precise performance evaluations, or developing demonstrations and a user's manual. Advanced students are strongly encouraged to complete their project early and commence a master's thesis.

3 credits. Prerequisite: ECE 195. Non-refundable materials fee: \$40

ECE 301 Communication Systems Design (formerly EE 301)

Topics in the design of large scale communication systems. Quality of service, system performance calculations, channel capacity and traffic models, scalability. Measurement and simulation techniques. Noise, interference, system noise figure, front-end design, power budgets. Communication electronics. Baseband DSP, IF and RF subsystems. Standards, evolution of technology, product roadmapping. Case studies.

3 credits. Prerequisites: ECE 101 and ECE 135

ECE 302 Probability Models & Stochastic Processes

Topics in probability, random variables and stochastic processes applied to the fields of electrical and computer engineering. Probability, events, random variables, expectation, moments, characteristic functions, conditional probability and expectation. Functions of random variables, random vectors, Gaussian random vectors, Poisson points. Bounding and limit theorems. Relations among important distributions and probability models. Stochastic processes: stationarity, ergodicity, Brownian motion, Markov processes. Deterministic systems with stochastic inputs, correlation and power spectral density, ARMA models. Hilbert space and applications: orthogonality principle, discrete Wiener and Kalman filters, linear prediction, lattice filters.

3 credits. Prerequisites: Ma 224 and ECE 101 or ECE 114 or permission of instructor

ECE 305 Computer Security

This course covers attack and defense perspectives of applied information security. Topics will include networked and embedded applications, access controls systems and their failure modes, privilege escalation, case studies and some applied cryptography. Safe practices and OS flaw mitigation will be reinforced through security-sensitive programming projects. Course work will include penetration testing, code auditing and independent programming projects using professional auditing frameworks.

3 credits. Prerequisite: CS 102

ECE 309 Introduction to Cryptography (formerly EE 360)

Selected topics in theoretical and applied cryptography, with an emphasis on "provably secure" systems. One-Time Pads and security in the Shannon sense, cryptographic hash functions, password schemes, basic number theory, hardcore bits, pseudo-random number generators and properties of pseudo-randomness (computational indistinguishability), block and stream ciphers, public key cryptography, message authentication and digital signatures. Real world examples including S/Key, DES, RSA, Diffie-Hellman. Students will have the choice to either program an implementation for a crypto-system or write a research paper.

3 credits. Prerequisites: Ma 111 and Ma 224

ECE 311 System Design for Signal Processing Applications

Design of digital signal processing systems. Implementation of DSP algorithms in programmable and custom VLSI processors. A/D and D/A converters. Real-time systems that handle large amounts of data such as sensor arrays, radar, medical imaging, and multimedia networks.

3 credits. Prerequisites: ECE 114 and ECE 151

ECE 313 Music & Engineering

Spectral representation and analysis of music. Analog and digital music signals, instruments and synthesizers, analog circuits and digital processing. Description of musical quality and perception, introduction to acoustics, stereo and special effects. Computer interfacing with MIDI and laboratory experiments.

3 credits. Prerequisites: ECE111, ECE150

ECE 321 Control Systems Design (formerly EE 372)

Control system design using Bode plots, Nichols chart, root locus. Design by pole placement, Ackermann's formula, state-variable feedback. Cascade compensation, minor-loop feedback. Controller and estimator design, regulator systems, systems with a reference input. Introduction to digital control: hybrid analog-digital control systems, sampled-data systems, digital extensions of Bode plots and root locus, Ragazzini's method. Extensive use of MATLAB.

3 credits. Prerequisite: ECE 121

ECE 323 Embedded System Design (formerly EE 381)

Hardware and software design for embedded systems. SBC and microcontroller architectures, A/D and D/A conversion, signal conditioning, interfacing and controlling electronic and electro-mechanical systems. Assembly language and high-level language programming, efficient use of computational and physical resources, considerations for speed and robustness, debugging methods, use of simulators and in-circuit emulators. The course is project-based, and students are required to design and construct an embedded system.

3 credits. Prerequisites: ECE 121 and ECE 151

ECE 341 Integrated Circuit Engineering

Feedback theory, frequency compensation. Integrated circuit fabrication and technology. Device modeling, thermal effects. VLSI CAD design tools. Circuit layout, extraction and simulation. Design and analysis of multistage MOS operational amplifiers, OTA architectures. Nonlinear circuits, comparators. Analog switches. Digital phase-locked loops. Sample and hold circuits. Data converter architectures. Switched capacitor circuits. Bandgap reference circuits. MOST digital circuit design and layout, hierarchical approaches. Final design project is a mixed analog/digital circuit (e.g., Flash A/D converter, phase-locked loop), which is sent for fabrication.

3 credits. Prerequisites: ECE131, ECE142

ECE 343 Bio-instrumentation and Sensing (formerly EE 391)

The basic human vital signs and some related elementary physiology viewed from an engineering standpoint with special emphasis placed upon current electronic measurement methods. Electrocardiographic and electromyographic signals. Safety problems related to electrical isolation. Guarded, fully isolated, modulated carrier operational amplifiers and microvolt-level amplification. Solid-state "grain of wheat" pressure sensors, microelectrodes, thermal probes, ultrasonic transducers and other biosignal sensors. Course work includes instrumentation and sensing projects.

3 credits. Prerequisites: ECE 114 and ECE 142

ECE 357 Computer Operating Systems

Theory and implementation of modern computer operating systems. Message-based and multiprocessor kernels. Networking and interprocess communication. Security, auditing and authentication. Device drivers, interrupt handling, task switching, virtual memory management, scheduling, synchronization and locking. File systems, resource allocation and management. Real-time, fault-tolerant and high security operating systems. User environment and interface issues. Projects in operating system design and programming, case studies.

3 credits. Prerequisites: ECE 150 (Dig. Logic Desc.), ECE 161 (Prog. Lang.)

ECE 361 Software Engineering & Large Systems Design

This course teaches about the development stages of large, robust, expandable software systems developed as part of a team. Topics include project management, capturing requirements, system design, UML, program design, testing, delivery and maintenance. The class will develop a large project as a team using Java throughout the semester. Tools, libraries and techniques necessary for the project will be covered in class, e.g., Eclipse, Javadoc, XML, SOAP, servlets, threads and processes, Swing, JUnit, MySQL, JDBC, etc. The specific resources might change from semester to semester.

3 credits. Prerequisite: ECE165

ECE 391 Research Problem

An elective course open to qualified upper division students. Students may approach an EE faculty member and apply to carry out research on problems of mutual interest in theoretical or applied electrical and computer engineering. Student performs creative work with faculty guidance.

3 credits. Prerequisite: Instructor approval

ECE 392 Research Problem II (continuation of ECE 391)

3 credits. Prerequisite: instructor approval

ECE 399 Selected Topics in Electrical & Computer Engineering (formerly EE 399)

Subjects may include seminars on topics related to advances in technology, current research areas. Also individual research, design and development or study of subjects in electrical and computer engineering.

1-3 credits. Prerequisite: Permission of instructor

Electrical and Computer Engineering (ECE)

Graduate

ECE 401 Selected Topics in Communication Theory (formerly EE 401)

Advanced topics in communications engineering, selected according to student and instructor interest. *3 credits. Prerequisite: ECE101 and permission of instructor*

ECE 402 Selected Topics in Probability & Stochastic Processes

Advanced topics in applied probability or stochastic processes. Possible areas of study include: Markov processes, queuing theory, information theory, estimation and decision theory and financial engineering. Topics vary year to year. *3 credits. Prerequisite: ECE 302 and permission of instructor*

ECE 403 Advanced Communication Networks (formerly EE 407)

A continuation of topics from ECE 103. Technical readings, case studies, and research in network architectures and protocols. Related topics such as distributed computing and ad hoc sensor networks may be covered as well. Topics from probability, stochastic processes and graph theory are presented as needed for the analysis and simulation of communication networks. *3 credits. Prerequisite: ECE 103*

ECE 404 Communication Coding (formerly EE 404)

Survey of topics from abstract algebra: groups, cosets, polynomials, finite fields. Block codes: cyclic, BCH and RS codes. Convolutional and trellis codes, Viterbi algorithm. Trellis coded modulation. Turbo codes. Performance of error detection and correction schemes in both hard-decision and soft-decision decoding environments. Efficient realizations of encoders and decoders. *3 credits. Prerequisite: ECE 101*

ECE 405 Advanced Digital Communications (formerly EE 405)

Advanced digital modulation including formats with memory, continuous-phase and constant-envelope schemes. Performance analysis for AWGN and other channels. Multitone and multicarrier communications. Spread spectrum with applications to multiple access schemes and secure communications. CDMA: PN sequence generation and properties, multi-user detection. Additional topics as time permits. *3 credits. Prerequisites: ECE 101 and ECE 302*

ECE 408 Wireless Communications (formerly EE 408)

Survey of cellular mobile radio systems and formats, including market trends and technological advances. The emphasis is on CDMA and 3G systems, and emerging schemes such as WiFi networks, although TDMA systems will be discussed as well. Propagation and multipath fading channel models and simulation. Cellular system capacity, traffic models, multiple-access techniques, handoff and power control algorithms. Modulation formats, detection schemes and performance. Mitigating fading: pulse shaping, DFE, MLSE (Viterbi). DSP algorithms for baseband processing. *3 credits. Prerequisite: ECE 101*

ECE 409 Advanced Cryptography (formerly EE 460)

Selected topics in theoretical cryptography, with an emphasis on definitions and proofs of security. Security in the Shannon sense, complexity of algorithms and non-deterministic algorithms, one-way functions, trapdoor functions, cryptographic hash functions, number theoretic constructs (such as RSA and Rabin's scheme), hardcore bits and the Goldreich-Levin construction, definition and construction of pseudo-random number generators and pseudo-random function families, computational indistinguishability and the hybrid argument, Feistel Networks and the Luby-Rackoff construction, stream and block ciphers, DES, public-key cryptosystems, semantic security, message authentication codes, digital signature schemes, commitment schemes, and zero knowledge proofs. *3 credits. Prerequisites: ECE 309 and Ma 224; Ma 352 recommended*

ECE 410 Radar & Sensor Array Processing

Terminology and system overview for modern radar and sensor array systems; antenna parameters; radar signals and waveforms; Doppler processing; detection; synthetic aperture imaging (SAR); beamforming and space-time array processing (STAP); adaptive methods; additional topics may be covered according to student and instructor interest. Computer simulations and readings in the technical literature. *3 credits. Prerequisites: ECE101, ECE114*

ECE 411 Selected Topics in Signal Processing

Advanced topics in signal processing selected according to student and instructor interest, and instructor approval. *3 credits. Prerequisite: ECE 114 and permission of instructor*

ECE 412 MRI Systems

A seminar course covering various topics in magnetic resonance imaging systems and applications. Strategies for design for k-space sampling and pulses. Fast imaging techniques, multi-channel MRI systems. Measurement and analysis of image quality and artifacts. Motion measurement and artifacts. Angiography-imaging blood flow, dynamic imaging of the heart. Various clinical applications. Technical readings and field trips. *3 credits. Prerequisites: Ma 417 and ECE 114, or permission of instructor*

ECE 413 Robust Digital Signal Processing (formerly EE 413)

Modern DSP algorithms are presented under the unifying concepts of passivity and structurally lossless realizations. Robust design perform well under non-ideal conditions, such as finite-precision arithmetic and failure of stationarity and other statistical assumptions. The theory of bounded real functions, lossless multiports, realization by extraction and interconnection of elementary lossless building blocks is presented. Applications include mitigating quantization effects in conventional and adaptive filters. Connections are also established with: multirate systems and filter banks; spectral analysis and stochastic realization. *3 credits. Prerequisite: ECE 114*

ECE 415 Wavelets & Multiresolution Imaging (formerly EE 415; same as Ma 415)

Wavelet analysis with emphasis on two- and three-dimensional spaces. Time-frequency analysis, multi-resolution analysis (MRA) of signal spaces, Mallat transforms,

construction and functional properties of wavelets, connection with multi-rate filter banks. Multidimensional lattices and sampling theory, multidimensional multi-rate systems. PR, QMF and para-unitary filter banks. Techniques for handling boundary effects. Wavelet representation of differential operators with application to image processing. Image and video coding and compression with wavelet transforms. Case studies and technical readings of recent research efforts. *3 credits. Prerequisites: Ma 240 and ECE 111. Taught jointly by electrical engineering and mathematics faculty*

ECE 416 Adaptive Filters (formerly EE 416)

Statistical signal processing theory: discrete-time Wiener and Kalman filters, linear prediction, steepest descent and stochastic gradient. LMS, normalized LMS, LS, RLS, QR-RLS, order-recursive algorithms. Applications include equalization, noise cancellation, system identification, sensor array processing. Numerical linear algebra: eigenanalysis, SVD, matrix factorizations. Transversal filters, lattice filters, systolic arrays. Performance: convergence, learning curves, misadjustment, tracking in nonstationary environments. Additional topics such as adaptive IIR filters, neural networks and quantization effects may be covered as time allows. Extensive use of MATLAB. *3 credits. Prerequisite: ECE 302 or permission of instructor*

ECE 417 DSP System Design (formerly EE 417)

Design of programmable and custom digital signal processors, and realization of DSP algorithms in specialized architectures. Features of programmable DSPs such as data-stationary and time-stationary coding, MAC and ACS ALUs, circular buffers. Very Long Instruction Word (VLIW) processors. Applications of graph theory and passivity theory to map DSP algorithms to custom structures: SFGs, DFGs, retiming, folding and unfolding, lattice and orthogonal filters, scheduling and allocation, systolic architectures. Optimization with respect to number of hardware units, speed (sample period and latency), VLSI area, power consumption and performance (quantization effects). Special CAD tools and languages for rapid prototyping. Case studies and programming exercises. *3 credits. Prerequisites: ECE 114 and ECE 151*

ECE 418 Digital Video (formerly EE 418)

Digital video coding, compression, processing and communications. Target applications from low bit-rate, low quality to high bit-rate, high quality. Two- and three-dimensional sampling, color spaces, motion representation. Motion estimation: optical flow, block-matching; constrained optimization: Bayesian methods, simulated annealing, Gibbs random fields. Mathematical basis for compression standards such as JPEG and MPEG, and digital television including HDTV. Rate-distortion based compression for optimal bit allocation via dynamic programming (Viterbi algorithm). Scalability in multimedia systems. *3 credits. Prerequisite: ECE 114*

ECE 421 Advanced Control System Design (formerly EE 471)

Design of control systems using two-degrees of freedom and PID compensators. Ackermann's formula, H-infinity control theory and applications. Analysis and design for nonlinear systems using describing function, state-variables, Lyapunov's stability criterion and Popov's method. Introduction to optimal control theory (dynamic programming). Design problems and extensive use of MATLAB. *3 credits. Prerequisites: ECE 114 and ECE 121*

ECE 422 Selected Topics in Embedded Systems (formerly EE 482)

A project oriented interdisciplinary course, where students design and construct embedded systems for particular applications. Aspects of mechanics, robotics, process control, bioengineering, communications, electronics, motors and motor drivers, sensors, actuators, signal conditioners, interfaces, computer hardware and computer programming. Problems encountered in real systems including: interrupts, timing, grounding, thermal and noise effects, documentation, reliability. *3 credits. Prerequisite: ECE 323*

ECE 423 Digital & Microprocessor Control (formerly EE 464)

A project oriented interdisciplinary course on microprocessor based control systems. Process control, PID algorithm, numerical machine tool control, robotics, measuring and controlling thermal, electrical, mechanical, biomedical and chemical systems. Considerations of overall system stability, logic design, response time and the design of algorithms. Student projects. *3 credits. Prerequisites: ECE 151 and ECE 121*

ECE 425 Digital Control Systems

Basic components of digitally controlled dynamic systems. Sampling and reconstruction: the ideal sampler, zero and higher order hold elements. The pulse transfer function and the z-transfer function description of dynamic systems. Stability criterion and analysis by the Nyquist, root locus and Bode methods. The modified Routh-Hurwitz and Jury stability criteria. The state-variable approach: state equations of dynamic systems with sample and hold devices, state equations of systems with all digital elements. Digital simulation and approximation. Controllability, observability and stability. State and output feedback, state observers and the separation principle. Digital control system design by state feedback. *3 credits. Prerequisites: ECE 121 (Control Systems)*

ECE 431 Microwave Engineering (formerly EE 421)

Passive circuits, open-boundary waveguides, perturbation theory, coupled modes, waveguide junctions, microstrip. Two- and three-terminal devices; varactor diodes, Gunn diodes; IMPATT and MESFET technology. Design of RF amplifiers and phase-shifters. Computer aided simulation and design. *3 credits. Prerequisite: ECE 135*

ECE 433 Optical Communications Devices & Systems (formerly EE 406)

PIN, avalanche and Schottky photodiodes; risetime, noise, amplifier requirements. Semiconductor optical devices: radiative and non-radiative recombination, quaternary semiconductors, heterojunctions, quantum wells, bandwidth minimization, lasers, distributed feedback, vertical cavity structures. Internal and external modulation, electro-optic modulators, Stark effect. Optical fibers: mode structure, attenuation, dispersion, PM fibers, WDM. System architecture, analog/digital communications, terabit data links. Solitons. *3 credits. Prerequisite: ECE 131 and ECE 135*

ECE 441 Digital Integrated Circuit Engineering

Design of static and dynamic CMOS combinational logic gates, layout and simulation. Standard cell construction. Sequential logic systems—registers, latches, clocks. Design of arithmetic building blocks, ALU, multipliers. Memory circuits and organization. FPGAs. System design—hardware description languages, floorplanning, system architecture. A major component of the course is the

design and fabrication of an ASIC using a variety of VLSI CAD tools. *3 credits. Prerequisite: ECE341*

ECE 442 Communication Electronics

Circuit design for advanced communications applications. Design of high-frequency amplifiers, oscillators and mixers using large signal analysis. Effects of noise and non-linearities are examined from the diode and transistor level to board level. Communication subsystems of interest include phase locked loops, modulators and demodulators (AM, PM FM), and signal processors for multiple access systems (TDMA, FDMA, CDMA). Course work includes computer-aided simulation and design projects. *3 credits. Prerequisites: ECE 101, ECE 135 and ECE 142*

ECE 443 Thin-Film Electronics (formerly EE 440)

Properties of polycrystalline, amorphous, liquid and organic semiconductors. Methods of deposition: vacuum and nonvacuum techniques, epitaxial and nonepitaxial growth. Assessment of thin film semiconductors: structural, optical, electrical. Thin film semiconductor devices: transistors, displays, photovoltaics, flexible conductors. Optical coatings and architectural applications. Thin film superconductors: metallic, allow and high T_c, fabrication and assessment. Superconducting devices: Cooper pairs, Josephson junctions, SQUIDS, Josephson computers. *3 credits. Prerequisites: ECE 131 and ECE 142*

ECE 445 Design with Operational Amplifiers

Analysis and design of operational amplifier circuits with various applications, including amplifiers, filters, comparators, signal generators, D/A and A/D converters and phase-locked loops. Introduction to issues such as static and dynamic limitations, noise and stability. Use of industry standard CAD software. *3 credits. Prerequisite: ECE142*

ECE 453 Advanced Computer Architecture

This course studies modern, advanced techniques used to design and produce current, state-of-the-art computer architectures. Technology, performance and price. The quantitative principle and Amdahl's law. Instruction sets; addressing modes, operands and opcodes; encoding instruction sets. RISC versus CISC architectures; MIPS. Pipelining; the classic five-stage pipeline, hazards, exceptions, floating point operations. Advanced pipelining techniques: dynamic scheduling, branch prediction.

Multiple issue, speculation. Limits of parallelism. Compiler support for parallelism, VLIW. Caches. Examination of modern processors. *3 credits. Prerequisites: ECE151*

ECE 457 Selected Topics in Operating Systems

Advanced topics in operating systems, selected according to student and instructor interest. *3 credits. Prerequisites: ECE 151 and ECE 161*

ECE 461 Advanced Programming Methods

This course addresses the need for engineers to craft algorithmic solutions to problems of ever-increasing complexity. The curriculum includes consideration of the man-machine interface, real-time control, remote sensing and computing in a distributed environment. Software fault tolerance and reliability and unbreakable database transactions. Computer network security and network reliability, safety of data through authentication and encryption. Engineering trade-offs between efficiency and portability and design for maintenance. *3 credits. Prerequisite: ECE151, ECE165*

ECE 462 Interactive Engineering Graphics (formerly EE 452)

Graphical primitives, windows, clipping and viewports. Two- and three-dimensional geometric transformations and translations; rotation, pan and zoom. Hidden line and surface removal. Region filling and shading. The architecture of high performance graphical engines. Representing lighting, shading and textures. Rendering. Rotation. GUIs. Animation. Course work includes design projects. *3 credits. Prerequisites: ECE 151 and ECE 165*

ECE 463 Web 2.0 Architecture & Development

Software engineering and networking issues related to the development of Web 2.0 solutions, focusing on mobile, web and voice applications. Coursework includes software projects and case studies. *3 credits. Prerequisites: ECE103, ECE165 or permission of instructor*

ECE 464 Databases (formerly EE 454) Database architecture. Relational, hierarchical and network data models. Data sublanguages, relational algebra and relational calculus. Data independence and integrity. The database management system. Security and privacy, logs. Low-level file structures, organization and indexing. Data compression, protection and encryption. Distributed databases. Course work involves the design of relational systems using commercial packages, followed by the design and implementation of a small general database built around relational algebra.
3 credits. Prerequisite: ECE 165

ECE 466 Compiler Theory (formerly EE 456) Regular expressions, production systems, grammars and language theory. Phases of compilation: lexical analysis, parsing and code generation. Standard compiler design tools such as Lex and YACC. Syntax directed translation, symbol tables and space reservation. Error detection at compile-time and run-time. Code generation and the run-time environment. Elements of code optimization. Course work involves the implementation of a compiler for a restricted language using standard tools and custom code.
3 credits. Prerequisites: ECE 151 and ECE 165

ECE 468 Computer Vision (formerly EE 458) Visual perception and imaging geometry. Pixels, pixel neighborhoods and pixel connectivity. Image transforms: Fourier, Hadamard, Walsh, Discrete Cosine, Haar, Slant and others. Techniques for image manipulation and enhancement in both the frequency and spatial domains. Histogram equalization, image subtraction and local averaging. Filtering, homomorphic methods. Color models and use of monochrome techniques on RGB channels. Image restoration: camera movement cancellation, scratch removal. Image compression techniques, lossy and lossless. Image segmentation, edge detection, edge linking, boundary detection; region growing, splitting and merging. Image representation as a hierarchical collection of objects, chain codes, Fourier descriptors. Object recognition, signatures.
3 credits. Prerequisites: ECE 111, ECE 151 and ECE 161

ECE469 Artificial Intelligence This course covers many subtopics of AI, focusing on a few important subtopics in detail. The “intelligent agent” approach is explained and forms a foundation for the rest of the course. Intelligent search: uninformed search, depth-first search, breadth-first search, iterative deepening; informed search, best-first search, A*, heuristics, hill climbing; constraint satisfaction problems; intelligent game playing, minimax search, alpha-beta pruning. Machine learning: probability, Bayesian learning; decision trees; statistical machine learning, neural networks, Naive Bayes, k-nearest neighbors, support vector machines. Natural language processing: syntax, semantics and pragmatics; real-world knowledge; parsing; statistical NLP. Philosophy of AI: AI and consciousness, the Turing test, the Chinese room experiment. Coursework includes two large individual programming projects.
3 credits. Prerequisite: ECE165

ECE 491 Selected Topics in Electrical & Computer Engineering (formerly EE 491)

Subjects may include study in electrical and computer engineering, or seminars on topics related to advances in technology. This course may not be used to expand the number of credits of thesis, or cover material related to the thesis.
1-3 credits. Prerequisite: Permission of instructor

ECE 499 Thesis/Project (formerly EE 499) Master’s candidates are required to conduct, under the guidance of a faculty adviser, an original individual investigation of a problem in electrical and computer engineering and to submit a written thesis describing the results of the work.
6 credits over 1 year

Electrical Engineering (EE-coded)

Undergraduate

EE 121 Circuits, Signals & Systems I Circuit elements and waveforms, network equations, loop and nodal analysis, matrix representations, systematic and “shortcut” methods. Transient analysis of first, second and higher order circuits, initial conditions, visualization in the complex plane. Sinusoidal steady-state, phasors, complex power. Laplace transforms with applications to circuit analysis. Introduction to systems analysis. Several assignments involve computer analysis of circuits, signals and systems.
3 credits. Prerequisite: Ma 113

EE 122 Circuits, Signals & Systems II Network theorems, network functions, two-port and multi-port parameters. Frequency response plots, resonance, stability. State-space equations, time-domain and Laplace domain solution of state-space equations. Fourier series and Fourier transforms. Analog filter design, passive and active filter realizations. Analysis and design using MATLAB.
3 credits. Prerequisite: EE 121

EE 125 Engineering Electromagnetics I

Electrostatics, magnetostatics, dielectrics, boundary value problems. Maxwell’s equations. Potential, power, polarization, boundary conditions, lossy and lossless media. Plane waves, transmission lines, Smith chart, impedance matching, reflection and refraction.
3 credits. Prerequisites: Ma 223 and Ph 213

EE 126 Engineering Electromagnetics II

Guided waves, TE and TM modes, cylindrical waveguides with rectangular and circular cross-section, cavity resonators. Linear networks and scattering parameters. Antenna dipoles, apertures, antenna arrays, radiation patterns. Introduction to optical and microwave systems and devices, with applications to communications and signal processing. Every student uses a vector network analyzer.
3 credits. Prerequisites: EE 125

EE 141 Electronic Devices & Circuits I Semiconductor principles. PN junction theory, diodes, diode models and circuit applications. Bipolar and field effect transistors: devices, models and the four basic circuit configurations. Linear BJT and FET amplifiers, discrete and integrated models, biasing, single stage, cascaded stages. Survey of integrated circuit fabrication techniques. Theoretical principles are supplemented with design problems.
3 credits. Prerequisite: EE 121

EE 142 Electronic Devices & Circuits II MOS circuits: DC operation and analysis. Single stage MOS amplifiers, circuit design, DC and small signal analysis. Cascode amplifier. Current mirrors, active loads, BJT and MOS differential amplifiers. Monolithic operational amplifiers. Output stages. Frequency response. Introduction to feedback theory, amplifier topologies. Circuit design and analysis are supplemented with industry standard CAD.
3 credits. Prerequisites: EE 122 and EE 141

Mechanical Engineering Courses

Undergraduate

ME 100 Stress and Applied Elasticity Three-dimensional theory of elasticity; state of stress, state of strain, elastic stress-strain relations. Applications include elementary three-dimensional problems, plane stress and plane strain, Saint Venant's long cylinder, beams and plates. Computer-aided design projects.
3 credits. Prerequisite: ESC 101

ME 101 Mechanical Vibrations Mechanical systems with single and multiple degrees of freedom; longitudinal, torsional and lateral vibrations; free and forced oscillations; vibration testing, dynamic stability, vibration isolation, design criteria. Computer-aided design assignments.
3 credits. Prerequisite: ESC 101

ME 105 Drawing and Sketching for Engineers (same as EID 105)

ME 107 Computer-Aided Analysis and Design Techniques Skill in use of computer-aided analysis and 3D-design software in solving engineering problems and in creating and visualizing engineering designs is among the most basic of an engineer's toolbox. This course takes students through a hands-on learning experience in the practice of a contemporary analysis tool, such as MATLAB, and a contemporary 3D-design tool, such as SolidWorks. Topics include data structuring and programming; numerical modeling and analysis; technical drawing and engineering graphics; conception and a visualization of 3D engineering models, parts and assemblies; and detailed generative 2D drawings.
1.5 credits

ME 116 (same as EID 116) Musical Instrument Design Theory and use of musical scales, including just intonation and equal temperament systems. Musical harmony and basic ear training. Human hearing and the subjective measures of sound: pitch, loudness and timbre. Acoustic analysis of design and operating principles of traditional instruments, including members of the percussion, string and wind families. Prototyping and testing of original musical instrument concepts.
3 credits. Prerequisite: permission of instructor

ME 120 Design Elements Application of the principles of mechanics to the design of basic machine elements; study of components subjected to static, impact and fatigue loading; influence of stress concentration; deflection of statically determinate and indeterminate structures by the energy method. Design projects apply basic criteria to the design of shafts, springs, screws and various frictional elements; design projects make use of computer, experimental and modeling techniques.
3 credits. Prerequisite: ME 100

ME 130 Advanced Thermodynamics Equations of state; properties of pure substances; ideal and real gas and gas-vapor mixture properties, fundamental process and cycle analysis of ideal and real systems; modern gas and vapor power cycles and refrigeration cycles. Computer applications to problem solving.
3 credits. Prerequisite: ESC 130

ME 131 Energetics (same as EID 131) Current and near-term energy sources, including coal, oil, natural gas, nuclear fission, hydroelectric, oil shale and refuse. Description of contemporary methods of energy conversion including conventional utility power plants and nuclear power plants. Introduction to direct energy conversion; magneto-hydrodynamics, fuel cells, thermionic and thermoelectric. Design of the thermodynamic operation of a steam power plant.
3 credits. Prerequisite: ESC 130

ME 133 Air-Conditioning, Heating and Refrigeration (same as EID 133) Introduction to air-conditioning, heating and refrigeration, with emphasis on application of thermodynamics, fluid dynamics, mass transfer and heat transfer; psychometrics, cycles, load calculation, component and system performance; absorption, refrigeration, heat pumps, solar heating and cooling.
3 credits. Prerequisite: ESC 130, ESC 140

ME 140 Gas Dynamics Integral form of the conservation equations; one-dimensional compressible flows, including isentropic flow, isothermal flow, flow with friction, flow with heat transfer and normal and oblique shock waves; generalized one-dimensional flow. Computer applications and a semester-long design project.
3 credits. Prerequisites: ME 130, ESC 140

ME 141 Fundamentals of Aerodynamics Study of incompressible potential flow around bodies of aerodynamic interest, by the use of equations of motion, method of singularities and conformal transformation. Investigation of experimental results and techniques. Consideration of the effects of viscosity and transition from laminar to turbulent flow. A design-oriented project, usually involving application of computer methods, will be required.
3 credits. Prerequisite: ESC 140

ME 142 Heat Transfer: Fundamentals and Design Applications One-dimensional steady-state conduction and transient conduction: finite-difference equations and computational solution methods. Convection; introduction to laminar and turbulent viscous flows; external and internal forced convection problems, including exact and numerical solution techniques; free convection. Introduction to radiation heat transfer and multimode problems. Open-ended design projects will include application to fins, heat exchangers, tube banks and radiation enclosures and will make use of computer-aided design techniques.
3 credits. Prerequisite: ESC 140

ME 151 Feedback Control Systems Modeling and representation of dynamic physical systems: transfer functions, block diagrams, state equations, and transient response. Principles of feedback control and linear analysis including root locus and frequency response methods. Practical applications and computer simulations using MATLAB. Discussions of ethics will be integrated into the curriculum.
3 credits. Prerequisite: Ma 240, ESC 161

ME 153 Mechatronics (same as EID 153) Topics include computer architecture, PIC processor overview, dynamic modeling, sensors, data acquisition, digital PID control theory, and utilization of assembly language to code the controller. Students will design, build and test a controller board and present a final prototype of a control system. Engineering economics will be introduced and integrated into the final project.
Prerequisite: ME 151 or ECE 121 or ChE 152

ME 155 Design and Prototyping A mechanical engineering hands-on workshop geared towards the understanding and practice of basic engineering design and fabrication tools. Topics include hand tools, simple machining, mold making, casting, materials, fasteners, adhesives, and finishes. 3-D digitizing, solid modeling, rapid prototyping and computer interfacing will also be presented. Team projects will familiarize the students with typical tools and processes employed in realizing a design concept, from sketch to functional prototype. Each student will participate in and contribute to the team-learning and creation process.
2 credits. Prerequisite: EID 101

ME 160 Engineering Experimentation Selection, calibration and use of subsystems for the measurement of mechanical, thermal/fluid and electrical phenomena. Laboratory work includes investigations of heat exchangers, fluid systems and internal combustion engines. Emphasis is placed on data collection and statistical reduction, computational methods and written and oral presentation skills.
3 credits

ME 163 Mechanical Engineering Projects Original investigations, involving design and experimental work which allow the application of engineering sciences to the analysis and synthesis of devices or systems and permit the deepening of experience in engineering decision making. Projects are carried out in small groups and are supervised by the instructor in accordance with professional practice.
3 credits. Prerequisite: permission of instructor

ME 164 Capstone Senior ME Design The application of open-ended design work to the synthesis of engineering devices and systems for the satisfaction of a specified need. Consideration of market requirements, production costs, safety and esthetics. Projects are carried out in small groups and are supervised by the instructor in accordance with professional practice. The goal of the course is to create a working design, clearly defined in drawings and specifications.
3 credits. Prerequisite or co-requisite: ME 163

ME 165 (same as EID 165) Sound and Space Basics of acoustics, including sound waves, room and hall acoustics and metrics of sound. Audio engineering, including microphones, signal processors, amplifiers and loudspeakers. Skills and techniques using Pro Tools brand audio editor system to create original sonic and musical compositions. Public exhibition of an electronic music program.
3 credits. Prerequisite: permission of instructor

ME 300 Space Dynamics Fundamental principles of advanced dynamics; kinematics, transformation or coordinates; particle and rigid body dynamics. Application to space problems; satellite orbits; gyro-dynamics, space vehicle motion; performance and optimization. Generalized theories of mechanics; virtual work, D'Alembert's principle; Lagrange's equation; Hamilton's principle.
3 credits. Prerequisite: ESC 100

ME 312 Manufacture Engineering (same as EID 312) Study of metal processing theory and application with emphasis on casting, machining, and metal deformation processes; plastic forming; special processing techniques; work-holder design principles. Specific areas studied include stages of processing, mathematical modeling of processes, equipment determination, relationship of plant layout, tooling, metrology, and product design to product cost.
3 credits. Prerequisite: EID 101

ME 313 Science of Materials for Engineering Design (same as EID 313) This course is intended to give the student the tools with which to design with materials: to choose an existing material for a new application or design the ideal material to replace one in use. The materials studied cover the full range: metals, ceramics, glasses, polymers, composite materials and wood. Topics include phase diagrams and phase transformations, structure and strength, normal use and failure, all with an eye on design.
3 credits. Prerequisite: ESC 110 or ESC 110.1

ME 314 (same as EID 314)
3 credits. Prerequisites: ESC 101, ESC 110 or ESC 110.1

ME 320 Mechanical Design Mechanical design of basic transmission elements; design optimization by blending fundamental principles and engineering judgment; design criteria for the various frictional machine elements. Design projects provide authentic involvement in problems from industry; design projects make use of computer, experimental and modeling techniques.
3 credits. Prerequisite: ME 120

ME 321 Engineering Kinematics Study of motion conversion through various types of mechanical components, using analytical and graphical techniques. Velocity and acceleration analysis; special kinematic devices, synthesis of mechanisms; linkage design. Theory applied to creative project assignments.
3 credits. Prerequisite: ESC 100

ME 322 Dynamics of Machines Application of mechanics to rigid bodies as found in machines and machine elements. Dynamics of machines as influenced by the kinematics of the motion, externally applied forces and self-generating inertia forces.
3 credits. Prerequisite: ME 101

ME 330 Advanced Engine Concepts Development of energy efficient, high-output, cleaner engine systems. Broad analytical and experimental review of the governing parameters involved in engine design and optimization. Topics include thermodynamics, fluid mechanics, heat transfer, combustion, emissions, thermochemistry, dynamic and static loading, and fuel efficiency, as they apply to different engine cycles and types. Research examples from industry, government, and academia are reviewed. Stationary and mobile applications, with particular emphasis on automotive engine design are analyzed. Hands-on learning skills are developed through computational and experimental assignments.
3 credits. Prerequisite: ME 142

ME 332 Internal Combustion Engine Design Increasingly stringent environmental and economic climates have prompted the development of energy-efficient, high-output, cleaner engine systems. This course is a broad analytical and experimental review of the governing parameters involved in engine design and optimization. Topics involve thermodynamics, fluid mechanics, heat transfer, combustion, emissions, thermochemistry, dynamic and static loading and fuel efficiency, as they apply to different engine cycles

and types. Research examples from industry, government and academic are reviewed. Stationary and mobile applications, with particular emphasis on automotive engine design, are analyzed from first principles. Students develop hands-on learning skills through computational and experimental assignments.
3 credits. Prerequisite: ME 142 or permission of instructor

ME 334 Combustion (same as EID 334) Thermodynamics and kinetics of reacting systems. Conservation laws for reacting gas mixtures. Gas phase and heterogeneous phase diffusion flames, including supersonic diffusion flames and fuel droplet combustion in liquid propellant rocket engines and in residential oil burners. Premixed flames in gases. Detonation waves in gases. Examples of current research in aerospace and environmental aspects of combustion processes.
3 credits. Prerequisite: ESC 141 or ME 142

ME 340 Advanced Aerodynamics Study of ideal compressible flow around aerodynamic bodies by the use of linearized subsonic and supersonic theory. Investigation of computational techniques and experimental methods and results. Consideration of real gas and viscous effects and hypersonic flow.
3 credits. Prerequisites: ESC 130 and ME 141

ME 343 Fluid Machinery The application of fluid mechanics and thermodynamics to the analysis and design of turbomachines. Topics to be studied include theory and three-dimensional flows. Both axial and radial flow fans, blowers, compressors, pumps and turbines will be considered as well as special topics in turbomachinery. A design project, usually involving application of computer methods, will be required.
3 credits. Prerequisites: ESC 130, ESC 140

ME 352 Advanced Control Theory (same as EID 352) Tools and methods of control system design and compensation; simulation, specifications, frequency domain techniques, state variable feedback, sensitivity analysis. Specific topics covered are controllability, observability, Lyapunov stability, pole placement technique, full order observers, reduced order observers and output feedback. Emphasis will be placed on modern control theory. Group design project to build working prototype. Both engineering economics

and ethics will be addressed when presenting the final working prototype.
3 credits. Prerequisite: ME 151 or ECE 121 or ChE 152

ME 353 Transducers, Sensors and Computer Interfacing (same as EID 353) Transducers and sensors are widely used in engineering and scientific research and as an integral part of products and automated systems. Students will be introduced to numerous available techniques for sensing displacement, force, pressure, acceleration, temperature, radiation and other physical parameters; digital computation and digital transducers; computer interfacing such as analog signal conversion, signal processing, interface components, communication; software systems such as programming real-time systems and real-time operating systems. The instructor will present case histories of several industrial instrumentation and sensing systems. Projects provide authentic involvement in problems from industry that require computer interfacing and experimental techniques.
3 credits. Prerequisite: permission of instructor

ME 356 Digital Control and Non-linear Control (same as EID 356) Introduction to digital control systems, z-transformations, discrete equivalents to continuous transfer functions, design of digital controllers, non-linear control theory. Laboratory experiments will be performed which will include control of the speed of a motor through computer programming.
3 credits. Prerequisite: ME 151

ME 363-364 Selected Topics in Mechanical Engineering This course will deal with current technological developments in various fields of mechanical engineering. Projects and design will be emphasized.
3 credits each. Prerequisite: ME faculty permission

ME 365 Mechanical Engineering Research Problem An elective course available to qualified students. Students may elect to consult with an ME faculty member and apply to carry out independent research on problems of mutual interest in theoretical or applied mechanical engineering.
3 credits. Prerequisite: ME faculty permission and senior standing. May be repeated

Graduate

ME 401 Advanced Mechanical Vibrations Combined analytical and experimental approach to mechanical vibration issues; characterization of the dynamic behavior of a structure in terms of its modal parameters; digital data acquisition and signal processing; experimental modal analysis procedures and excitation techniques; extraction of modal parameters from measured frequency response functions. Students will acquire hands-on experience with impact hammer and shaker data acquisition and analysis. *3 credits. Prerequisite: ME 101*

ME 402 Advanced Stress Analysis Elements of stress and deformation analysis. Numerical and analytical techniques include finite difference, relaxation, finite element, complex variables and energy and variational methods. Applications include torsion, two-dimensional problems, bending of bars, elastic stability, wave propagation, thin plates and shells and curved beams and plates. *3 credits. Prerequisite: ME 100*

ME 403 Advanced Engineering Dynamics Elements of classical dynamics: kinematics, kinetics, work and energy, impulse and momentum, vibration. Motion of a system of particles and rigid bodies. Lagrangian dynamics. *3 credits. Prerequisite: ME 101*

ME 405 Automotive Engineering Fundamentals An introductory course in modern automotive design, covering aspects of prime movers, aerodynamics, brakes, tires, steering, transmission, suspension and handling, chassis and advanced hybrid powertrain concepts. Simulations and physical prototyping give students a hands-on approach to the design, optimization, fabrication and testing of various vehicle subsystems in a team-based learning environment. *3 credits. Prerequisite: ME 130 or permission of instructor*

ME 407 Introduction to Computational Fluid Dynamics The need for and applications of computational fluid dynamics (CFD). Introduction to CFD analysis and commercially available codes. Governing equations and numerical solution methodologies for basic fluid flow systems. Geometric modeling and grid generation. Examination of various physical models. Use of a commercial CFD code. *3 credits. Prerequisite: ESC 140*

ME 410 Materials and Manufacturing Process (same as EID 410) In manufacturing operations, materials are subjected to large forces for producing useful shapes. This course attempts to establish an understanding of the behavior of materials in response to such forces. Topics covered will include elastic behavior, plasticity, strengthening mechanisms, basic manufacturing processes and testing. Vital aspects of the continuum behavioral response of materials to manufacturing processes will be covered emphasizing the mechanical and metallurgical factors that control the processes. *3 credits*

ME 412 Autonomous Mobile Robots This course introduces basic concepts, technologies, and limitations of autonomous mobile robots. Topics include digital and analog I/O, tactile sensing, IR sensing and range finding, light sensing, sonar, magnetic field sensing, encoders, DC motor actuators, servo motor actuators, high-level microprocessor control, low-level microprocessor control, power management, and prototyping. Students will form teams to design and build autonomous mobile robots configured to compete with each other in a singles-match game, or to perform a team-oriented task. *3 credits. Prerequisite: ME 153 or ECE 151*

ME 413 Microelectromechanical Systems (MEMS) Advances in the design, fabrication, analysis and control of microelectromechanical systems (MEMS) have positioned MEMS at the forefront of high-value, cutting-edge technologies. The scope of this course covers both the fundamental and advanced aspects of MEMS. Topics include introduction to MEMS, materials and fabrication processes, sensors and actuators, microfluidics, scaling principles, device concepts and system design. MEMS processing simulation and modeling, testing and packaging of MEMS will also be presented. Furthermore, exposure to basic MEMS processing and cleanroom protocol will be included. *3 credits. Prerequisite: ESC 110 or ESC 110.1*

ME 415 Introduction to Nanotechnology Understanding and control of matter at dimensions in the range from one to 100 nanometers for novel applications are the main objectives of nanotechnology. The scope of this course encompasses nanoscale science and engineering. Typical topics will include the unique

properties of some nanometer scale materials, processing and fabrication technologies for nanomaterials, imaging, measuring, modeling and manipulating matter at this length scale. In addition, laboratory demonstrations on nanomaterials processing, nanoarchitecturing and self-assembling of nanostructures will be included. *3 credits. Prerequisite: ESC 110 or ESC 110.1*

ME 417 Mechanobiology Mechanical factors play important roles in development, maintenance of healthy tissue, the initiation of disease and the development of repair strategies. This course will introduce students to the principles and disease, and the development of repair strategies, as well as to the principles and concepts of mechanobiology through the investigation of recent work in the field. Specific topics will include mechanical regulation of cell behavior, applications to tissue engineering, mechanotransduction and experimental techniques. *3 credits. Prerequisites: ESC 101 and Bio 101, or permission of instructor*

ME 420 Axiomatic Design (same as EID 420). *3 credits. Prerequisite: permission of instructor*

ME 421 Rehabilitation Engineering (same as EID 421) *3 credits. Prerequisite: permission of instructor*

ME 423 Measurement of Human Performance (same as EID 423) *3 credits. Prerequisite: permission of instructor*

ME 425 Product Design I (same as EID 425) *3 credits*

ME 426 Product Design II Continuation of ME/EID 425 *3 credits. Prerequisite: ME/EID 425*

ME 430 Thermodynamics of Special Systems (same as EID 430 and ChE 430) *3 credits. Prerequisite: ME 130*

ME 431 Heat Convection Conservation equations; forced convection in laminar and turbulent flows; natural convection; combined natural and forced convection; heat transfer at high velocities, special heat transfer problems. *3 credits. Prerequisite: ESC 141*

ME 432 Heat Conduction and Radiation Theory of heat conduction in isotropic and anisotropic solids; analytical, graphical and numerical solutions to steady- and non-steady-state heat conduction equations. Thermal radiation in absorbing and non-absorbing media. Application to selected problems involving combined energy transport mechanisms and to heat transfer problems of current interest. *3 credits. Prerequisite: ESC 141*

ME 434 Special Topics In Combustion (same as ChE 434) Analysis of diffusion and premixed flame processes, including droplet and particle flames, combustion in sprays, chemical reactions in boundary layers, combustion instability in liquid and solid rocket engines and gas burner flames. Consideration of ignition and quenching processes and flammability limits. *3 credits. Prerequisite: ME 334*

ME 440 Advanced Fluid Mechanics (same as EID 440 and ChE 440) *3 credits. Prerequisites: ESC 140 and permission of instructor*

ME 451 Introduction to Applied Optimal Control Theory and Design An introduction to the concepts and techniques utilized in the analysis and design of optimal (deterministic) control systems. Topics include a review of state-space control systems concepts; reduced order observers and state-feedback controllers; basic theory of linear quadratic optimal control; standard regulator problem; optimal tracking systems; introduction to the calculus of variations and functional optimization; utilization of computer-aided optimal control systems design software such as MATLAB. Techniques developed will be applied, in the form of student design projects, to a variety of challenging control systems design problems. *3 credits. Prerequisite: ME 151 or ECE 121 or ChE 152*

ME 453 Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) (same as EID 453) Computer design aids, languages, databases, and data structures; geometric modeling; rapid prototyping; design verification, simulation, and testing; investigation of commercial CAD/CAM packages. Student projects include geometric modeling with commercial CAD/CAM packages, team-based product design, and programming of basic CAD applications. Students are grouped into design teams and are expected to work

on a term project starting with specifications, carrying out the full work and documentation of actual design processes.

3 credits. Prerequisite: ECE 161

ME 455 Optimal Estimation Methods (same as EID 455)

Introduction to linear and nonlinear estimation methods with emphasis on both theory and implementation. Batch and sequential strategies, real-time and post-experiment estimation are covered. Includes both parameter estimation and state estimation. Topics covered are a review of probability and optimization, parameter estimation (linear and nonlinear least squares), minimal variance and maximum likelihood estimation, system identification and estimation, Kalman filtering, smoothing, covariance propagation for continuous and discrete systems as well as linear and nonlinear, real-time and post-processing and minimum model error estimation. Students will work on realistic problems such as global positioning using geosynchronous satellites. MATLAB software used extensively.

3 credits. Prerequisite: ME 151 or ECE 121 or ChE 152

ME 457 Optimization Techniques for Design (same as EID 457)

Optimization techniques with applications in various aspects of engineering design. Concepts of design variables, constraints, objective functions, penalty functions, Lagrange multipliers. Techniques for solving constrained and unconstrained optimization problems: classical approaches, steepest descent, conjugate directions, conjugate gradient, controlled random searches, etc. Discussion of generalized reduced gradient, sequential linear programming, and recursive quadratic programming strategies. Special topics will be discussed such as optimum sensitivity analysis, multilevel optimization, and integer programming. Computer implementation of optimization schemes. Applications and examples in the design of engineering components and systems. A design project will be assigned that will require the use of several optimization schemes.

3 credits. Prerequisite: Ma 223

ME 458 Industrial Robots (same as EID 458) Basic concepts, techniques, and limitations of modern industrial robots; industrial automation; robot programming languages; definition and description of a robot work space; application of transform and operator matrices in industrial robotics. Student projects include computer programming of forward and inverse kinematics, and application programming with an industrial robot.

3 credits. Prerequisite: ECE 151

ME 464 Computer-Integrated Manufacturing (same as EID 464)

Fundamentals of computer-aided design, analysis, and manufacturing; geometric modeling, IGES, PDES, and STEP; rapid prototyping; mechanism simulation and finite element analysis; CNC part programming and machining; group technology and process planning. Student projects emphasize concurrent engineering and teamwork.

3 credits. Prerequisite: ME 312

ME 470 Microelectromechanical systems (MEMS) This course covers the fundamental and advanced aspects of MEMS. Topics include introduction to MEMS, materials and fabrication processes, sensors and actuators, microfluidics, scaling principles, device concepts and system design. MEMS processing simulation and modeling, testing and packaging of MEMS will also be presented. Exposure to basic MEMS processing and clean-room protocol will be included.

3 credits. Prerequisite: ESC 110

ME 493-494 Selected Advanced Topics in Mechanical Engineering

These courses will deal with current advanced technological developments in various fields of mechanical engineering. Projects and design will be emphasized.

3 credits. Prerequisite: ME faculty permission and graduate standing

ME 499 Thesis/Project

Master's candidates are required to conduct, under the guidance of a faculty adviser, an original investigation of a problem in mechanical engineering, individually or in a group and to submit a written thesis describing the results of the work.

6 credits for full year

Engineering Sciences Courses

Undergraduate

ESC 000.1- 000.4 Engineering Professional Development Seminars

The Engineering Professional Seminars and Workshops offer students an introduction to the profession of engineering as well as deal with their development as students. The Cooper Union's CONNECT program is an integral part of these courses and provides intensive training in effective communications skills. A wide range of topics is covered in addition to communications skills including ethics, environmental awareness, life-long learning, career development, conflict resolution, entrepreneurship, marketing, work-place issues, team dynamics, professional licensure and organizational psychology.

0 credits. Attendance required by all first and second year students.

Pass/Fail grade based on attendance and participation

ESC 100 Engineering Mechanics

Equivalent system of forces, distributed forces; forces in structure; friction forces. Particle and rigid body mechanics; kinematics, kinetics. Newton's laws of motion; work and energy; impulse and momentum.

3 credits. Prerequisite: Ph 112

ESC 101 Mechanics of Materials

Introduction to solid mechanics; analysis of stress and deformation. Extension; flexure; torsion. Axisymmetric problems, beam theory elastic stability, yield and failure theory.

3 credits. Prerequisite: ESC 100

ESC 110 Materials Science

The objective of this course is to promote an understanding of the relationship between the molecular structure of a material and its physical properties. Topics include bonding in atoms and molecules, crystallinity, metals and alloys, polymers, mechanical properties of inorganic materials and composite materials.

3 credits

ESC 110.1 Materials Science for Chemical Engineers

Understanding relationships among atomic or molecular structures, physical properties and performances of substances. Bonding, crystallinity, metals, alloys and polymers. Mechanical properties

of inorganic and composite materials. Selection of materials for process equipment design, its effect on economics. Design concerning effect of corrosion and its prevention.

3 credits

ESC 120 Principles of Electrical Engineering

Survey of Electrical Engineering for the non-major. Signal and circuit analysis, DC and AC circuits, transients, frequency response and filters, power systems. Additional topics may be covered as time permits.

3 credits. Prerequisite: Ma 113

ESC 121 Basic Principles of Electrical Engineering

Selection of topics from ESC 120. This class meets with ESC120 for the first ten (10) weeks.

2 credits. Prerequisite: Ma 113

ESC 130 Engineering Thermodynamics

Rigorous development of the basic principles of classical thermodynamics. Zeroth, first and second laws of thermodynamics and their applications to open and closed systems. Analysis of thermodynamic processes, properties of real substances and thermodynamic diagrams.

3 credits

ESC 130.1 Chemical Engineering Thermodynamics

First law of thermodynamics for closed systems; perfect gasses, 2- and 3-phase systems of one component; transient and steady state analyses using the first law of thermodynamics for open systems; second law of thermodynamics; introduction to concepts of entropy. Gibbs free energy and Helmholtz free energy; derivation and application of equations describing the auxiliary thermodynamic functions and conditions of equilibrium in imperfect gasses.

3 credits. Prerequisites: Ch 160, ESC 170

ESC 140 Fluid Mechanics and Flow Systems

Introductory concepts of fluid mechanics and fluid statics. Development and applications of differential forms of basic equations. Dynamics of inviscid and viscous fluids, flow measurement and dimensional analysis with applications in fluid dynamics. Friction loss and friction factor correlation; design of piping systems.

3 credits

ESC 141 Transport Phenomena

A unified approach to the rate processes involved in heat, mass and momentum transfer, including chemically reactive systems; reviews of generalized rate equation, mechanisms of transport processes; equations of continuity, motion and energy; applications to conduction, radiation, convective heat and mass transfer and diffusion; emphasis on the derivation of the applicable differential equations and methods of solving same for both laminar and turbulent flows; macroscopic balances for non-isothermal systems.

3 credits. Prerequisite: ESC 140

ESC 160 Systems Analysis

An introductory course in the basic concepts and techniques of systems analysis and optimization and their applications to the planning, design and managing of large-scale engineering systems. Topics include production functions, marginal analysis, linear and dynamic programming, decision analysis, project evaluation and selection, systems modeling and economic methods. Methodology is demonstrated through design projects.

3 credits

ESC 161 Systems Engineering

An introductory course to the mathematical modeling of systems. Topics include mechanical elements and systems, electric circuits and analogous systems, fluid elements and systems, analysis of systems using transfer functions, state space equations, analog simulation and digital simulation. Also covered are block diagrams, Laplace transforms, and linear system analysis. Computer projects will be assigned that will use MATLAB software.

3 credits

ESC 170 Material and Energy Balances

Introduction to the analysis of chemical process systems, using material and energy conservation equations. Estimation of thermodynamics and thermochemical properties of real fluids for engineering calculations. Numerical methods and their implementation on the digital computer for solution of chemical engineering problems.

3 credits. Prerequisite: Ch 160

Interdisciplinary Engineering Courses

Undergraduate

EID 101 Engineering Design and Problem Solving

Students work on cutting-edge, exploratory design projects in inter-disciplinary groups of 20 to 25. Each project has an industrial sponsor/partner who is available for student/faculty consultation and support. Oral and visual presentations as well as formal written reports are required for all projects. Professional competencies, team-work, human values and social concerns are stressed in the engineering design.

3 credits

EID 102 Introduction to Computer Science

This course has been renumbered: see CS 102.

3 credits

EID 103 Principles of Design

This course is designed to introduce students from all disciplines to the concepts of rational design. It is open to first-year students and sophomores. In the first part of the course students will learn by hands-on experience the importance of giving attention at the design stage to consideration of accessibility, repair, replacement, choice of materials, recycling, safety, etc. Students will develop the ability to make observations and record them in suitable form for further analysis of the design process. From this, concepts of "good" design will be developed, and students will be introduced to the formal design axioms and principles. This will lead to the second part of the course which will consist of a comprehensive, realistic design problem. Creativity, intuition and cultivation of engineering "common sense" will be fostered within the framework of design principles and axioms. The course will constitute a direct introduction to the disciplines in their interdisciplinary context.

3 credits. Prerequisite: EID 101

EID 105 Drawing and Sketching for Engineers (same as ME 105)

This course introduces engineering students to the fundamentals of free-hand drawing and sketching with an emphasis on the interpretation and communication of insights, concepts and dimensioned solutions. Drawings and sketches are often the first steps in innovative engineering solutions and

invention. The primary goal of this course is to provide a comprehensive foundation in traditional drawing and sketching methods for engineers.

2 credits

EID 110 Engineering Design Graphics

This course is for students who are well versed in basic AutoCAD and want to develop their 3D modeling skills plus learn how to customize the system. Course work includes writing custom AutoCAD menus and programs that are useful for the various engineering disciplines, using the Lisp programming language. Students will be given a number of 3D modeling assignments throughout the semester, building up to a final term project that utilizes their 3D modeling skills as well as their programming and customization knowledge.

3 credits. Prerequisite: permission of instructor

EID 111 Design, Illusion and Reality

There is much that we can do as engineers, artists and architects to restore the necessary constructive connection between humankind and nature. In this, a small but vital step is to see the design process in any branch of human activity as a whole and not as a matter of watertight compartments arbitrarily contrived. By taking a variety of particular examples from real situations, having known backgrounds in engineering, art and architecture, students get a glimpse of how the design processes are initiated and how the subsequent available options are resolved. The emphasis will be on the synthesis of, rather than the analytical approach to, problem solving.

1-3 credits

EID 112 Interactive Graphic Design

The course teaches usage of the web as a medium for publishing, exhibition, and communication. It familiarizes students with programming languages (HTML, JavaScript, and graphic software (Photoshop, Illustrator, Flash, and DreamWeaver). Besides the technical aspects, the course also introduces the basic artistic design principles, such as color, typography, composition, and layout. Furthermore, the practical issues of designing and organizing information for web communication will be discussed. Overall, students will develop proficiency in creatively and persuasively presenting information. Projects include assignments on individual programming languages and design principles. The main project is to construct a website for the presentation of a product or idea. The format of the

class consists of lectures studio time, presentations, and critiques.

3 credits: 4 hours—NOTE: This course cannot be taken for credit as a technical elective by EE students

EID 121 Biotransport Phenomena

Engineering principles are used to mathematically model momentum, heat and mass transfer processes that occur in biological systems. After a general introduction to human anatomy and physiology, topics examined include blood rheology, circulatory system fluid dynamics, whole body heat transfer, vascular heat transfer, oxygen transport in tissue and blood, pharmacokinetics and the design of an artificial kidney (hemodialysis).

3 credits. Prerequisite: junior standing

EID 122 Biomaterials

A study of both natural and synthetic materials, especially those for orthopaedic applications. Mechanical properties, design considerations, biocompatibility, potential for allergic response and carcinogenic ramifications, mechanical compatibility and effects of long-term implantation. Metallics, ceramics and polymers. Relative advantages and disadvantages of various materials. Materials for cardiovascular applications. Corrosion and chemical degradation.

3 credits. Prerequisite: permission of instructor

EID 123 Biosystems and Instrumentation

Introduction to mathematical modeling and the formulation of analogs for biological systems. Electrical aspects of nerve signals, coupled with their analysis and measurement. Design and construction of electro-cardiographic systems. Computer analysis of electro-cardiograms. Applications of systems theory to various physiological subsystems including muscle response and pupillary-retinal response. Laboratory work required.

3 credits. Prerequisite: Superior grades or at least one course in control theory. Suggested for seniors only

EID 124 Bioengineering in Safety, Design and Injury Analysis and Prevention

Accident reconstruction. Correlation between the events of an accident and injuries sustained. Analysis of sports injuries. Effects of seat belts/air bags in vehicular accidents. Analysis of injuries sustained by failure of equipment, medical devices, etc. Industrial and construction accidents. Special computational techniques to pinpoint product defects and reconstruct the chain of events leading up to and occurring during an accident.
3 credits. Prerequisite: ESC 100; co-requisite: ESC 110

EID 125 Biomechanics

An in-depth treatment of orthopaedic biomechanics, including freebody analysis applied to the musculoskeletal system, applied statics, dynamics and kinematics. Clinical problems relating to biomechanics. Lubrication theory applied to hard and soft tissues. Mechanical testing of tissue, including both static tests and dynamics tests. Tensor treatment of kinematic motions. Extensive reference to current literature. Muscle function, evaluation and testing. Exploration of the concepts of development of muscular power, work and fatigue.
3 credits. Prerequisites: ESC 100 and permission of instructor

EID 131 Energetics (same as ME 131)

3 credits. Prerequisite: ESC 130

EID 133 Air-Conditioning, Heating and Refrigeration (same as ME 133)

3 credits. Prerequisites: ESC 130, ESC 140

EID 140 Environmental Systems Engineering (Same as CE 141)

3 credits. Prerequisite: permission of instructor

EID 141 Air Pollution Control

Systems System design for particulate, gas and vapor recovery. Study of dynamics of particulate behavior in fluid stream, Brownian motion, interception, inertial impact; target geometry and effects, nucleation and particle growth; energy consumption and collection efficiency. Diffusional operations studies, transfer unit requirements. Kinetics of diffusion in gas-gas, gas-liquid, gas-solid and gas-extended surface systems. Unsteady-state behavior, surface renewal; wave-front analysis. Effect of fluid dynamics. Energy consumption related to transfer units. Fundamentals of mechanisms in real systems. Design problems.
3 credits

EID 142 Water Resources Engineering (same as CE 142)

4.5 credits (3 hours of lecture, 3 hours of laboratory). Prerequisite: ESC 140

EID 153 Mechatronics (same as ME 153)

EID 160 Acoustics, Noise and Vibration Control Interdisciplinary overview of acoustics and its applications in industrial and environmental noise control, acoustics of buildings, vibration systems and control. Topics include: sound levels, decibels and directivity, hearing, hearing loss and psychological effect of noise, noise control criteria and regulations, instrumentation, source of noise, room acoustics, acoustics of walls, enclosures and barriers, acoustics materials and structures, vibration control systems; design projects.
3 credits. Prerequisite: permission of instructor

EID 165 (same as ME 165) Sound and Space

Basics of acoustics, including sound waves, room and hall acoustics and metrics of sound. Audio engineering, including microphones, signal processors, amplifiers and loudspeakers. Skills and techniques using Pro Tools brand audio editor system to create original sonic and musical compositions. Public exhibition of an electronic music program.
3 credits. Prerequisite: permission of instructor

EID 170 Engineering Economy

Comparison of alternatives in monetary terms; meaning and use of interest rates; results evaluation including intangibles; risk in alternatives; principles underlying the determination of economic life; depreciation and depreciation accounting; financing business ventures; financial statement analysis; replacement of capital assets.
3 credits. Prerequisite: Ma 113

EID 176 Legal and Ethical Aspects of Engineering

A survey of the courts and their jurisdiction; civil and criminal law; equity jurisprudence; expert witness, contracts and the importance of business law to the engineer. Other topics include patents, trademarks and copyrights; product liability; unfair competition; professional ethics and professional advancement.
3 credits

EID 300 Special Research Project

Students will work on individual projects in engineering under supervision of faculty. Problems will vary according to individual interest. Permission to register is required from the Office of the Dean of Engineering. Students on academic probation are ineligible for registration.
3–6 credits

EID 311 Production Automation

Concepts and principles of automated production lines; analysis of high volume, discrete parts production systems in metal working industry; partial automation; mechanized assembly systems. Features of numerically controlled machine tools, NC part programming, control loops of NC systems, computerized numerical control, adaptive control system, group technology, flexible manufacturing systems, application of manufacturing engineering principles to optimize manufacturing process flow. Student projects with emphasis upon design and application.
3 credits. Prerequisite: CS 102

EID 312 Manufacturing Engineering (same as ME 312)

3 credits. Prerequisite: EID 101

EID 313 Science of Material for Engineering Design (same as ME 313)

3 credits. Prerequisite: ESC 110 or ESC 110.1

EID 314 Introduction to Composite Materials (same as ME 314)

Composite materials are becoming increasingly important to engineering applications in mechanical, aerospace and civil engineering. This new course offers both basic principles and some general applications for composite materials and structures. The knowledge students acquired from this course will prepare them for both advanced graduate study and practical engineering practice in industry. In this course a design project will also be assigned so that the students can use what they have learnt in the course to design a pressure vessel using laminated composite materials for optimal strength of the structure.
3 credits. Prerequisites: ESC 101; ESC 110 or ESC 110.1

EID 320 Special Topics in

Bioengineering Seminars on topics of current interest in biotechnology.
3 credits. Prerequisites: a basic understanding of engineering mechanics and materials; permission of instructor. May be repeated

EID 325 Science and Application of Bioengineering Technology

The overall purpose of the course is to provide the student with a general overview of the scope of bio-engineering. The major areas in the course are design in biomedical engineering, tissue engineering, medical imaging, cardiovascular, vision, rehabilitation, musculoskeletal system, robotic surgery and medical business.
3 credits. Prerequisites: permission of instructor

EID 326 Ergonomics

Principles of human-machine interactions with emphasis on the design of the workplace/machine, for maximum output or minimum risk to the operator. Mechanics of injury; case studies.
3 credits. Prerequisite: EID 120

EID 327 Tissue Engineering

Tissue Engineering involves the application of engineering and the life sciences to gain a fundamental understanding of structure-function relationships in normal and pathological tissues and the development of biological substitutes to restore, maintain or improve tissue functions. This course will provide an introduction to the science, methods and applications of tissue engineering. Topics include quantitative cell biology, tissue characterization, engineering design and clinical implementation.
3 credits. Prerequisites: working knowledge of engineering fundamentals, senior standing or instructor approval

EID 330 Introduction to Neurophysiology and the Biophysics of Neural Computation (Same as Ph 330)

3 credits

EID 333 Renewable Energy

Technologies This course is designed as an introduction to renewable energy technologies, with special focus on wind energy, kinetic hydropower and solar energy. The course will address both the current technological status and the commercialization challenges facing each sector, including licensing, deployment, distribution and economic feasibility issues. Guest lectures by industry experts and field trips to various technology sites are planned. The course is open to all engineering juniors and seniors.
3 credits

EID 334 Combustion (same as ME 334)

3 credits. Prerequisite: ESC 141 or ME 142

EID 352 Advanced Control Theory (same as ME 352)

3 credits. Prerequisite: ME 151, ECE 121 or ChE 152

EID 353 Transducers, sensors and computer interfacing (same as ME 353)

3 credits. Prerequisite: permission of the instructor

EID 356 Digital Control and Non-linear Control (same as ME 356)

3 credits. Prerequisite: ME 151

EID 357 Sustainable Engineering and Development

Sustainable engineering is examined, starting with an analysis of resources, (materials, energy, water) upon which manufacturing is based. Each resource is critically examined in terms of its availability and form and the ultimate impact of its usage on the state of the planet. A comparison of the design and construction of contemporary and primitive structure is used to illustrate the differences between the required infrastructure and environmental footprint, leading to a definition of "green" design. The technologies required to support contemporary lifestyles in the developed and the developing world are discussed within the context of manufacturing techniques, usage of natural resources and the generation of waste. Workshops, guest lectures and a term project incorporating the concepts of minimalism, materials usage, and aesthetic design are used to present students with a unique perspective engineering.

3 credits. Prerequisite: permission of instructor

EID 362 Interdisciplinary Senior Project I

Individual or group design projects in interdisciplinary areas of engineering. These projects are based on the interest of the students and must have the approval of their adviser(s) and course instructor. Periodic and final engineering reports and formal presentations are required for all projects. In addition to technical aspects projects must also address some of the following: economic feasibility environmental impact social impact, ethics, reliability and safety. 3 or 4 credits*. Prerequisite: students are required to have completed necessary preparatory engineering courses related to the project topic

EID 363 Interdisciplinary Senior Project II Continuation of EID 362

3 or 4 credits*. Prerequisite: EID 362

EID 364 Interdisciplinary Engineering Research Problem

An elective course, available to qualified upper division students. Students may approach a faculty mentor and apply to carry out independent or group projects in interdisciplinary fields.

3 credits. Prerequisites: Permission of adviser(s)

EID 365 Engineering and Entrepreneurship

Students will learn the fundamentals of being an entrepreneur and operating a successful business. From its original idea to the open market, students will choose an engineering related project or service and learn the principles of accounting, marketing, managing, financing, and continuing research. Students are required to choose their own service or product and write a business plan as their final project. Lectures include case studies on the various projects and guest speakers from the industry. Readings include articles from journals and textbooks.

3 credits

EID 370 Engineering Management

An exploration of the theories and techniques of management beginning with the classical models of management and continuing through to Japanese and American contemporary models. The course is specifically directed to those circumstances and techniques appropriate to the management of engineering. Lecture, discussion and case studies will be used.

3 credits

EID 371 Operations Management

An in-depth exploration of specific problems and techniques applicable to the management of production and large operating systems (e.g., engineering projects). The specific problems of demand analysis, capacity planning, production and inventory planning as well as scheduling and progress control will be presented. In addition, the concepts of total quality management, material requirements planning and statistical quality control will be presented. The presentation will include lectures and case problems.

3 credits. Prerequisite: EID 370

EID 372 Global Perspectives in Technology Management

Current global political, social and economic developments and future trends as they relate to technology management are discussed. Students learn to address issues of international technology transfer, multinational sourcing, quality control, diverse staff management, environmental

considerations, etc. Working in teams on case studies and projects, students learn to conduct international negotiations and develop solutions to complex business problems. Special emphasis is placed on team cooperation and personal leadership. Oral presentations and written reports are required.

3 credits. Prerequisite: permission of ME faculty required

EID 373 Patent Law

In this course a student will study patent law in detail: the requirements for obtaining a patent ("utility, novelty and non-obviousness"); "trade secrets" as an alternative to patent protection; computer software and "business methods" as patentable subject matter. The class will focus on the theoretical (patent cases from the U.S. Supreme Court and the Federal Court, the patent statute, 35 U.S.C.) and the practical (analysis of issued patents; individual and group exercises in drafting and critiquing patent claims, familiarity with the Manual of Patent Examining Procedure). The course is open to juniors, seniors, graduate students and faculty.

3 credits. Prerequisite: permission of instructor

EID 374 Business Economics

In this course, the class will carry out a real-time forecast of the U.S. economy and explore its implications for the bond and stock markets. The course will build upon principles of both macro- and micro-economics. It will provide an introduction to the work done by business economists and the techniques they use. Students will become familiar with the database looking for relationships between key economic variables, and studying movements in interest rates over the period 1960-present. The class will be divided into teams of two students with each team choosing a particular aspect of the economy to forecast. The class will also work with various leading indicators of economic activity and will prepare forecasts of the key components of gross domestic product and other important variables. A formal presentation of the economic with invited guests from the Wall Street investment world will take place. To put forecasting exercise in context, there will be class discussions of business cycles, credit cycles, long waves in inflation and interest rates and the impact of the Internet on the economy and the stock market.

3 credits. Prerequisites: either S 334, S 347, or, EID 170, or, permission of the instructor

CE 380 Fundamentals of Construction Management (same as CE 380)

Introduction to the construction industry, Discussion of construction management, scheduling, estimating, contracts, equipment selection and cost, Building materials and methods, latest developments in technology. 3 credits. Prerequisite: permission of instructor

Graduate**EID 410 Materials and Manufacturing Processes (same as ME 410)**

3 credits

EID 414 Solid Waste Management (same as CE 414)

3 credits. Prerequisite: permission of instructor

EID 420 Axiomatic Design (same as ME 420)

An interdisciplinary design course open to graduates and senior undergraduates. Axiomatic design theory and methodology provide a systematic and scientific basis for making design decisions. Axioms, corollaries and theorems give designers a firm basis for conceptualizing design issues, eliminating bad design ideas during the conceptual stage, choosing the best design among those proposed and improving designs. The Independence Axiom and its implications together with the Information Axiom and its implications form the foundation of this approach. Basic concepts and methodologies will be illustrated by case studies taken from many different fields. Project required.

3 credits. Prerequisite: permission of instructor

EID 421 Rehabilitation Engineering (same as ME 421)

Rehabilitation engineering is the application of engineering principles, technical expertise and design methodology in the development and provision of assistive technology, to help a person with a disability achieve his/her goals. Topics include the design of rehabilitation devices, human factors, client assessment, workplace assessment, high- and low-tech assistive devices and alternative and augmentative communication devices. Students will conduct research and design and lubricate custom assistive devices. Interdisciplinary teams will be encouraged.

3 credits. Prerequisite: permission of instructor

EID 422/CE 422 Finite Element Methods

Shape functions and generalized displacements. Assemblage of elements, Convergence criteria. Triangular, rectangular and quadrilateral elements in plane stress and strain. Isoparametric formulations. General Solids. Hexahedral and tetrahedral elements. Flexure in plates. General solids. Natural Coordinates. Special applications in blast mitigation design. Computer codes.

3 credits. Prerequisite: CE 122 or ME 100

EID 423 Measurement of Human Performance (same as ME 423)

Application of advanced engineering principles to the design of systems to evaluate muscle groups for strength, endurance and range of motion. Topics include isometric, isokinetic and sensibility testing; biofeedback, and strategies to minimize "faking." Students will conduct intensive research and design and fabricate a device to evaluate a single muscle group. Interdisciplinary teams will be encouraged.

3 credits. Prerequisite: permission of instructor

EID 424 Bioengineering Applications in Sports Medicine

Application of engineering principles to athletic performance and injury. Topics include athletic training; mechanical causes of sport injuries; methods of injury prevention; design of protective and prophylactic sport devices; proper application of wound dressing, taping and bandaging; first aid for musculoskeletal sports injuries and healing and rehabilitation. Students will work in teams on case studies and projects.

3 credits. Prerequisite: permission of instructor

EID 425 Product Design I (same as ME 425)

An interdisciplinary design project course open to graduate and senior students. Students will work in small teams to design and build engineered solution to real-world problems. This is an advanced product development class to initiate students to industrial practice.

3 credits

EID 426 Product Design II (same as ME 426)

*(continuation of ME/EID 425)
3 credits. Prerequisite: ME/EID 425*

EID 430 Thermodynamics of Special Systems (same as ChE 430 and ME 430)

Thermodynamic analyses of solid systems undergoing elastic strain and of magnetic, electric and biological systems. Equations of state for these and other fluid and non-fluid systems. Thermodynamics of low temperature systems. Recent advances in obtaining real fluid and solid properties.

3 credits. Prerequisite: ChE 131 or ME 130

EID 435 GeoEnvironmental Engineering (same as CE 435)

Discussion of pertinent regulations and regulatory programs relevant to contaminated soil. Identification and characterization of contaminated soils, discussion of current treatment technologies both ex-situ and in-situ. Geotechnical design of waste facilities, the closure and improvement of waste facilities and construction on waste

Utilization of waste for engineering purposes, the reuse and recycling of contaminated soil.

3 credits. Prerequisites: ESC 140, CE 141, CE 131 and permission of instructor

EID 438 Industrial Waste Treatment Design (same as CE 440)

3 credits. Prerequisite: permission of instructor

EID 439 Water and Wastewater Technology (same as CE 441)

3 credits. Prerequisite: permission of instructor

EID 440 Advanced Fluid Mechanics (same as ChE 440 and ME 440)

Introduction to multi-dimensional steady and unsteady compressible flow, velocity distribution, velocity potential and stream function. Turbulent flow. Boundary layer theory. Supersonic flows.

3 credits. Prerequisites: ESC 140 and permission of instructor

EID 441 Advanced Heat and Mass Transfer (same as ChE 441)

Principles of heat and mass transfer are used to solve various engineering problems. Topics studied include analytical and numerical solution techniques for steady and unsteady conduction processes, boundary layer flow, re-circulation phenomena, turbulent flow, radiation heat transfer, combined convection and radiation, diffusion mass transfer and chemically reacting systems.

3 credits. Prerequisite: ESC 141

EID 446 Pollution Prevention of Minimization (same as CE 446)

3 credits. Prerequisite: permission of instructor

EID 448 Environmental and Sanitary Engineering (same as CE 448)

3 credits. Prerequisite: permission of instructor

EID 449 Hazardous Waste Management (same as CE 449)

3 credits. Prerequisite: permission of instructor

EID 452 Principles of Interactive Computer Graphics

Point plotting, line drawing and raster graphics techniques. Two-dimensional transformations, clipping and windowing, graphical input devices and techniques. Graphics data structures and display lists. Principles of three-dimensional representation and solid modeling concepts. Specialized computer architectures for graphics. User interface design. Each student will undertake a design project to realize some aspect of the course material, related to his or her area of specialization. (This course will be limited to 8 students.)

3 credits. Prerequisite: ECE 161

EID 453 Computer-Aided Design/Computer-Aided Manufacturing (CAD/CAM) (same as ME 453)

3 credits. Prerequisite: ECE 161

EID 455 Optimal Estimation Methods (same as ME 455)

3 credits. Prerequisite: ME 151 or ECE 121 or ChE 152

EID 457 Optimization Techniques For Design (same as ME 457)

3 credits. Prerequisite: Ma 223

EID 458 Industrial Robots (same as ME 458)

3 credits. Prerequisite: ME 312

EID 464 Computer-Integrated Manufacturing (same as ME 464)

3 credits. Prerequisite: ME 312

EID 470/CE 470 Urban Security

Design of urban systems to protect against terrorism. Analysis of blast loads. Blast mitigation design considerations. Technology transfer; military/defense to civilian sector. Response spectra. Pressure/impulse diagrams. Stand off distances. Blast mitigation measures for buildings, bridges and tunnels. Prevention of progressive collapse in tall buildings. Design of glazing. Retrofit upgrade of existing urban infrastructure. Building code and insurance issues.

3 credits. Prerequisites: CE 122 or ME 101 and permission of instructor

EID 480 Challenges Facing Engineering Start-ups in Innovative Technologies

This course will address the various issues facing engineering start-ups in innovative technologies such as urban security engineering businesses, distributed electric generators, bio-medical engineering businesses. Topics include definition of mission and core values, business plans financing strategies, marketing considerations, intellectual property issues, employee relations and regulatory hurdles. The course will feature guest speakers with first-hand experience in relevant start-ups.

3 credits. Prerequisite: Open to seniors and graduate students

EID 481 Environmental Economics

How environmental regulations affect economic growth. Analytical framework and tools: valuing the environment for decision making; marginal damage function and marginal abatement cost: risk assessment; alternatives assessment; cost-benefit analysis; cost-effectiveness; distributive equity; precautionary principle. Issues relating to air, water, energy and materials. Environmental health issues. Creation of markets for new technologies.

3 credits

Biology

Bio 101 Biology for Engineers I

This course will examine in depth the genetics, molecular and cellular biology, pathology, toxins, microbiology and environment as they relate to humans and disease using organ-based or systems biology approaches (e.g., gastrointestinal pulmonary, cardiovascular, urinary endocrine, etc.) Major assignments will be individualized to student's interests and majors when possible. As such, this course will provide the biological fundamentals for further study in biotransport, biochemistry, graduate school in biomedical engineering, etc. Combined with Biology 102 and Biochemistry, it will provide a solid foundation for medical school.
3 credits (includes lab experience). Pre-requisite Ch 110 and Ch 160 or permission of instructor

Bio 102 Biology for Engineers II

This course will provide human biology fundamentals to springboard into research projects at the intersection of biology and engineering. Topics will include anatomy and physiology of musculoskeletal and other major organ systems not covered in Bio 101, imaging modalities, concepts behind diagnostic and therapeutic surgical procedures, and their limitations, human body repair, artificial organs, tissue engineering, immunology and cancer. Students will develop an extensive biological vocabulary and have requisite knowledge for further study in biomechanics, rehabilitation medicine, biomaterials, bioremediation, etc.
3 credits. Sophomore standing preferred, but freshman with AP Biology welcome

Chemistry Courses

Undergraduate

Ch 110 General Chemistry

An introduction to the general scientific principles associated with chemistry. This course will deal with fundamental ideas such as the concept of the atom, the molecule, the mole and their applications to chemical problems. The classical topics include: dimensional analysis and significant figures; atomic weights; periodic properties; chemical reactions and stoichiometry; redox reactions; ideal gas law and real gas equations of state; the liquid state and intermolecular forces; solution concentrations; chemical equilibrium and equilibrium constants; acids and bases; solubility equilibria; nomenclature of inorganic and organic compounds. The topics for atomic and molecular properties include: atomic structure and the quantum theory; electronic structure of atoms; the covalent bond and bond properties; molecular geometries and hybridization; molecular orbital theory.
3 credits

Ch 111 General Chemistry

Laboratory Methods of quantitative analysis are used to explore chemical reactions and analyze unknowns. Modern chemical instrumentation as well as "classic" wet chemistry analytical techniques are covered. Statistical analysis of the experimental data is used to analyze results. Chemical laboratory safety and industrial chemical regulations are covered, as are the fundamentals of writing a technical report.
1.5 credits. Prerequisite: Ch 110; co-requisite Ch 160

Ch 160 Physical Principles of Chemistry

The study of physicochemical properties will be extended and advanced. The laws of thermodynamics, which involve energy, enthalpy, entropy and free energy concepts, will be applied to chemical systems. Other topics include: vapor pressures and colligative properties of solutions; the phase rule; kinetics of homogeneous reactions; electrolytic conductance and electrochemistry.
3 credits. Prerequisite: Ch 110; co-requisite: Ch 111

Ch 231 Organic Chemistry I

Bond types and strengths, structural theory, bond angles and hybrid bonds; covalent bonds, polarity of bonds and molecules; dipole moments; molar refraction; melting points and boiling points relative to properties and natures of molecules; solubilities based on structures; functional groups; critical temperature, pressure and volume as a function of structure and functional groups, prediction of vapor pressure curves, latent heats. Nomenclature isomers and properties. Resonance and delocalization of charge phenomena; acidity and basicity (Lewis concept).
3 credits. Prerequisite: Ch 160

Ch 232 Organic Chemistry II

Extension of Ch 231 to systematic study of aliphatic and aromatic compounds, with emphasis on functional behavior and interpretation of mechanisms and bond types, polyfunctional compounds, carbohydrates and heterocyclic compounds.
2 credits (2 lecture hours). Prerequisite: Ch 231; co-requisite Ch 233

Ch 233 Organic Chemistry

Laboratory Laboratory work will cover subject matter studied in Ch 231 and Ch 232, including synthesis and type reactions and identification of organic compounds.
2 credits (4 laboratory hours) Prerequisite: Ch 231

Ch 251 Instrumental Analysis

Laboratory Fundamental principles of instrumental methods will be covered, including laboratory applications and limitations in scientific research. Specific methods include electrometric, such as polarography, electrogravimetry and potentiometry; optical (such as visible and ultraviolet absorption), spectroscopy, emission spectroscopy and infrared spectroscopy; and other techniques such as chromatography and mass spectroscopy shall be included.
2 credits (4 laboratory hours). Prerequisite: Ch 160

Ch 261 Physical Chemistry I

With an emphasis on the basic theoretical justifications underlying observed physical phenomena, quantum mechanics will be developed and applied to the study of chemical systems with an emphasis on interpreting spectroscopic data. Modern methods of computational molecular modeling are introduced. Statistical mechanics is introduced as a link between quantum mechanics and thermodynamics.
3 credits. Prerequisites: Ch 160 and Ph 214

Ch 262 Physical Chemistry II

Continuation of Ch 261 with emphasis on electrochemistry, chemical kinetics and solid state chemistry. Selected topics.
2 credits. Prerequisite: Ch 261

Ch 333 Advanced Organic

Chemistry Modern areas of organic chemistry, including synthesis, structure determination, stereochemistry and conformational analysis, reaction mechanisms, photochemistry, conservation of orbital symmetry, molecular rearrangements and other selected topics. Advanced laboratory studies in research problem form. Typical problems would involve studies of the synthesis, structure and properties of organic compounds, utilizing modern instrumental techniques. Independent laboratory work may be arranged.
3 credits. (2 hours of lecture; 4 hours of Laboratory). Prerequisite: Ch 232

Ch 334 Physical Organic Chemistry

Molecular orbital theory in organic chemistry, orbital symmetry and stereoelectronic selection rules, rate theory, kinetic isotope effects, carbonium ions and rearrangements, acid-base catalysis, quantitative correlations of reactivity and other selected topics.
3 credits. Prerequisites: Ch 232, Ch 261

Ch 340 Biochemistry

This course in the fundamentals of biochemistry will cover the following: Chemistry of carbohydrates, lipids, amino acids, proteins, and nucleotides; bioenergetics; kinetics and mechanisms of enzymes; and an introduction to molecular genetics, and biochemical dynamics of DNA and RNA.
3 credits. Prerequisites: Bio 101, Ch 231

Ch 363 Advanced Physical Chemistry

Modern applications of physical chemistry and chemical physics are developed. Topics covered include: Quantum and classical statistical mechanics, phase space, and fluctuations. Intermolecular forces and their experimental/theoretical determination. Computational molecular modeling, including ab initio, semiempirical and molecular mechanics predictions of molecular properties, as well as Monte Carlo and molecular dynamics methods. Some projects will require computer programming. Applications to liquids, nanoclusters, polymers, surface adsorbates and biomolecules are considered. Guest speakers from academia and industry are invited to share their perspectives.
3 credits. Prerequisites: Ch 261, Ch 262 (or by permission from instructor)

Ch 364 Solid-State Chemistry

Solid-state reactions; nucleation and diffusion theory; thin films of elements and compounds; current topics.
3 credits. Prerequisite: Ch 262

Ch 365 Chemical Kinetics

Fundamental study of chemical reaction systems in gaseous and condensed phases; absolute rate theory; collision theory; energetics from molecular and macroscopic viewpoints. Experimental rate techniques, interpretation of experimental data. Reaction mechanisms and models for complex and elementary reactions. Homogeneous and surface catalysis; enzyme-controlled reaction rates.
3 credits. Prerequisite: Ch 262

Ch 370 Inorganic Chemistry

The vast and fascinating chemistry of inorganic compounds and materials will be covered. Atomic structure and the periodic table; molecular symmetry and spectroscopy selection rules; coordination chemistry; ligand-field theory and other electrostatic bonding models; superacids; reaction mechanisms; organometallic chemistry; chemistry of the heavy elements; nuclear chemistry. Chemistry and physics of ionic and molecular solids; atomic and molecular clusters; chemisorption and physisorption of surface-bound species; cage compounds and catalysts; bioinorganic chemistry. A useful course for chemical engineers to extend their knowledge of inorganic chemistry beyond the content of Ch 110. Strongly recommended for students interested in graduate work in chemistry.
3 credits. Prerequisites: Ch 110, Ch 160, Ch 231, Ch 261

Ch 380 Selected Topics in Chemistry

Study of topics related to specialized areas as well as advanced fundamentals.
2-6 credits. Chemistry faculty approval required

Ch 391 Research Problem I

An elective course available to any qualified and interested student irrespective of year or major. Students may approach a faculty member and apply to carry out independent research on problems of mutual interest, in pure or applied chemistry. Topics may range from the completely practical to the highly theoretical, and each student is encouraged to do creative work on his/her own with faculty guidance.
3 credits

Ch 392 to 398 Research Problem II to VIII

This is intended to allow students to continue ongoing research.
3 credits each. Prerequisite: permission of research adviser and student's advisor(s)

Graduate**Ch 440 Biochemistry II (continuation of Ch 340)**

Discussion of metabolism: Glycolysis, Glycogen Metabolism, Transport through membranes including ATP-Driven Active Transport and Ion Gradient-Driven Active Transport, Citric Acid Cycle, Electron Transport and Oxidative Phosphorylation, Lipid Metabolism including Fatty Acid Oxidation and Biosynthesis, Cholesterol Metabolism, Arachidonate Metabolism: Prostaglandins, Prostacyclins, Thromboxanes and Leukotrienes; DNA Repair and Recombination, Eukaryotic Gene Expression including Chromosome Structure, Genomic Organization, Control of Expression, Cell Differentiation.
3 credits. Prerequisite: Ch 340

Computer Science**CS 102 Introduction to Computer Science**

Introduction to Engineering Problem Solving using algorithms and their design. Logics and basic analysis techniques are explored using programming languages 'C', C++ and Java. Students will also master one or more significant engineering design packages such as MATLAB, AUTOCAD, MAPLE, MATHEMATICA etc. Projects will be assigned.
3 credits, no prerequisites

Mathematics Courses**Undergraduate****Ma 110 Introduction to Linear Algebra**

Vectors in two- and three-dimensions, vector algebra, inner product, cross product and applications. Analytic geometry in three dimensions: lines, planes, spheres. Matrix algebra; solution of system of linear equations, determinants, inverses.
2 credits

Ma 111 Calculus I

Functions; limit of functions, continuity. The derivative and its applications: curve sketching, maxima and minima, related rates, velocity and acceleration in one dimension; trigonometric, exponential, logarithmic and hyperbolic functions. Definite and indefinite integrals; area, the fundamental theorem, techniques of integration.
4 credits

Ma 113 Calculus II

Applications of definite integrals: area, volume, improper integrals, work, arc length, surface area, centroid. Polar coordinates. Parametric curves in two and three dimensions: velocity, speed and accelerations. Partial derivatives and the chain rule, properties of the gradient. Maxima and minima. Sequences and series: convergence of sequences and series, Taylor and Maclaurin series, power series.
4 credits. Prerequisite: Ma 111; Prerequisite or co-requisite: Ma 110

Ma 151.1 Mathematics in Art

This course deals with the period beginning with Pythagoras in ancient Greece and goes up to the present day. Topics include: Goedel's incompleteness theorem. Euclidean and non-Euclidean geometries, infinity, paradoxes, soap film experiments. Also discussed are black holes, the Big-Bang theory, relativity and quantum theory. The course is open to all Cooper Union students but is primarily oriented toward making the above-mentioned concepts comprehensive to those with very little mathematics in their background. Engineering students should see the Mathematics faculty and their adviser(s) for permission to take this course. The relatedness of seemingly distant fields (science, art, mathematics, music) is a central theme of the course.
3 credits

Ma 163-164 Calculus and Analytic Geometry I, II

Second year mathematics course for architecture students. Emphasis is on topics that involve the mathematical approach to geometrical and physical relationships and on basic concepts and applications of calculus of functions of one and two variables. *3 credits each semester. Cannot be used to satisfy any degree requirement in the School of Engineering*

Ma 223 Vector Calculus

Double and triple integrals and their applications. Vector fields. Gradient, divergence and curl. Line and surface integrals. Theorems of Green, Gauss and Stokes. Path independence of line integrals. *2 credits. Prerequisite: Ma 110 and 113. Usually given in fall and spring semesters*

Ma 224 Probability

Sample spaces. Random variables. Probability. Distribution and density functions. Expectation. Mean and variance. Moments and generating function. Central limit theorem. *2 credits. Prerequisite: Ma 113. Corequisite Ma 223. Usually given in both fall and spring semesters*

Ma 224.1 Probability and Statistics

This course deals with sample spaces, random variables, probability. Distribution and density functions. Expectation. Mean and variance. Moments and generating function. Central limit theorem. Point estimation. Confidence intervals. Hypothesis tests. Chi-square. ANOVA. Estimations, sampling theory. *3 credits. Prerequisites: Ma 113. Co-requisite Ma 223*

Ma 240 Ordinary and Partial Differential Equations

Ordinary differential equations of the first order. Linear equations of higher order with constant coefficients. Power series solutions. Laplace transformation. Fourier series. Partial differential equations: method of separations of variables, applications to vibration and heat flow. *3 credits. Prerequisite: Ma 113*

Ma 326 Linear Algebra

Finite-dimensional vector spaces. Linear independence. Dimension. Basis. Subspaces. Inner product. Matrices. Rank. Determinant. Systems of linear equations. Matrix algebra. Coordinate transformation. Orthogonal matrices. Linear transformation. Eigenvalues and eigenvectors. Quadratic forms. Canonical form. *3 credits. Prerequisite: Ma 223*

Ma 336 Statistics

Statistical central limit theorem. Decision theory. Estimation: properties of estimators, point estimation, confidence intervals. Hypothesis testing: simple and composite hypothesis, Neyman-Pearson lemma, sequential methods, relationship to estimation. Normal distribution tests: t-test, chi-square, F-test. Introduction to non-parametric methods, regression and analysis of variance. *3 credits. Prerequisites: Ma 223 and Ma 224*

Ma 337 Operations Research

Linear programming, simplex method, graphs and network theory, dynamic programming, game theory, queues, variational techniques, duality, Markov chains, Monte Carlo simulation, decision theory. Special topics depending on student interest, possibly including language questions, integer programming, nonlinear programming and topics from mathematical biology, econometrics and other applications of mathematics to the sciences and social sciences. *3 credits. Prerequisite: Ma 224*

Ma 341 Differential Geometry

Theory of curves and surfaces, curvature, torsion, mean and Gaussian curvatures length, area, geodesics, 1st and 2nd quadratic forms, conformal mapping, minimal surfaces, tensor formulation and applications. *3 credits. Prerequisite: Ma 223 and permission of instructor*

Ma 344 Tensor Analysis

Tensor algebra, covariant and contravariant tensors, metric tensors, Christoffel symbols and applications. *3 credits. Prerequisite: Ma 326*

Ma 345 Functions of a Complex Variable

Topological properties of complex plane, complex analytic functions, Cauchy-Riemann equations, line integrals, Cauchy's integral theorem and formula. Taylor series, uniform convergence, residues, analytic continuation, conformal mappings and applications. *3 credits. Prerequisite: Ma 223*

Ma 347 Modern Algebra

Sets and mappings, the integers: well ordering, induction residue class arithmetic, Euler-Fermat theorems. Permutation groups: cyclic decompositions, transpositions, conjugate classes of permutations. Abstract groups: morphisms, subgroups, cyclic groups, coset decompositions. Factor and isomorphism theorems. Direct products of groups. Sylow's theorems. *3 credits. Prerequisite: Ma 326*

Ma 350 Advanced Calculus I

Sets and functions, topological properties of real line, continuity and uniform continuity, differentiability, mean value theorems, the Riemann-Stieltjes integral and Taylor's theorem. *4 credits. Prerequisite: Ma 223*

Ma 351 Advanced Calculus II

Uniform convergence. Differentiation of transformations, inverse and implicit function theorems. Applications to geometry and analysis. *4 credits. Prerequisite: Ma 350*

Ma 352 Discrete Mathematics

Relations. Mathematical structures. Number theory. Algorithms. Complexity of algorithms. Cryptology. Recurrence relations. Graph theory. A shortest-path algorithm. Planar graphs. Trees. A maximal flow algorithm. Finite-state automata. Languages and grammars. Turing machines. The Church-Turing thesis. Unsolvable problems. *3 credits. Prerequisite: Ma 110*

Ma 370 Selected Topics In Mathematics

This is a seminar course involving discussion of topics in pure or applied mathematics that will be chosen by mutual agreement between the students and the instructor. Students will work independently on projects that may be of special interest to them. *3 credits. Prerequisites: Ma 326 and permission of the mathematics faculty*

Ma 381 Seminar Individual investigation of selected topics in pure or applied mathematics, centered on a subject to be agreed on between students and the faculty leader. Emphasis will be on training in independent reading of mathematical literature, oral presentations and group discussions of the theory and problems. *Credits and class hours to be determined by faculty on individual basis. Prerequisite: Ma 223*

Ma 382 Seminar (continuation of Ma 381)

Credits to be determined by faculty on individual basis. Prerequisite: Ma 381

Ma 391 Research Problem 1

An elective course available to qualified upper division students. Students may approach a faculty member and apply to carry out independent research on problems of mutual interest in pure or applied mathematics. Each student is encouraged to do independent creative work with faculty guidance. *3 credits. Prerequisite: Ma 240 and permission of research advisor.*

Ma 392 Research Problem 2 Continuation of Ma 391

This is intended to allow students to continue ongoing research. *3 credits. Prerequisite: Ma 391 and permission of research advisor*

Graduate**Ma 401 Boundary Value Problems**

Orthogonal polynomials, Fourier series; properties of Legendre polynomials and Bessel functions. Applications to the wave equation and the differential equations of heat transfer in several dimensions. *3 credits. Prerequisites: Ma 223, Ma 240*

Ma 402 Numerical Analysis

Techniques for the solutions of ordinary and partial differential equations, the classical problems of linear algebra, integration and systems of nonlinear equations. Error analysis, convergence and stability theory. Course assignments will include use of computing facilities. *3 credits. Prerequisites: Ma 223, Ma 240*

Ma 403 Special Topics in Applied Mathematics

Introduction to the general theory of partial differential equations; existence and uniqueness of solutions; integral equations; computational techniques using finite-element and probabilistic methods. Other current topics in engineering may be included also. *3 credits. Prerequisites: Ma 223, Ma 240*

Ma 415 Wavelets and Multiresolution Imaging (same as ECE 415)

3 credits. Prerequisite: Permission of instructors. Taught by the faculties of mathematics and electrical engineering

Ma 417 Mathematics of Medical Imaging

Mathematical basis for various medical imaging methods including CT, MRI, PET. Radon transform, tomography (recovery from projections), inverse problems, artifacts and noise. Mathematical physics of related topics such as wave propagation, signal generation and detection, quantum mechanics. *3 credits. Prerequisite: Ma 240, Ma 326, or permission of instructor*

Ma 470 Selected Advanced Topics in Mathematics

Selected topics in Mathematics treated at an advanced level. *Credits to be determined by Mathematics faculty. Prerequisite: Ma 326 and permission of the faculty member*

Physics Courses

Undergraduate

Ph 112 Physics I: Mechanics

Static equilibrium, kinematics, Newton's Law's, non-inertial frames of reference, system of particles, work and energy, linear and angular momentum, rigid body motion, conservation laws, oscillation.
4 credits

Ph 151 Optics: The Physical Basis of What Is Seen

This course is intended primarily for students in the Schools of Art and Architecture. It requires little mathematical background, but much interest in such questions as: Why are sunsets red? Why does colorless rain splatter dark on the pavement? How do one-way mirrors work? Topics will include light and color; mirrors, lenses and optical devices; reflection, refraction, absorption, emission, interference, diffraction and polarization of light; addition and subtraction of "color," the visual response of the eye. There also will be special topics based upon student interest. Emphasis will be on scientific concepts and their application to optical and visual phenomena.
3 credits. Cannot be used to satisfy any degree requirement in the School of Engineering

Ph 165 Concepts of Physics I

An introduction to physics with an emphasis on statics and dynamics.
2 credits. Prerequisites: Ma 160, CS 102; co-requisite: Ma 163. Cannot be used to satisfy any degree requirement in the School of Engineering

Ph 166 Concepts of Physics II (continuation of Ph 165)

Additional topics include optics, waves and an introduction to structural analysis.
2 credits. Prerequisite: Ph 165; co-requisite: Ma 164. Cannot be used to satisfy any degree requirement in the School of Engineering

Ph 213 Physics II: Electromagnetic Phenomena

Oscillations; transverse and longitudinal waves. Electric fields; Gauss' Law; electric potential; capacitance; D.C. circuits; magnetic fields; Faraday's law; inductance; A.C. circuits; electromagnetic waves.
4 credits. Prerequisite: Ph 112

Ph 214 Physics III: Optics and Modern Physics

Geometric and physical optics. Special theory of relativity. The quantum theory of light. The quantum theory of matter. Atomic structure. Nuclear structure and radioactivity.
3 credits. Prerequisite: Ph 213

Ph 291 Introductory Physics Laboratory

Physical measurements and analysis of experimental data. The experiments test and apply some basic principles selected from the following fields: mechanics, sound, electromagnetism, optics and modern physics. Experiments and topics may vary each semester. Digital and analog laboratory instruments; computer acquisition and analysis of data. Estimate of systematic and random error, propagation of error, interpretation of results. This course complements three lecture courses, Ph 112, Ph 213, Ph 214.
1.5 credits. Prerequisite: Ph 112; co-requisite: Ph 213

Ph 319 Introductory Quantum and Solid-State Physics

Wave-particle experiments, wave-particle duality. Formalism and interpretation of quantum mechanics. Schroedinger's equation; its solution for selected simple cases. Atomic, molecular and crystalline structure. Binding and energy bands in solids. Thermal, electrical and magnetic properties. Imperfections; semiconductors, lasers.
3 credits. Prerequisite: Ph 214

Ph 327 Topics in Modern Physics

Seminar course with student participation in several topics of current interest in experimental and theoretical science.
3 credits. Prerequisite: Ph 214

Ph 330/EID 330 Introduction to Neurophysiology and the Biophysics of Neural Computation

This course will introduce students to the fundamentals of neurophysiology through a combination of traditional classroom instruction and laboratories. Each topic covered will include a physiological introduction, laboratory exploration, physical/mathematical analysis and computer modeling. Topics include biophysics of single neurons (e.g. ion movement through cell membranes, generation of action potentials, synapses and neurotransmitters), Hodgkin-Huxley and other related models of neural excitability, signal detection and signal reconstruction and neural coding in sensory systems. In the laboratories,

students will learn a variety of extracellular and intracellular experimental techniques using invertebrate preparations. The class will culminate with an independent project.
3 credits. Prerequisites: permission of instructor, Ph 213, Ph 214, Ph 291, Ma 240

Ph 328 Relativity and Electrodynamics

Introduction to tensors; formulation of electromagnetic theory. Special and general theories of relativity. Topics include space-time transformations, electromagnetic stress- energy-momentum tensor, four-space curvature and gravitational field equations, description of basic experiments, gravitational waves, cosmological models.
3 credits. Prerequisite: Ph 214

Ph 360 Special Projects in Physics

Special projects in experimental or theoretical physics.
Credits and prerequisites determined in each case by the physics faculty

Ph 370 Introduction to Astronomy and Astrophysics

A quantitative introduction to Astronomy and Astrophysics. Topics include: Introduction to observational Astrophysics. The Sun, "normal stars" and interacting binaries. Stellar evolution and energy generation. Supernovae, pulsars, white dwarfs, neutron stars, black holes. Star clusters. Galaxies, and interstellar medium, galaxy clusters. Quasars and Active Galactic Nuclei. Cosmology. Prior knowledge of astronomy not necessary.
3 credits. Prerequisites: permission of instructor

Graduate

Ph 429 Deterministic Chaos with Engineering Applications

A simple mathematical formalism explains how a nonlinear system with no random element may be intrinsically unpredictable even when its governing equations are known. The mathematics of chaos (including fractals) will be presented, with applications drawn from mechanical, biological, chemical processes; the weather; electric circuits; lasers; general relativity; models of war; the economy; the spread of epidemics, etc.
3 credits. Prerequisites: Ph 214, Ma 113 (Ma 240 preferred) and CS 102

Ph 462 Nuclear Physics

Historical introduction, relativity kinematics, basic nuclear properties, nuclear chain reactions, phenomenological nuclear models (shell, liquid drop and collective), equation of state (with computer exercises), an overview of particle physics, quantum chromodynamics, standard model, current research topics (neutron stars, big-bang nucleosynthesis, heavy-ion collider experiments)
3 credits. Prerequisites: permission of instructor, Ph 214, Ma 240

FACULTY

Administration

Eleanor Baum, *Dean*

Simon Ben-Avi, *Associate Dean*

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Sara Foley, *Senior Audio-Visual
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Bernie Brandell, *Technician*

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FACULTY OF HUMANITIES AND SOCIAL SCIENCES

AIMS AND OBJECTIVES

The Cooper Union is committed to the principle that an education in the liberal arts provides the ethical, social and humanistic framework crucial to personal development and professional excellence. Through their work in the humanities and social sciences, students gain a deeper awareness of the world in which they must live and act. They learn to think, write and speak clearly and effectively. Most significantly, an education in the liberal arts offers students the opportunity to become attentive to the social and humanistic implications of their professional work and to acquire the basis for a satisfying cultural and intellectual life.

Curriculum All students take a four-semester core curriculum of required courses in the humanities and social sciences. In addition, students in the School of Art take a three-semester sequence in art history. The core curriculum is a prerequisite to all elective offerings in Humanities and Social Sciences. During the third and fourth years, students have considerable latitude to explore the humanities and social sciences through elective courses. All students are expected to take core curriculum courses at The Cooper Union.

Transfer Credit Transfer credits may be granted for courses with a grade of **B** or better upon review by the office of the dean of Humanities and Social Sciences to determine that the work accomplished meets the Faculty's requirements. Students may be required to provide evidence of work completed in the course: syllabi, papers, etc. In rare circumstances, the freshman and sophomore requirements may be waived if an equivalent course of study has been satisfactorily completed elsewhere. Eligible credits should be transferred during a student's first semester at The Cooper Union. Interested students should make an appointment with the dean or the academic adviser of the Faculty of Humanities and Social Sciences during the first week of classes in the fall semester.

Advanced Placement Credit The Faculty of Humanities and Social Sciences rarely grants AP credit. However, a student who has attained a grade of 5 in an AP course may petition the dean for permission to waive a core requirement and to substitute an appropriate elective course.

Independent Study Only juniors and seniors in good academic standing are eligible for independent study. Independent study may be taken for a maximum of three credits per semester. The student must obtain permission of both the instructor and the dean of the Faculty of Humanities and Social Sciences. The major consideration in approving proposals for independent study is the educational value of the study project within the structure of the degree requirements. The Faculty of Humanities and Social Sciences insists on very high standards as a condition for approving any independent study project.

Minor Students who complete a minimum of 15 upper-division credits in a specific field of liberal arts may qualify for a minor in that field of Humanities and Social Sciences. Minors are offered and may be designated on student transcripts in the following four fields: American studies, art history, literature and history and society. Additional information is available from the office of the dean of Humanities and Social Sciences.

ACADEMIC REGULATIONS

Credits Unless otherwise noted, HSS courses with the prefixes H and S carry three credits and courses with the prefix HTA carry two credits.

Prerequisites The prerequisites for all courses with the prefixes H and S are HSS1, 2, 3 and 4. HTA 1, 2 and 3 are prerequisites for HTA electives. Exceptions may be granted by special permission of the dean.

Grades At the end of every semester, each student receives a grade for his or her semester's work in each subject. Grades, with their official significance, are as follows:

- A** Outstanding performance
- B** Very good performance
- C** Average performance
- D** Passing but unsatisfactory
- F** Failure to meet minimum requirements
- I** Work of the course not completed and assignment of grade and credit postponed. This designation will be given only in cases of illness (confirmed by authorized physician's letter) or of other documented extraordinary circumstances beyond the student's

control, and only with the approval of the dean of the Faculty of Humanities and Social Sciences.

The deadline for removal of an I designation will be determined by the instructor, but will not be later than six weeks after the start of the spring semester for students who receive such a grade in the fall semester and not later than two weeks after the start of the fall semester for students who receive such a grade in the spring semester. If the I is not removed within the set time limit, either by completing the work in the subject or by passing a re-examination, the I will automatically become an F unless the dean of the Faculty of Humanities and Social Sciences extends the time or the student withdraws from school.

W Withdrawal (see below)

WU Unauthorized withdrawal (see below)

Indicators of plus (+) and minus (-) are used with the grades A, B, C and D. (The grade of A+ is, however, not given.) These indicators are included in computing grade point averages.

Dropped Courses and Withdrawals Courses dropped during the first and second week of the semester will not be entered in the transcript.

Dropping courses in Weeks 3-8: A student anticipating inability to continue a course should immediately seek advice. It is the responsibility of the student to notify the instructor and to file an official drop form by the end of the eighth week of the semester in order to receive a W grade. The grade W is not included in the calculation of the student's semester rating.

Dropping courses after Week 8: It is the policy of the Faculty not to approve any withdrawal after the eighth week of classes except under extreme, extenuating circumstances. If a student has stopped attending the class without consultation with the instructor and filing an official drop form, a WU will appear as the grade for the course. However, if the student is failing the course at the time of the unauthorized withdrawal, the instructor is free to record an F grade.

Assignments Students are required to complete all assignments and examinations on time. In the case of schedule conflict or an unavoidable delay in completing an assignment, the student should discuss the problem with his or her instructor. Failure to complete assignments on time may result in an F grade for the course.

Attendance Students are expected to attend all classes. No more than two unexcused absences will be permitted during any given semester. In the case of an unavoidable absence, the student should contact the instructor in advance. Students who are absent three or more times may receive a reduction of the final grade or, at the

discretion of the instructor, be asked to withdraw from the course.

Lateness Students are expected to be punctual. Late students may be refused entry to a class. Chronic, unexcused lateness may result in a reduction of the final grade or in failure.

Academic Integrity The Faculty of Humanities and Social Sciences expects all students to demonstrate the highest levels of academic integrity. Violations of academic integrity have consequences, including, but not limited to, failure for the course. Further information concerning the policy on academic integrity is available from the dean's office.

Student Behavior Students are expected to conduct themselves in accordance with the guidelines in "A Code of Fair Practice" (see page 21.)

ACADEMIC ADVISING AND SUPPORT

Academic Advising In addition to the dean, an academic adviser is available in the office of Humanities and Social Sciences for consultation by students in all three schools. Students are also encouraged to seek the advice of individual faculty members about general curricular and scholarly matters. A course instructor may not sign add/drop forms, determine transfer or AP credits, or pre-approve courses to be taken elsewhere. Such questions must be referred to the dean's office.

The Center for Writing

The communication of ideas in written and oral form is central to an education in the liberal arts. All humanities, social sciences and art history courses include a substantial writing requirement and additional requirements for presentations. The Center for Writing offers feedback, support, and instruction in all areas of written and spoken communication. The Center is staffed by experienced teachers, writers and editors, most with advanced graduate degrees. The Center offers one-on-one and small group sessions; students may sign up for single appointments as needed or may enroll for regularly scheduled ongoing sessions. Center associates provide feedback, work with students on issues of structure and argument and help all writers—regardless of level—to engage with their work more effectively. The Center also offers special support for non-native English speakers, students with learning difficulties, and students without a strong background in writing, as well as intensive support for students working on Fulbright and other grants.

COURSES

Courses in the Humanities, Social Sciences, Art History and Foreign Languages

Prior to registration each semester, students should consult the latest announcement of scheduled courses in the humanities, social sciences, and art history. (Inquiries concerning courses in foreign languages should be directed to Professor Mary Stieber, Academic Advisor for HSS, during the first week of the fall semester.) Some courses listed below may not be offered every year and new courses may be added each semester.

Core Curriculum

HSS 1 Literary Forms and Expressions

A literature course concentrating on poetry and drama, HSS1 develops college-level skills in reading and writing, analysis, and argumentation through engagements with major texts and themes. Through close reading and extended discussion, students learn to articulate their responses in written and spoken form. A range of critical responses is encouraged. Drafts and revisions are key elements of written work.
3 credits

HSS 2 Texts and Contexts: Old Worlds and New

A study of texts and topics from 1500 to 1800, with emphasis on literary expression and cultural context. Topics include the formation of states, exploration, the encounter with the New World, the crises in religious orthodoxy, the origins of modern science and the beginnings of political and economic individualism. This semester develops both cultural and political understanding through close reading, class discussion and careful writing.
3 credits

HSS 3 The Making of Modern Society

A study of the key political, social and intellectual developments of modern Europe in global context. This course is organized chronologically, beginning with the Industrial and French Revolutions. Students develop an understanding of the political grammar and material bases of the present day by exploring the social origins of conservatism, liberalism, feminism, imperialism and totalitarianism. In discussions and in lectures students learn to study and to respond critically in written and spoken form to a variety of historical documents and secondary texts.
3 credits

HSS 4 The Modern Context: Figures and Topics

A study of an important figure or topic from the modern period whose influence extends into contemporary culture. The figures and subjects are chosen from a broad range of disciplines (including literature, history, politics, technology and art history, among others). Through concentration on a single figure or focused topic students are encouraged to develop a deep awareness of works of great significance and to understand them in the context of modernity. Guided independent writing projects and oral presentations give students an appreciation for what constitutes research in the humanities and social sciences.
3 credits

HSS4 may be repeated for Free Elective credit in the Schools of Art and Engineering. HSS4 may be repeated for Elective credit in the School of Architecture, provided the minimum requirement of six Elective credits in Humanities and Social Sciences is fulfilled by elective-level courses. In both cases, permission of the dean of Humanities and Social Sciences is required.

Note: The Center for Writing provides targeted support for HSS Core courses. Associates are available to work on all aspects of essay writing, including close reading, analysis, development of ideas, planning and structure, writing in stages, arguments and conclusions, and revision. Associates are also available to help students prepare for presentations and public speaking in the HSS Core. Center associates can help you to organize your thinking, to challenge yourself and to create better, more engaged, more interesting work through focused discussion and targeted writing work. Students from all writing backgrounds are encouraged to make use of the Center. Students may make one-time appointments or may choose to enroll in ongoing sessions for a particular semester. Sessions tend to fill up quickly, and students are encouraged to make appointments in advance. Students working on specific written or spoken communication issues (ESL, learning differences, writing skills difficulties) are strongly encouraged to enroll in ongoing sessions early in the semester.

Elective Courses

Humanities

The Faculty of Humanities and Social Sciences offers a varied and flexible elective program that provides rigorous study while responding to the changing needs of students.

H105 Fundamentals of Music

A study of the elements and forms of music and consideration of how they define the stylistic characteristics of the literature of music from the late Renaissance to the present. There will be extensive use of recordings, as well as attendance at concerts and recitals.
3 credits

H107 Creative Writing

Starting with exercises and word games, then moving to, e.g., the objective poem, collage and concrete poetry, metrics, translations. As well as writing, students are expected to read widely in poetry and fiction. Attendance at a poetry or prose reading is obligatory. Grade based on class performance and portfolio of work.
3 credits

H129 Environmental Literature

In this class, we will look at ways of imagining and approaching the natural environment through writing, ranging from travelogue to activism. Readings will include essays, poetry and fiction by Wordsworth, Thoreau, Carson, Abbey and others. Topics for reading and writing will center on such issues as encounters with nature, sustainability, species extinction and global warming.
3 credits

H207 Music Cultures of the World

Examines music from a variety of musical cultures around the world, from Native American to Indonesian Gamelan music, including ethnic musical events in New York City.
3 credits

H208 Aristophanes

Athenian Old Comedy is one of the timelessly funniest and widest-ranging forms of comedy ever produced. In this course we will read, perform (selections), and examine four plays by Aristophanes, the greatest of ancient comic playwrights: *Frogs*, *Clouds*, *Birds*, and *Wasps*, each named for the characters assumed by its masked chorus. Aristophanes' irreverent portrait of the philosopher Socrates in *Clouds* will be weighed against Plato's more flattering, and ultimately more influential version in the *Apology*,

which we will also read. Slides will be shown to recreate the stunning visual environment of Periclean Athens which literally and figuratively formed the backdrop to the original performances of the plays. This broadly based course will encompass a little military and political history, a little art history, a little social history, a little literary criticism, and a lot of fun.
3 credits

H306 Native America

An examination of Native American world views against a background of history. The stress will be on written literary texts drawn from oral cultures, including collections of traditional songs and stories, as well as contemporary writers. In addition, we will watch videos and listen to music.
3 credits

H307 Playwriting and Theater

Practicum This course will introduce students to two disciplines essential to creating theater: acting and playwriting. To help guide the beginning of their practice in these disciplines, students will read and critique contemporary and master works, write plays of their own, perform monologues and scenes written by master playwrights and bring the work of their peers alive through in-class readings and a final staged reading performance open to the Cooper Union community.
3 credits

H311 New Media This course considers what makes media "new" and why those characteristics are relevant in contemporary society. We will consider how older media have been adapted to incorporate new media technologies and strategies, how video games and the internet have changed our expectations of media experiences, the impact of new media on artistic practice, the important of new media in contemporary cultural economy, and related topics.
3 credits

H316 United States Cultural History

This course traces the development over time of "America" as place, idea, nation and culture. It is concerned with tracing the emergence and contours of a widely-shared, if indeterminate and contested, sense of American identity and culture by studying several enduring forces and themes in its formation. These include the encounters of Europeans and Indians, the institution of slavery, the West in myth and reality, modernization and metropolitan life and the United States in global culture.

3 credits

H319 Russian Art, Architecture and Literature

Survey of Russian arts from 1703, the founding of St. Petersburg, to 1924, the death of Lenin. This course is a study of the history and ideology underlying the remarkable literary and artistic achievement of Russia and, in its early phase, the Soviet Union.

3 credits

H321 The Novel This course concerns itself with particular trends, moments, issues or movements in the history of the novel as a literary form. Because of the nature and length of the material, any version of this course must be focused on a particular set of issues, literary-historical phenomena or cultural concerns. The course will typically take as its subject four to six works that illuminate or ask interesting questions about the topic at hand.

H323 Presence of Poetry

This will be a class in which the center of attention is the poem itself. We will concentrate on modern English and American poetry. The common text will be *The Norton Anthology of Modern Poetry*, 2nd edition, edited by Richard Ellman and Robert O'Clair (Norton, 1998), but students are encouraged to look into other anthologies and into such studies as those of William Empson in *Seven Types of Ambiguity* and Martin Heidegger in *Poetry, Language, Thought*.

3 credits

H327 The History of the Cinema

A history of the motion picture from its origins until now, emphasizing the evolution of the language of cinematic representation—in feature, documentary, animated and experimental filmmaking. Canonical works and the major figures of the silent and sound cinema are treated, including Griffith, Chaplin, Eisenstein, Vertov, Renoir, Welles, Deren, Hitchcock and Godard.

3 credits

H328 History of the Cinema:

1895–1945 This course surveys the history of the motion picture, along with some of the discourses it inspired, from the nickelodeon period through World War II, considering avant-garde, documentary and commercial films, with particular emphasis on the movie as urban entertainment, expression of modernity and cult enthusiasm. Important figures include D.W. Griffith, Fritz Lang, Dziga Vertov, Carl Th. Dreyer, Leni Riefenstahl, Orson Welles, and Maya Deren. The transition from silent to sound cinema and the surrealist theory of film spectatorship will be given particular attention.

3 credits

H329 The History of the Cinema:

1945 to the Present A history of the cinema from World War II through the present day, with particular attention to the development of neo-realist, new wave and third-world movements. Topics include the impact of television, the influence of Pop Art and the development of digital technology. Alfred Hitchcock, Jean-Luc Godard, and Andrei Tarkovsky are among the major figures treated.

3 credits

H331 Eros in Antiquity

Focuses on love in the ancient world, from Egypt through late Roman/early Christian times, with the major emphasis on Greece. Readings drawn from Sappho, Aristophanes, Plato and Ovid explore the range of ancient attitudes toward married, heterosexual love and homosexuality, fidelity and infidelity, the body and the mind and the roles of the sexes in various kinds of erotic relationships.

3 credits

H332 Ut Pictura Poesis

A study of ekphrasis and other interconnections between the visual and the verbal arts from antiquity to the present. Primary readings are drawn from Homer, Hesiod, Plato, Aristotle, lyric poetry, tragedy, Virgil, Horace, Lessing, Keats and Ashbery, among others.

3 credits

H342 Gender Studies Study of the "first wave" of feminism, including Mary Wollstonecraft and Abigail Adams, through the achievement of suffrage in 1920 and then study of the more radical claims of "second wave" feminists in the 1970s, with Marxist and Freudian analysis. This course will conclude with contemporary "postfeminisms" and changing gender relationships.

3 credits

H343 The Modernist Tradition

This course is concerned with major issues in the transition from 19th to 20th century European culture, focusing on the interaction of politics and aesthetics.

3 credits

H345 Readings in Aesthetics

Key aesthetic concepts in relation to artistic practice and audience reception. This course includes a number of historical debates that remain ongoing and unresolved, and it concludes with contemporary attempts to reestablish beauty and pleasure as aesthetic categories.

3 credits

H346 Western Theories of Art

This course examines the variety and development of Western theories of art from antiquity to the present, with special attention to theoretical constructs of the past century. Topics include connoisseurship and formalism; modernist criticism; iconology, Marxism and the social history of art; feminism; psychoanalytic theory; structuralism and post-structuralism; postmodern challenges to modernist theory; and museology and institutional critique.

3 credits

H352 The Personal Essay

In this course we will study and discuss essays in Philip Lopate, ed., *The Art of the Personal Essay*, and we will also write our own, on any topics we choose, on all manner of subjects—the daily round, pleasures and pains, taking a walk, solitude, friendship, in short, our personal responses to any number of objects and situations, multiplying ourselves in the process.

3 credits

H353 Public Speaking: Contemporary Issues

Develops skills in persuasive and expository speech-making—extemporaneous, written and memorized—on contemporary issues and topics. Students learn how to research a speech, marshal arguments and use language effectively by speaking clearly and eloquently.

3 credits

H355 Literature, Gender, the Body: Gender and Literary Works

Explores a series of signal novels through the lens of gender, beginning with Charlotte Brontë's *Jane Eyre* as a foundational text and continuing with such works as Oscar Wilde's *The Picture of Dorian Gray*, Virginia Woolf's *Mrs. Dalloway*, Ernest Hemingway's *The Sun Also Rises*, Jean Rhys' *Wide Sargasso Sea* and other novels. All readings are informed by recent work in feminist, gender and queer theory.

3 credits

H356 Issues in Contemporary Fiction

Study of literary topics including particular genres, themes, sensibilities and critical approaches. The focus of this course will change in individual semesters.

3 credits

H358 Studies in Cinema A seminar based on a special topic in the study of cinema. The seminar may be repeated for credit with the permission of the dean of the Faculty of Humanities and Social Sciences.

3 credits

H359 Intention, Action and Self-Knowledge

Studies the problem of defining the philosophical nature of action by investigating the nature of intention and coherent self-knowledge. The course seeks to distinguish various forms of action—involuntary, intentional, teleological (goal-directed)—by examining relationships among levels of agency, conditions of freedom and states of awareness.

3 credits

H360 Mind and Morals

Examines the philosophical dichotomy of moral realism and moral naturalism, with emphasis on three types of new moral naturalism: normative moral naturalism, meta-ethical moral naturalism and cognitive moral naturalism. Authors include Bratman, Churchland, Descartes, Flanagan, Goldman, Hume, Johnson, Kant, Longino, Mill, Millikan, Moore and Strebbe.

3 credits

H361 Modern Philosophy: Knowledge and the Mind

Shows how issues related to knowledge and mind overlap in the questions that revolve around knowledge of language, knowledge of other minds and self-knowledge. A principal consideration is the extent to which cognitive science and contemporary philosophy can continue to be held apart from one another.

3 credits

H362 Black Literature in a World Perspective

An examination of black literature from South America to Papua New Guinea, chiefly in the 20th century. Stress is placed on the connections between various literatures and how they form a world culture. The course considers oral literature, the Harlem Renaissance, Negritude poetry, the African novel and Indian Ocean poets.

3 credits

H369 History of the Book

An introduction to the creation, use and meaning of "the book" over its long history from the clay tablet to the digital download. Readings and discussions will bring together literary and cultural history, as well as aspects of politics, art history and the history of technology. Topics will include the moves from oral to written cultures, from the scroll to the codex, and from public reading to reading as a private experience; the emergence of printers and publishers; the invention of the library; censorship and the spread of reading publics; the rise of the novel and "popular reading"; the comic book; the paperback; and the movement through digital technologies to non-print books.

3 credits

H373 Seminar in Humanities

Seminar giving close attention to special topics in the humanities. The seminar may be repeated for credit with the permission of the dean of the Faculty of Humanities and Social Sciences.

3 credits

H374 Contemporary Culture and Criticism

A survey of the cultural climate since the 1950s, including the influence of works by such writers as Benjamin and Bakhtin and the concern with contemporary life in terms of fundamental shifts in community, representation, identity and power.

3 credits

H375 Critical Theory This course begins with the post World War II generation of social thinkers and critics, such as Barthes, de Beauvoir, Foucault, Adorno, Horkheimer, Lacan, in the development of what later became known of as the critical theory of culture. We then proceed to more recent critics, each time taking our clues from real life examples. This course emphasizing learning how to "see" and think in "cultural practices." It offers a chance to have our understanding extended into everyday life and its ways of making us cultural beings.

3 credits

H377 General Linguistics

Survey of two major types of linguistic study: diachronic or historical linguistics and synchronic or structural linguistics. The course concludes with presentation of recent linguistic theory, with emphasis on cognitive grammar and biolinguistics.

3 credits

H379 Visual Culture

An historical account of the developing wealth and intensity of visual experience in the United States in the last century and study of the circulation of images as a cultural sign system shaping class, gender, race and sexual subjectivities.

3 credits

H381 Post-Colonial Studies

This course engages with the legacy of colonialism in literature and theory. Topics include the relationship between colonizer and colonized, independence, apartheid and immigration in novels from South Asia, the Caribbean and Africa. Works by Rudyard Kipling, E.M. Forster, Aime Cesaire, Salman Rushdie, Nadine Gordimer, Jhumpa Lahiri and Zadie Smith will be addressed.

3 credits

H382 African-American Literature

Under this rubric, courses may address a range of issues, periods, themes or questions in African-American literature. Specific topics and descriptions will be detailed in the relevant course bulletin each time the course is offered.

3 credits

H383 Opera This course will examine the history, materials and structures of opera, a rich and complicated art that is both musical and theatrical. We will address such topics as the origins of opera in 17th-century Italy, the Baroque style, the art of bel canto, opera and politics, Wagner's revolutionary ideas, realism and impressionism in music, experiments in tonality, and opera in English. Several works will be considered in detail. Classes will

combine lecture-discussion and screenings of performance on DVDs. An interest in music is essential, but no ability to read scores or play an instrument is required.

3 credits

H386 The Romantic Movement

Beginning with an examination of Romantic aesthetic theory and its application to some of the major poems of the period, the course will explore writing by Goethe, Blake, Wordsworth, Coleridge, Byron, Shelley and Keats. Philosophical and critical readings will be drawn from Kant, Lessing, Burke, DeQuincey, Wollstonecraft and others.

3 credits

H387 The Life and Death of Socrates

Socrates, the son of a humble stonemason, Sophroniskos, was one of the most remarkable, controversial and influential human beings who ever lived. Though he left behind no written testimonial of his peculiar, singular genius, we know quite a bit about him through the accounts and recollections of his contemporaries, critics and followers, primary among them, Plato, Xenophon and Aristophanes. Based almost exclusively on readings of the major ancient texts, the course focuses less on the philosophy of Socrates, as filtered through the great and not unbiased lens of his most famous student, Plato, than on the man, his physical demeanor, his way of life, his loves, his friendships and especially his trial and death in 399 B.C.E.

3 credits

H388 Space and the Modern Novel

This course will focus on representations of space in the 20th-century novel. We will begin by considering topics such as the shift from Modernism to Postmodernism in literature, dynamics between public and private places, how cities are characterized and represented, the concept of "home," and ideas of "safety." Among the questions we will try to answer are: How do modernization, urbanization and industrialization affect the imagination and perception of space? How do characters inhabit their homes and their cities? What are the relationships between urban and domestic environments and how do human beings alter when they move between them? How do attempts to define "ordinary" experience address the ways we interact with the spaces in which we live? The course will be broken into three sections: the house, the city and the imaginary.

3 credits

H389 Love in Western Art and Literature: Beauty, the Body, and the Perjured Eye/I

This course address the representation of love in Western art, with specific attention to the body, gender, and identity. The course will be grounded across two crucial poles: the so-called Greek revolution as a founding moment in the West, with its idea of Eros and the ideally beautiful body, and the rise of the individual in the Renaissance/Baroque period, with its concepts of subjectivity, self, and vision (including Shakespeare's provocative formulation of "a perjured eye/I." Readings will include Plato's Symposium, poetry in the troubadour and Petrarchan traditions, Ficino and the Neoplatonists, Shakespeare, Keats, Shelley, Austen, Foucault, Derrida, Anne Carson, and others.

3 credits

H391 Landscapes in Mind

A study of the great landscapes, real and imaginary, of western art and literature. The course will consider landscape both as idea and as subject in art and literature from antiquity to the present. From the imaginary ekphraseis of Homer, Aeschylus, Euripides, Theocritus and Virgil to the idealized naturalism of the English Romantic poets; from the surprising remains of Greek and Roman wall painting, to the great masters of 17th-century Europe, the many and various genres of landscape will be examined.

3 credits

H430 Postmodernism and Technology

This course will explore postmodern theory and practice and its relationship to the problems and solutions posed by technology in contemporary society.

3 credits

H442 Greek Mythology The course will concentrate not just on the endlessly fascinating stories of the gods drawn from the classic sources, but on a critical analysis of the question: How do the gods fare throughout the course of western history? Periods to be focused on include the time of Homer, Hesiod and the Homeric Hymns; the Archaic period (the time of the Lyric poets); the high Classical period (the golden age of Greek tragedy); the late Classical and Hellenistic periods (the age of the great philosophers and their schools); the Augustan era of the Roman Empire (the time of Virgil and Ovid); and the Renaissance.

3 credits

H450 Shakespeare

A course devoted to understanding how the plays work, what characters say and do, the imagery and thematics of Shakespeare's dramas and the performance practices of the Elizabethan and Jacobean era. Also to be addressed is the cultural milieu of the plays—the historical, political and religious world they inhabit—in order to deepen our access to Shakespeare's language and to hear it with both his ears and our own.

3 credits

H99 Independent Study (Humanities)

3 credits

Social Sciences**S305 Leonardo, Scientist and Engineer**

This course uses the life and work of Leonardo da Vinci (1453–1519) to explore science, medicine, and engineering in Renaissance Europe. We will look at the social and economic life of the era and examine the institutions and influences that served Leonardo's imagination, his inventiveness, and his arts.

3 credits

S308 Public Policy in Contemporary America

Issues such as conservation, environmental law and policy, mass transportation, transfer of development rights, incentive zoning and historic preservation, beginning with an introduction to and general analysis of the policy process.

3 credits

S318 Seminar in Social Science

Seminar giving close attention to special topics in the social sciences. Recent topics have included sustainability and the economy. The seminar may be repeated for credit with the permission of the dean of the Faculty of Humanities and Social Sciences.

3 credits

S320 Comparative Politics

Comparing political systems is at least as old as Aristotle, whose library contained more than 135 studies of constitutions of the ancient world. This course will compare contemporary political systems and consider some of the main challenges they face: forging a common identity and sense of community; meeting social and economic needs; and securing civil and political liberties and human rights. Recognizing that political societies of today's worlds can differ dramatically, the course will begin by introducing concepts and approaches that make it possible to compare systems as different as those of China and Great Britain. In addition to the broader paradigms of system, structure and function, we will also consider forms of political culture and socialization, interest articulation and aggregation, party systems and policymaking. Several distinct systems will be studied; these will be chosen not only for their geographical, but also for their political diversity, representing first-world nations such as the United States, Britain and France, as well as post-communist and post-colonial states such as Russia, China and Nigeria.

3 credits

S321 The American Presidency

The nature and sources of the power of the American presidency, the ways in which it is wielded and the Constitutional restraints upon its exercise.

3 credits

S323 Politics and Collective Memory

The political uses of collective memory can range from defining national and social identities to shaping public opinion. In exploring the interactions between memory and politics, this course will focus on the nature and forms of collective memory, its development and reconstruction and its relationship to structures of authority. Emphasis will be placed on examples from recent political history.

3 credits

S333 Politics of Ethnonational Conflict

An examination of the movements for national liberation and independence that have become an increasingly important phenomenon in the second half of the 20th century. Among the movements considered are those of Algeria, Nigeria, Cyprus, Bangladesh, Northern Ireland, Quebec, Lebanon and the PLO.

3 credits

S334 Microeconomics

The relationship between economic theory and public policy, focusing on the central axioms of modern economics in the light of recent problems in energy employment and inflation.

3 credits

S335 Science and Technology in the Long 18th Century (1687–1839)

This course will examine the changing roles of science and technology in the West during the 18th and early 19th centuries. We will use a case-study approach to consider such topics as color in theories (light and optics) and color in practice (painting, dyeing and glassmaking); geology mineralogy and the development of ceramic industries in Europe; the invention, use (and misuse) of the natural classifications; and automation and automatons: Vaucanson's duck, Jacquard's loom, Babbage's Difference Engine.

3 credits

S337 American Foreign Policy

In the 20th century, challenges to Western liberalism came from fascism and communism, while more recent challenges have come from terrorist movements on the one hand and the European Union on the other. This course examines American foreign policy since the collapse of communism in the context of these changing challenges.

3 credits

S342 Anthropology of Ritual

The study of ritual takes us to the heart of anthropological approaches to experience, performance, symbolism and association. Once thought to be "vestigial" organs of archaic societies, rituals are now seen as arenas through which social change may emerge and are recognized to be present in all societies. Throughout the course we will explore varying definitions of ritual and its universal and particular aspects, while surveying ethnographic case studies from around the world.

3 credits

S345 The Raymond G. Brown Seminar

A seminar in the social sciences on a topic central to the interests of the late Professor Raymond G. Brown.

3 credits

S346 Urban Sociology: Reading the City

Focuses on the relationship between the built environment and human behavior, the design of public, urban spaces as a reflection of and impetus for certain types of human interactions and reactions. Another interest of the course will be to consider the notion of community as it plays out in the disciplines of sociology and architecture—how they intersect, and how they are changing in our postmodern, post-industrial terrain. Some of the broad areas of interest of urban sociologists will also be considered.

3 credits

S347 Macroeconomics

The development of modern macroeconomic theory as it evolves in response to a succession of economic problems and crises. Emphasis on the recent Keynesian/monetarist debates and the role of the Federal Reserve Bank.

3 credits

S348 Global Cities

Considers specific and general factors that contribute to the rise of global cities—New York, London, Tokyo—and how such cities impact other city-types, existing and emerging. This course examines the forces underpinning globalization, including the shift from industrial to informational economies, the development of new technologies and the emergence of new patterns of immigration, in order to understand the complexities of global processes in urban terrains.

3 credits

S349 American Cities Examination of the crisis of urban America seen through the lens of New York City. Individual topics will include urban poverty, relocation of manufacturing and foreign competition, but students will be encouraged to examine closely a particular aspect of New York City's problems.

3 credits

S351 History of 20th-Century Europe

A study of the dramatic ruptures of Europe's 20th century, haunted by imperialism, war and genocide. Topics include the First World War; modernity and modernism in interwar culture; fascism, National Socialism and the Holocaust; postwar displacements and migrations; decolonization, the cold war and the postwar economic miracle; 1968 and 1989 in both East and West; and the ongoing challenges of integration and multiculturalism.

3 credits

S354 New York, 1820–1920: An Urban and Cultural History

A presentation of two "maps" to the city. The first is a history of the built environment, focusing on the changing systems of transportation, the development of building forms and the way the city's population and functions have been distributed in that space. The second historical map is made up from people's imaginative responses to those changes, especially as seen in literature and visual iconography. Among the areas singled out for special examination are the Bowery and the Lower East Side, Central Park and the "downtown" of amusement and vice, wherever it happened to be at the time.

3 credits

S358 Social History of Food

A study of the transformations in food production and consumption, 1492 to the present. The course examines the passage of "new world" foods into Europe and Asia, the rise of commercial agriculture in the colonies, especially sugar, the rise of national cuisines, the advent of restaurant culture and the perils of fast and industrial food.

3 credits

S360 American Intellectual History

A study of major works in intellectual and literary history written from 1780 to the present, focusing on changing notions of the self, character and community and the ways these concepts have gained intellectual and literary expression in the United States.

3 credits

S361 Urban Archaeology

An introduction to the new field of urban archaeology. Topics include how archaeologists work in cities; the special problems and rewards of urban archaeology; and what can be learned about the development of particular cities through this field of study, including changes in subsistence patterns, the use of urban space and the definition of ethnicity and gender.

3 credits

S362 Popular Culture

This course studies popular culture in a primarily 20th-century context. Using both creative and theoretical texts, it considers developments in contemporary popular culture including the rise of mass media and consumerism, the elaboration of pop-cultural theory and the trend toward multiculturalism. We will sharpen our critical perspective on our cultural surroundings by questioning boundaries between the popular and other cultural categories, notions of creativity in the high and popular arts and the bases of our own preferences.

3 credits

S367 Acting Globally

This course introduces students to the developments sometimes called the post-postmodern era of globalization, with a particular focus on the study of cultural impact. Our approach will entail both the macro level discussion of conditions and possibilities for effecting a decent global future and the micro level of actual sites of responses to (1) technology transfer; (2) cultural preservation, resistance, odernization and integration; and (3) the new dialogues around ecological sustainability. We study analytical texts, autobiographies, films and proposals on how to humanize the New World Order.

3 credits

S368 History of Modern Asia

This course seeks to explore the history of Asia from the late imperial eras of China, Japan, Korea and Southeast Asia into the modern era. The course examines a wide variety of political, social, economic and cultural issues that predominated during this period. While emphasizing the distinctive nature of the region, the course will stress the wide diversity and interconnectedness of ideas, technologies and religions of modern East Asia.

3 credits

S369 Psychoanalytic Theory

An introduction to forms of psychoanalytic thinking and theory making, with special attention paid to the ways in which different theorists conceptualize and invoke psychoanalysis as a theory of mind, research tool, therapeutic process and utopian vision. Readings include foundational texts by Freud, Ferenczi and Klein, as well as responses to classical theory by Horney, Winnicott, Lacan and others.

3 credits

S371 Women and Men: Power and Politics

An introduction to women's and gender studies, and to feminist theory. Students will examine the ways and the historical basis for construction of gender and the interlocking of gender with other forms of hierarchy, including race, ethnicity, class and sexuality. Readings include classic texts and current scholarship in literature, film, history and social science.

3 credits

S372 Global Issues This course will examine current issues of global significance and their implications for policy and decision-making. Among the trends we will consider are the tensions between resource competition and authority; the emergence of a global economy; the environment and sustainable development; demographic change; and the emergence of new security issues, including societal and environmental stress.

3 credits

S373 Modernity and Modernism: Culture and Society in the Weimar Republic

This course explores the turbulent and innovative interwar years 1918-1933 in Weimar Germany, paying particular attention to cultural and social politics. We will study the difficult establishment of the "republic that nobody wanted" in the wake of a lost war, a collapsed empire and a failed revolution; the chaotic period of rebellion and inflation until 1923; the brief "Golden Twenties" of relative

stabilization and *Neue Sachlichkeit* (New Sobriety) with its burst of social welfare initiatives, architectural and engineering innovations and efflorescence of art, music, theater and literature; and finally the crises of economic depression and political polarization that culminated with Adolf Hitler's appointment as chancellor of Germany in January 1933.

3 credits

S374 Contemporary Social Psychology

Utilizing a variety of social psychological perspectives, general issues such as human nature, socialization, attitude formation and change, verbal and non-verbal language, interpersonal behavior and the art of persuasion will be explored with interest in cross-cultural comparisons. The core questions we will explore include: What does it mean to be human? How is the self defined and determined? What impact do social groups, culture and the (built) environment have on the development of the self and on our everyday behavior?

3 credits

S376 City and Urban Experience in Latin America

Surveys the history of urban settlement in Latin America, from the foundation of colonial fortresses and capitals to the emergence of the "megacity." Through readings that approach Latin American cities such as Mexico City, São Paulo and Brasília from a range of disciplinary perspectives students examine 1) the role of the city in empire; 2) the city as a crucible of colonial society; 3) the city and the mission of civilization; 4) the city as "the nation"; 5) the historical production of social, cultural and political spaces by architects, policy makers and city-dwellers; 6) the dilemmas of politics and governance that contemporary urban and suburban growth creates; and 7) the emergence of "Latin American" cities in the United States.

3 credits

S378 Time, Travel and Communication in Early Modern Europe

This course is a history of early modern European technology with a strong focus on design technologies and material culture. It will cover the time period extending approximately from the Age of Exploration through the French Revolution (about 1500-1800). We will examine early modern ideas about three critical aspects of modern life: time, communication and travel. (Interpretation of these themes will be broad and may include not only carriages and bridges but also carriage upholstery and passports; not only letters, newspapers and books but also

songs and emblems; not only the shift from public to personal time but also calendar reform.) In addition to readings (both primary and secondary) and discussions (in-class and online), students will choose to study three artifacts that are relevant to the themes of time, communication and travel, research them and present their findings to the class.

3 credits

S381 Developmental Psychology

The course will follow the unfolding of human development from conception through adolescence by means of an array of analytic perspectives. We will examine and critique cognitive, psychoanalytic, information processing, and psychosocial models of brain/body/mind growth. Reading assignments will be from a textbook on child development as well as primary sources, which will include academic writing, memoir, and fiction. We will also view educational and fictional films, and may also include family video chronicles.

3 credits

S382 Game Theory

Since its introduction in 1943 by John von Neumann and Oskar Morgenstern, the general theory of games has been instrumental to our understanding of various social behaviors. With key contributions of such renowned scholars as John Nash, Robert Arrow, Thomas Schelling and John Harsanyi, among other Nobel Laureates, game theory has quickly gained a large following among students of economics, evolutionary biology and even political science. Though at times seemingly abstract, game theory has shown us that it has practical value with applications in firm-level management and strategic decisions making in military campaigns. The course has two dimensions: the first is to explore the theoretical basis of games; the second is to consider the application of these concepts in economics and political science.

3 credits

S384 Anthropology and the Other

This course provides an introduction to concepts in social-cultural anthropology. Students will rethink such concepts as culture, race, ethnicity, nationalism, transnationalism, gentrification, power and memory. We will use these concepts to address the questions of human universals and the origins of cultural differences. At the bases of these inquiries will be the question of the "Other." Who are the "Others" in culture or society?

3 credits

S385 Science and Technology in the Modern World (1815 to the Present)

This course will explore the social intellectual and economic relationships of science and technology in the modern West (i.e., after 1815). Using modified case studies to provide "snapshots," students will learn to recognize changes to such factors as who participates, where work is conducted and the supports (social, financial, emotional) necessary to individual and collective pursuits.

3 credits

S386 The Early Modern Atlantic World

This course examines the history of the Atlantic world from the mid-fifteenth century through the end of the eighteenth century. Incorporating the histories of Europe, North America, South America, and Africa, the course will explore social, cultural, economic, and political developments of the early modern era as men and women came together to form the societies in the Americas. Topics will include European-Amerindian relations, European-African relations, the slave trade, gender structures, the development of an Atlantic economy, and the maturation of colonial societies.

3 credits

S387 The History of the Family in America

This course explores the changing construction and function of the family across American history. We will examine how women and men, sons and daughters, experienced revolution, war, economic transformation, politics, sexuality, and religion. We will consider how the purposes and experience of family life have changed over time, as well as how the ideologies or ideals about family pressed against the grinding wheel of history to shape events. Our historical actors will include Native Americans, European colonists, rebels and republicans, masters and slaves, freedmen and immigrants, free-love communities, patriarchal polygamists, Victorian lovers, Cold War housewives, Baby Boomers, and our own contemporaries.

3 credits

S390 The Rise of the Modern City in the European Middle Ages

Explores how early medieval landscapes with castles and small villages became wider communities—the first modern cities. Focuses on the major debates of the Middle Ages: the tensions between country and city life; the role of the church; Scholasticism; the debate between reason and faith; the role of the French cathedral in medieval life; the lay reaction to ecclesiastical control and the rise of

communal Italian cities such as Florence, Venice and Siena centered around the civic palace; and the early requirements for city beautification. We will "visit" (virtually) the first hospital, universities and prototypical housing. Everyday life will be illustrated from the material remains of art and architecture through a cross section of different social environments.

3 credits

S391 Introduction to Mind and Brain

The goal of this is to introduce the student to the basic principles of psychology, to guide the student through the brain and to provide a basic understanding of the relationship between the brain and mind addressing issues of consciousness. The first third of the course will examine the brain and underlying theories in psychology. The majority of the course will be focused on the relationship between the brain and consciousness including self-awareness, theory of mind, deception, abstract reasoning, art, music, spatial abilities and language. Steeped in recent findings in both psychology and neuroscience, the goal of this class will be to provide a modern foundation in the mind and the brain.

3 credits

S393 Darwin and His Times

This course uses the life of Charles Darwin (1809-1882) to examine the nature of scientific practices during the nineteenth century and their changing, often revolutionary, role in contemporary life. We will read closely Darwin's writings on geology and evolutionary biology, and we will consider interpretations and implications of "Darwinism." Both readings and films will be assigned.

3 credits

S394 American Radicalism

This course will examine cultural radicalism in American thought from the Young Americans of the 1910s and the New York Intellectuals of the 1930s to the Beat poets of the 1950s and the Neo-Conservatives of the 1970s. Through figures such as Randolph Bourne, John Dewey, Meyer Schapiro, Lewis Mumford, C. Wright Mills and Dorothy Day, we will trace the rise and fall of the American avant-garde, the quest for an indigenous theory of culture, the social sources of counterculture, and the shifting meanings of the concepts "mass culture," "consumer culture," "kitsch," and highbrow/middlebrow/lowbrow. Among the questions we will address are: Can one be a political radical and a cultural conservative? A political conservative and a cultural radical?

3 credits

S420 Environmentalism in the Urban Context

The recent work of environmental activists and scholars has produced a new urbanism in which the city form and function is intimately connected with natural processes. This rethinking of the city has opened several new possibilities for looking at human-environment interactions. In particular, the everyday environment of the city may be examined as a site for identifying the hidden geographies of raw materials, energy and waste flows. This course looks at three central issues: (1) identification of the material and ecological processes that make possible city form and function possible; (2) interpretation of the city as a constellation of economic institutions and social practices that transform nature over different temporal and spatial scales; and (3) the examination of the environmental and health impacts stemming from a city's role in production and consumption. Students will work on projects using the principles of ecological design in the redevelopment of urban sites.

3 credits

S99 Independent Study (Social Sciences)

3 credits

History and Theory of Art

While contributing to the required curriculum of students enrolled in the School of Art, courses in the History of Art are also available to students in the other schools.

All HTA courses are normally offered for two credits. In exceptional circumstances, students may petition to take an HTA course for an additional credit. The student must get permission from both the instructor and the dean of Humanities and Social Sciences.

Core Curriculum

HTA 1 Art History I: Origins to the Middle Ages

Study of artifacts, architecture and visual culture of ancient civilizations and their continuing significance. Topics include prehistory, ancient Near East, Egypt, Greece, Rome, India, China, pre-Columbian Americas, Islam, the Byzantine Empire and medieval Europe, with special attention given to crosscultural relationships and affinities.

2 credits

HTA 2 Art History II: Renaissance to Revolution

Study of painting, sculpture and architecture produced from the 14th through the mid-19th centuries. Topics include Renaissance, Mannerism, Baroque, Rococo, Neoclassicism and Romanticism, with emphasis on the artist as creative genius and on the political and ideological climates in which works were commissioned, conceived and made.

2 credits

HTA 3 Art History III: Modern to Contemporary

Study of modern art through a survey of major movements from the mid-19th century on. Topics include Realism, Impressionism, Post-impressionism, Expressionism, Cubism, Suprematism and Constructivism, Dada and Surrealism, abstract expressionism, pop art, minimalism, conceptualism and recent trends. With assigned readings and museum visits, the course leads students to engage critically with issues of modernism and modernity.

2 credits

Electives

HTA 209 Medieval Art and Architecture

Investigates the art, architecture and archaeology of medieval Europe from Constantine (fourth century) to approximately 1450, a period when different cultures clashed and mixed together to shape the eclectic Western medieval world that rose from Roman imperial ruins and ideals. This course will follow a chronological sequence, but use recent data from medieval excavations to challenge traditional art historical statements. Early Christian, Byzantine, Barbarian, Islamic, Romanesque and Gothic periods are examined.

2 credits

HTA 210 The Art and Culture of Fifteenth-Century Florence

This course examines the unique historical circumstances and artistic personalities that brought about a new kind of art. Special focus will be placed on the role of the Medici family as patrons. Painters, sculptors and architects to be considered include Masaccio, Fra Angelico, Ghirlandaio, Botticelli, Ghiberti, Donatello, the Pollaiuolo brothers, Brunelleschi and Alberti. Monuments such as Orsanmichele, the Baptistry, the Cathedral and the Medici Palace will be placed in their social context and discussed in detail.

2 credits

HTA 220 Japanese Art

A chronological survey of Japanese art from prehistoric times to the 17th century, examining the interaction of the uniquely Japanese aesthetic sensibility with arts and cultural traditions transmitted from the Asian mainland. Although the primary emphasis is on painting and sculpture, attention is also paid to architecture, gardens, pottery, lacquerware and woodblock prints. Museum visits are an integral part of the course.

2 credits

HTA 221 Buddhist Art in Asia

An examination of Buddhist art in India, Afghanistan, Nepal, Tibet, Central Asia, Sri Lanka, Southeast Asia, China, Japan and Korea in the most characteristic styles, in order to show how each culture received and interpreted the Buddhist Doctrines and way of life.

2 credits

HTA 222 Asian Painting

A chronological survey of Chinese and Japanese painting and an exploration of the aesthetic and spiritual values that shaped the arts of the brush in the Far East.

2 credits

HTA 223 Rome, the Eternal City

The course focuses on how the city of Rome changes through time and the way its idea of eternity reflects on its culture and urban changes.

Monumental Imperial Rome will be compared to the recent results from excavations and research of the poorly preserved archaic and Medieval Rome. Fifteenth-century Rome, with its powerful popes, initiated a radical urban transformation by attracting the best architects and artists for the next 300 years. With the monarchy of the end of the 19th century and then Mussolini, the city undergoes radical changes once again.

2 credits

HTA 231 History of Industrial Design

In tracing the history of industrial design from its emergence at the beginning of the Industrial Revolution to the present, this course will examine not only aesthetics (of furniture and the decorative arts, typography, advertising, machinery, toys, etc.) but also the social and political forces that have shaped the many styles. Throughout, we will also demonstrate how movements in industrial design relate to parallel developments in the history of painting, sculpture and architecture.

2 credits

HTA 240 Issues of Identity in Asian Contemporary Art

In this course, students will build a foundation in critical theory revolving around issues of race, nationality, sexuality and gender as they relate to the formation of an artist's identity, and how that identity in turn is reflected in the artist's output. Attention will be paid to Asian contemporary artists working outside of their own cultures and to Asian-American artists, in an attempt to analyze the role of the Asian diaspora and its connection to contemporary art production in Asia proper. Special focus will be paid to the contemporary art of India, China, Korea and Japan, although other nations and regions will also be discussed.

2 credits

HTA 261 Special Topics in Nineteenth-Century Art

Recent topics have included Charles Darwin's writings, the "Darwin effect," and the relationship between evolutionary theory and modern art, and the history of the bather in European art, with particular attention to the work of Courbet, Manet, Daumier, Cézanne and Seurat.

2 credits

HTA 263 African Art

An introduction to the stylistic, conceptual, functional and historical aspects of sub-Saharan African sculpture and architecture, the place of these arts in the traditional context of black African life and their relationship to the worldview of the African.

2 credits

HTA 264 Black Artists of the Americas

Studies the influence of African art and culture on black painters and sculptors in North and South America. Symbols, myths, religious rituals and deities will be explicated in terms of the correspondence they develop between distant antiquity and the present, allowing, in some cases, for new creative possibilities.

2 credits

HTA 265 American Art History

This course studies art and visual culture made in North America, primarily after European contact. It will survey the visual expression of the colonial period, trace the 19th-century development of a self-consciously American art and include Native- and African-American work. It will consider 20th-century developments prior to World War II, such as early modernism, the social art movements of the 1930s and New York as a cosmopolitan art center.

2 credits

HTA 273 Topics in the History of Photography

Writing by the critics, historians and photographers that have influenced creation and reception of photography throughout its history. Issues include definitions and redefinitions of art, documentary debates and revisionist canons and histories.

2 credits

HTA 274 History of Photography (1839–1965) A survey of the great artists and their work throughout the history of photography with emphasis on the images that were made. The importance of key images is discussed. This historical period was one of constant technical innovation and the class studies the effect this had on the work of the individual photographers. *2 credits*

HTA 275, 276 Twentieth-Century Art History Considers the flourishing "isms" of the 20th century, as well as historical events, intellectual currents and conflicting aesthetic views, explored in relation to such enduring artists as Picasso, Matisse, Malevich, Kandinsky, Miro, Klee, Dubuffet, Giacometti, Pollock, Smith, Calder and others. *2 credits each semester*

HTA 277 Contemporary Art Survey of the development of contemporary art after Minimalism and Pop Art of the 1960s. Chronological treatment includes canonical texts of critical theory and issues such as genre, multiculturalism and site specificity crucial to the current practice of art. *2 credits*

HTA 282 Public Sculpture in New York City This course will examine trends that have informed the history of public sculpture in New York City, including commemoration of historical events, artistic and civic education for the masses, natural history in the service of the nation, and the cult of great men and women. We will also examine individual monuments such as Augustus Saint-Gaudens's Farragut Monument (1880), Frédéric-Auguste Bartholdi's Statue of Liberty (1886), the sculptural programs of Central Park, Prospect Park, and Green-Wood Cemetery, the decorations of Rockefeller Center (including Paul Manship's 1934 Prometheus and Lee Lawrie's 1937 Atlas), Isamu Noguchi's News (1940) and the sculpture garden he created at his Long Island City studio, and Richard Serra's Tilted Arc (1978). Emphasis will be placed on reading works or art as primary texts; viewing sculpture, in local museums or in situ, will be a key component of the course. *2 credits*

HTA 283 The "Genius" of the Baroque This course examines the genius of European Baroque art as distilled in the work of its greatest exemplars. We will also address the ideology of the counter-reformation church, the emergence of Protestant capitalism and a pluralist, bourgeois society in the north, patronage and social identity, propaganda, religious faith, skepticism, sexual identity and the family, all focused through the position of the artist in society. In no other period were body and spirit, sensual and sublime, so closely intermeshed. Art history resides precisely in the relation between our present interest in these artists and the past conditions in which they worked. *2 credits*

HTA 285 Duccio's Maestà This course will concentrate on one single, monumentally important work of art: Duccio's "Maestà," a large and complex altarpiece created for the powerful commune of Siena at the beginning of the fourteenth century. We will examine the "Maestà" in terms of art history, politics, religion, archaeology, the economics of patronage, the shift from Byzantine representation to an emerging naturalism, public display, and the history of collecting and dispersal. The course will include visits to see two fragments of the "Maestà" in New York museums. *2 credits*

HTA 296 Synartesis A recurring seminar with a changing focus taught by Professor Dore Ashton. *2 credits*

HTA 297 History of Printmaking Explores the history of printmaking and its various processes from the 15th century to the present with an eye to the unique contribution of this graphic art to the history of visual language in both popular and fine art. While major printmakers (e.g., Durer, Rembrandt, Daumier, the Nabis, the German Expressionists, Jasper Johns) will be addressed, attention will also be given to the practical and popular use of prints through the centuries. *2 credits*

HTA 298 History of Graphic Design A study of the history of graphic design work arising out of the important cultural, political and social configurations in Europe, Asia and the United States from the time of the industrial revolution to the present day. Points of reference include posters, publications and promotional pieces being drawn from an unusual collection. *2 credits*

HTA 313 Seminar in Art History A seminar based on a special topic in the study of art history. The seminar may be repeated for credit with the permission of the dean of the Faculty of Humanities and Social Sciences. *2 credits*

HTA 315 Mysteries of Northern Renaissance Art This course examines some of the most hauntingly beautiful and enigmatic works in the history of art, from a period of deep religiosity and aristocratic ideals, emerging contrary middle-class values and exceptional artistic ambition and self-consciousness. We will begin with a solution for the still unsolved riddle of the Ghent Altarpiece and the birth of modern painting in the north, move through debates about disguised symbolism and new conceptions of the artwork in Robert Campin and Rogier van der Weyden, the crisis of modernity in Hieronymus Bosch and the emergence of a new (sublime) order in the art of Pieter Bruegel, among others. *2 credits*

HTA 317 Art and Architecture of Ancient Peru Introduction to the ancient cultures of Peru from about 3000 B.C.E. to the Spanish conquest, as seen in architecture, stone sculpture, ceramics, metalwork and textiles. *2 credits*

HTA 318 Pre-Columbian Art and Architecture in Mesoamerica A survey of the arts and architecture of the pre-Columbian civilizations of Mexico and Central America from the earliest times through the Spanish conquest. Visits to museums and private collections are an integral part of the course. *2 credits*

HTA 321 Art of Egypt A survey of the 3,000-year history of art, architecture and archaeology in the Nile Valley and the Sudan. Primary readings are used to supplement the visual record of life and art in the ancient world and the continual influence of Egypt in both high and popular culture. *2 credits*

HTA 323, 333 Islamic Art and Architecture A chronological study of Islamic art and architecture, including an introduction to Islamic aesthetics, history and philosophy. The course will examine samples from religious and literary texts, architectural monuments, painting, ceramics, metal works and calligraphy from Spain, North Africa, the Levant, Iraq, Central Asia and India. *2 credits each semester*

HTA 324 Arts of the Islamic Book This course looks at the elements that contributed to the evolution of Islamic book illustration from the 10th century to the 17th century, such as materials, styles, patronage, administration, choice of text and the relationship between text and image, with special concentration on the Persian book. *2 credits*

HTA 327 The New York Art Collector This course investigates the history of art collecting as it unfolded in Manhattan and the surrounding boroughs. Beginning in colonial times with Governor Morris' acquisition of 18th-century French furniture and ending in the mid-20th century with the formation of such public institutions as the Museum of Modern Art, the Whitney Museum of American Art and the Solomon R. Guggenheim Museum, the course will focus on both the men and women instrumental in the establishment of these collections and the specific objects they collected. *2 credits*

HTA 328 Dada and Surrealism Since their appearance early in the 20th century, Dada and Surrealism have had a profound and lasting influence on the arts. This course explores the art and ideas of these two movements within the social, political, intellectual and art historical context of the years 1914–1947. *2 credits*

HTA 329 Nineteenth-Century

Printmaking The 19th century witnessed an explosion of imagery, in part led by the technical developments in commercial printmaking and the advent of photography. This course will survey the major themes of the period, including the changing cityscape, the iconography of peasants and local landscapes, the influence of caricature and the popular press and the development of Japonism. Classes will be based on the hands-on viewing of original prints in the New York Public Library by artists including Eugene Delacroix, Edouard Manet, Charles Meryon, Camille Pissarro, Mary Cassatt and James McNeill Whistler.
2 credits

HTA 331 The Arts of China

This course is a chronological survey of the arts of China from the pottery-making and jade-carving cultures of the Neolithic up to contemporary works of art. A brief discussion of historical events as well as background in Chinese philosophy, political systems and religious practices will be presented in order to allow students to recontextualize selected works within their originating culture. The course is designed to provide students with a foundation in visual literacy of China, facilitate written expression and familiarize them with New York City's cultural institutions exhibiting Chinese art.
2 credits

HTA 333 See HTA 323**HTA 334 Art and Architecture of**

Islamic India A chronological study from the 16th century to the 19th century of the development of the art and architecture of the Mughals; and an examination of the Arab, Persian, Indian and European influences that shaped that culture.
2 credits

HTA 335 Art and Architecture of the Ancient Near East

More than 5,000 years ago, the earliest components of civilization, writing, law-giving and the city appeared as Mesopotamia, the fertile strip of land between the Tigris and the Euphrates, today called Iraq. The course will begin with an introductory history of Iraq; then it will focus on ancient Iraq and its interaction with surrounding regions in today's Iran, Turkey and Syria. It will also consider contemporary civilizations in Egypt and the Indus Valley. Lectures will look at the geographical, economical, political and spiritual factors that led to the birth of this civilization, with its visual legacy of temples, tombs and palaces decorated with artworks of distinctive forms and styles.
2 credits

HTA 340 The Artist in Renaissance

Italy This course will focus on artists working in the Italian peninsula between ca 1400 and ca 1600, with the goal of learning how and why they created the paintings, tapestries, sculpture, prints and decorative art that we now think as "Renaissance." In addition to studying materials, techniques and iconography, we shall consider the important role of patronage, both sacred and secular.
2 credits

HTA 400 Single Artist Seminar

A course devoted entirely to the life and work of one important artist, selected anew from across the spectrum of world art each time it is offered. The seminar is designed to allow for an in-depth experience in the discipline of art history that extends well beyond what is possible in period survey courses.
2 credits

HTA 99 Independent Study (History/Theory of Art)

2 credits

ID441 Interdisciplinary Seminar Shifting Territories

An interdisciplinary seminar shared by the Faculty of Humanities and Social Sciences and the three schools. Each seminar is taught by a team of faculty representing at least two of the four divisions. The theme of the seminar will be announced in advance.
3 credits

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Katherine Apolito
Administrative Associate

Gwen Hyman, *Director,
Center for Writing*

Mary Stieber, *Academic Advisor*

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M.A., Harvard University;
Litt.D., Moore College

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Ph.D., Indiana University

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M.A., Ph.D., New York University

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M.A., Ph.D., Princeton University

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M.A., M.Phil., Ph.D., Columbia
University

Maren Stange
Associate Professor of Humanities
B.A., Radcliffe College
M.A., Tufts University
Ph.D., Boston University

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* deceased

THE COOPER UNION Discrimination Policies July 2009

Nondiscrimination and Anti Harassment Policies and Complaint Procedures

The Cooper Union's Vice President for Business Affairs/Equal Opportunity Officer has overall responsibility for the management of the College's Equal Opportunity and Nondiscrimination Policies and has been designated to coordinate compliance activities under these policies and applicable federal, state and local laws. Students, faculty, and staff may contact the Vice President for Business Affairs/Equal Opportunity Officer, Human Resources Director, Dean of Students or their Academic Dean to inquire about their rights under the College's policies, request counseling, or seek information about filing a complaint.

Complaints by students against students are governed by the College's Code of Fair Practice and Student Equal Educational Opportunity and Nondiscrimination and Anti Harassment policies. Complaints by students against faculty or other college employees are governed by the Student Equal Educational Opportunity and Nondiscrimination and Anti Harassment Policies.

Complaints by faculty and other employees are governed by the Equal Employment Opportunity and Nondiscrimination and Anti Harassment Policies, published in the Staff Handbooks. Links to those policies are available at: <http://www.cooper.edu/> hr. Faculty and bargaining unit staff may also refer to their collective bargaining agreements.

All students, faculty and other employees are protected from retaliation for filing a complaint or assisting in an investigation under the Nondiscrimination and Anti Harassment Policies. The College's policies apply to all students, faculty, other employees, and applicants for admission and employment, and all such persons are protected from coercion, intimidation, interference, or retaliation for filing an internal or external complaint of discrimination or harassment or assisting in an investigation under any of the above-named policies and applicable laws.

Student Equal Educational Opportunity And Nondiscrimination And Anti Harassment Policies

The Cooper Union is committed to providing a learning environment free from unlawful discrimination and harassment and to fostering a nurturing and vibrant community founded upon the fundamental dignity and worth of all of its members. Consistent with this commitment and with applicable laws, it is the policy of The Cooper Union not to tolerate unlawful discrimination or harassment in any form and to provide students who feel that they are victims of discrimination or harassment with mechanisms for seeking redress.

Continuing its long standing policy to support actively equality of opportunity for all persons, The Cooper Union does not discriminate on the basis of age, race, religion, sex, color, sexual orientation, national and ethnic origin, nor does it discriminate against qualified handicapped or disabled persons or any other legally protected characteristic, in the administration of its admission and educational policies or scholarship, loan, athletic and other school administered programs. Rather, The Cooper Union affirms that it admits students regardless of their age, race, religion, sex, color, handicap or disability, sexual orientation, ethnicity, national origin or any other legally protected characteristic and thereafter accords them all the rights and privileges generally made available to students at the school.

Consistent with The Cooper Union's policy of supporting cultural diversity, no student shall be refused admission to or be dismissed from The Cooper Union solely because he/she is unable to participate in any examination, study, or work requirement due to his/her religious observances and practices. It is the intent of The Cooper Union to reasonably accommodate an individual student's religious obligations and practices without penalty, based on good faith, effort and due notice to those relevantly concerned of the anticipated religious observance date. It is the student's obligation to provide prior notice of anticipated absences. Students absent due to religious observances and practices will be given an opportunity to make up any examination, study, or work requirement missed, without penalty.

The College also reasonably accommodates students with disabilities in accordance with law. Discriminatory harassment and sexual harassment pose a direct threat to the right of every member of The Cooper Union community to be treated respectfully. Students, professors, staff, and administrators share an obligation to maintain an environment in which members of the community are free to pursue and to promote learning, scholarly

inquiry, and artistic achievement without harassment. The harassment of any student is unacceptable and will not be tolerated at The Cooper Union.

Nothing in this policy shall abridge academic freedom or the College's educational mission. Prohibitions against discrimination and harassment do not extend to statements or written materials that are germane to the classroom subject matter.

Definitions

For purposes of these policies and procedures, discrimination, discriminatory harassment, and sexual harassment are defined as follows:

Discrimination

Discrimination is defined as:

- Treating members of a protected class less favorably because of their membership in that class; or
- Having a policy or practice that has a disproportionately adverse impact on protected class members, without sufficient justification.

"Protected class" refers to any personal trait or category that is protected by law, including an individual's race, religion, sex, color, ethnicity, national origin, age, marital status, creed, genetic predisposition and carrier status, sexual orientation, alienage, citizenship status, veteran status, disability or any other characteristic protected by law.

Discriminatory Harassment

Discriminatory harassment is defined as substantially interfering with an individual's educational or college living experience by subjecting him or her to severe or threatening conduct or to repeated humiliating or abusive conduct, based on his or her membership in a protected class. This includes sexual harassment, which is described below in further detail.

Under this policy, harassment is verbal or physical conduct that belittles or shows hostility or aversion toward an individual because of his or her race, religion, sex, color, ethnicity, national origin, age, marital status, creed, genetic predisposition and carrier status, sexual orientation, alienage, citizenship status, veteran status, disability, or any other characteristic protected by law, or that of his or her relatives, friends, or associates, and that:

- Has the purpose or effect of creating an intimidating, hostile, or offensive academic environment;
- Has the purpose or effect of unreasonably interfering with an individual's academic performance; or
- Otherwise adversely affects an individual's academic experience.

Harassing conduct includes, but is not limited to: epithets, slurs, or negative stereotyping; threatening, intimidating, or hostile acts; and written or graphic material that belittles or shows hostility or aversion toward an individual or group and that is placed on walls or elsewhere on The Cooper Union premises or circulated in the school (including through e-mail).

Sexual Harassment

Unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature constitute sexual harassment when:

- Submission to such conduct is made either explicitly or implicitly a term or condition of an individual's education or employment; or
- Submission to or rejection of such conduct by an individual is used as the basis for academic or employment decisions affecting that individual; or
- Such conduct has the purpose or effect of unreasonably interfering with an individual's academic or work performance or creating an intimidating, hostile, demeaning, or offensive academic, work or college living environment.

Sexual harassment may include a range of subtle and not so subtle behaviors and may involve individuals of the same or different gender. Depending on the circumstances, these behaviors may include, but are not limited to: unwanted sexual advances or requests for sexual favors; sexual jokes and innuendo; verbal abuse of a sexual nature; commentary about an individual's body, sexual prowess or sexual deficiencies; leering, catcalls or touching; insulting or obscene comments or gestures; display or circulation of sexually suggestive objects or pictures (including through email); and other physical, verbal or visual conduct of a sexual nature. Sex based harassment—that is, harassment not involving sexual activity or language—may also constitute discrimination if it is severe or pervasive and directed at an individual because of his or her sex.

Truly consensual romantic relationships are not sexual harassment and are not prohibited by The Cooper Union's policies. Individuals should be aware, however, that romantic relationships are susceptible to being determined after the fact to have been nonconsensual, and even coercive, whenever there is an inherent power differential between the parties. Therefore, any such relationship between a faculty or staff member and a student is strongly discouraged.

Requests for Disability Accommodation

Students seeking an accommodation for a disability should contact the Dean of Students. Such requests may also be given to the Vice President for Business Affairs/Equal Opportunity Officer.

Inquiries About Policy

Inquiries concerning any policy, program or other activity at The Cooper Union may be referred to the following individual who has been designated by The Cooper Union to oversee the continued application of the School's nondiscrimination and anti-harassment policies:

Robert E. Hawks
 Vice President for Business Affairs/ Equal Opportunity Officer
 The Cooper Union for the Advancement of Science and Art
 Business Office 30 Cooper Square, 7th Floor
 New York, NY 10003
 Tel. 212.353.4150

Procedures for Students with Concerns or Complaints About Discrimination and Harassment and Non Retaliation Policy

All members of the College community are expected to adhere to the College's policies and to cooperate with the procedures for responding to complaints of discrimination and harassment. All are encouraged to report any conduct believed to be in violation of these policies. It is in the best interest of the entire Cooper Union community for students to report incidents of discrimination and harassment. All students and applicants for admission are protected from coercion, intimidation, interference, or retaliation for filing a complaint or assisting in an investigation under any of the applicable policies and laws. Subjecting another to retaliatory, intimidating or coercive conduct for filing a complaint or participating in an investigation is prohibited and may be addressed as a separate violation.

Any person who believes that he or she has been the subject of discrimination or harassment may initially choose to deal with the alleged offender directly through a face_to_face discussion, a personal telephone conversation, e_mail correspondence, or letters. In many cases, this may effectively resolve the situation; however, individuals are not required to address the alleged offender directly. Such an approach may be ineffective in correcting the problem, or an individual may be uncomfortable in handling the situation alone. All students are strongly urged to promptly report concerns of discrimination and harassment under the procedures outlined below.

Formal Complaint Procedures for Students

Students who wish to make a formal complaint may do so in accordance with the procedures set forth below.

Complaints About Other Students

The harassment of any student is unacceptable and will not be tolerated at The Cooper Union. It is in the best interest of the entire Cooper Union community for students to report incidents of discrimination and harassment. Any student who believes he or she has been subjected to harassment by another student should submit a complaint, if possible in writing, to the Vice President for Business Affairs/Equal Opportunity Officer, the Dean of Students or his or her Academic Dean. The College will then designate the appropriate person to address the complaint. After a complaint is made, it will be investigated and an attempt will be made to resolve the matter as amicably and privately as possible. The penalties of expulsion, suspension, dismissal, warning, probation, or loss of privileges can be meted out to the offending student in the

College's discretion and as the College deems appropriate. The matter may be referred to the Student Judicial Committee, in accordance with the procedures set forth in the Code of Fair Practice.

Complaints About Faculty And Employees

The Cooper Union has established separate procedures to handle student complaints about harassment and discrimination imposed on students by faculty or staff.

Sexual harassment, whether it imposes a requirement of sexual cooperation as a condition of academic achievement or not, is inimical to the College's academic environment. Harassment and discrimination on the basis of race, religion, national origin, sex, and/or sexual orientation and any other characteristic protected by law are also prohibited. Student complaints about harassment by staff or faculty should be filed with the Dean of Students, the Vice President for Business Affairs/Equal Opportunity Officer, or the Academic Dean.

The Vice President for Business Affairs/Equal Opportunity Officer will investigate, or will appoint an investigator to investigate the matter and try to resolve the matter as amicably and privately as possible. If this effort is not successful and if the Vice President for Business Affairs or the President deems it appropriate under the circumstances, a Hearing Board may be appointed by the President to review the complaint, conduct any additional investigation deemed appropriate, and make recommendations to the President.

A Hearing Board is typically comprised of an Academic Dean, a faculty member, and an elected student representative, all from schools other than that of the complainant, although the College retains discretion to alter the composition of a Hearing Board as it deems appropriate.

In resolving any matter, the College retains discretion to take any remedial action it deems appropriate, including, without limitation, warning, demotion, transfer, suspension, training and termination.

Complaints against persons represented by a labor organization will be handled in a manner that is consistent with the applicable collective bargaining agreement.

Complaints About Third Parties

Student complaints of discrimination or harassment by third parties (e.g. visitors to the school or contractors working on school premises) may be filed in the same manner as complaints about faculty and employees and will be governed by the same procedures.

Independent Investigation and Review by Trustees

The Cooper Union, in its discretion, may conduct an investigation independent of or in addition to the procedures outlined above, at any time. In addition, although the Board of Trustees will not typically be involved in the receipt, investigation and remediation of complaints of discrimination and harassment, the Board of Trustees or a committee authorized by the Chairman of the Board of Trustees is authorized to modify the procedures herein as it deems appropriate under the circumstances, and to take remedial action as it deems appropriate.

At the conclusion of the investigation under any of the procedures set forth above, the complaining party and the accused party will be notified of the outcome of the investigation. Students with questions as to the appropriate procedure in a particular situation should contact the Dean of Students, the Vice President for Business Affairs/Equal Opportunity Officer, or their Academic Dean.

Non Retaliation

Retaliation against students who complain about perceived discrimination or harassment is strictly prohibited. Complaints of retaliation will be investigated and treated as violations of the College's Nondiscrimination and Anti Harassment Policy.

Compliance with Laws Promoting Equal Educational Opportunity and Prohibiting Discrimination and Harassment

In accordance with all applicable laws and pursuant to its own policies and operating procedures, The Cooper Union provides for equal opportunity and prohibits unlawful discrimination and harassment. The applicable laws include:

Title VI of the Civil Rights Act of 1964, as amended, prohibits discrimination against any person on the basis of race, color, or national origin in programs or activities receiving federal financial assistance.

Title VII of the Civil Rights Act of 1964, as amended, prohibits discrimination against any person because of race, color, sex, religion, pregnancy or national origin in connection with employment.

Title IX of the Education Amendments of 1972, as amended, prohibits discrimination on the basis of sex in the conduct or operation of a school's educational programs or activities, including admission to these programs and activities.

Section 504 of the Rehabilitation Act of 1973 prohibits the exclusion of any person solely on the basis of a disability from participation in or access to benefits of any federally .nanced program or activity; it also prohibits discrimination against any person solely on the basis of disability in any federally .nanced program or activity.

The Americans with Disabilities Act of 1990 prohibits discrimination against persons with disabilities in public accommodation.

The Age Discrimination Act of 1975 prohibits discrimination on the basis of age in programs and activities receiving federal financial assistance.

The New York Executive Law, Article 15, Section 296(4), prohibits an educational institution from denying the use of its facilities to anyone otherwise qualified or permitting harassment of a student or applicant on the basis of color, race, religion, disability, national origin, sexual orientation, military status, sex, age, and marital status.

The New York Education Law, Section 313, as amended, prohibits educational institutions from discriminating against persons seeking admission as students to any institution, program, or course because of race, color, sex, religion, creed, marital status, age, sexual orientation, or national origin.

The New York City Human Rights Law, Section 8_107, prohibits discrimination on the basis of actual or perceived race, creed, color, national origin, age, gender (including gender identity and expression), disability, marital status, partnership status, sexual orientation, or alienage or citizenship status in public accommodations.

Any person wanting to file an external complaint under any of these laws should consult the Web site of the relevant government agency listed below:

**Office of Civil Rights,
U.S. Department of Education**

<http://www.ed.gov/about/of.ces/list/ocr/index.html>

New York State Division of Human Rights

<http://www.dhr.state.ny.us/of.ces.html>

New York City Commission on Human Rights

<http://www.nyc.gov/html/cchr/home.html>

Policy and Procedures for Faculty and Staff

Faculty and Staff Equal Employment Opportunity and Nondiscrimination and Anti Harassment Policies

The Cooper Union is an equal opportunity employer and is committed to providing a working and learning environment free from unlawful discrimination and to fostering a nurturing and vibrant community founded upon the fundamental dignity and worth of all of its members. The College does not discriminate against or permit harassment of employees or applicants for employment on the basis of race, color, sex, gender (including gender identity and expression), pregnancy, religion, creed, national origin, age, alienage and citizenship, status as a perceived or actual victim of domestic violence, disability, marital status, sexual orientation, military status, partnership status, genetic predisposition or carrier status, arrest record, or any other legally protected status.

Sexual harassment is strictly prohibited. Harassment on the basis of any other protected characteristic is also strictly prohibited.

The Cooper Union reasonably accommodates employees and applicants with disabilities and also provides reasonable accommodation of religious beliefs and practices in accordance with law.

Nothing in these policies shall abridge academic freedom or the College's educational mission. Prohibitions against discrimination and harassment do not extend to statements or written materials that are germane to classroom subject matter.

All members of The Cooper Union community are expected to adhere to these policies and to cooperate with the procedures for responding to complaints of discrimination and harassment. They also are encouraged to report any conduct they believe to be in violation of these policies. Management and supervisory personnel in particular are responsible for taking reasonable and necessary action to prevent discrimination and harassment in the workplace and for responding promptly and thoroughly to any such claims. Those individuals include any officer or dean having formal supervisory responsibility over employees. For the purpose of these policies, faculty are supervisors of other faculty when they are acting in a supervisory role as department chair, dean, academic vice president, or similar position.

Employees may file an informal or formal complaint under this policy as set forth below. Any individual found to have engaged in discrimination or harassment will be subject to discipline up to and including termination. Retaliation against anyone who files a complaint or participates in an investigation of a complaint is prohibited and will be addressed as a separate violation of this policy.

The Cooper Union provides training programs to educate faculty and administrators about conduct that may constitute a violation of its policies and to inform them of the procedures that are available to respond to alleged violations.

Definitions

For purposes of these policies and procedures, discrimination, discriminatory harassment, and sexual harassment are defined as follows:

Discrimination

Discrimination is defined as:

- Treating members of a protected class less favorably because of their membership in that class; or
- Having a policy or practice that has a disproportionately adverse impact on protected class members, without sufficient justification.
- “Protected class” refers to any personal trait or category that is protected by law, including an individual’s race, religion, sex, color, ethnicity, national origin, age, marital status, creed, genetic predisposition and carrier status, sexual orientation, alienage, citizenship status, veteran status, disability, or any other characteristic protected by law.

Discriminatory Harassment

Discriminatory Harassment is defined as subjecting an individual to humiliating, abusive, or threatening conduct that creates an intimidating, hostile, or abusive work environment; alters the conditions of employment; or unreasonably interferes with an individual’s work performance on the basis of that individual’s membership in a protected class. This includes sexual harassment, which is described in further detail below.

Under this policy, harassment is verbal or physical conduct that belittles or shows hostility or aversion toward an individual because of his or her race, religion, sex, color, ethnicity, national origin, age, marital status, creed, genetic predisposition and carrier status, sexual orientation, alienage, citizenship status, veteran status, disability, or any other characteristic protected by law, or that of his or her relatives, friends, associates, and that:

- Has the purpose or effect of creating an intimidating, hostile, or offensive work environment;
- Has the purpose or effect of unreasonably interfering with an individual’s work performance; or
- Otherwise adversely affects an individual’s employment.

Harassing conduct includes, but is not limited to: epithets, slurs, or negative stereotyping; threatening, intimidating, or hostile acts; and written or graphic material that belittles or shows hostility or aversion toward an individual or group and that is placed on walls or elsewhere on The Cooper Union premises or circulated in the workplace (including through e_mail).

Sexual Harassment

Unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature constitute sexual harassment when:

- Submission to such conduct is made either explicitly or implicitly a term or condition of an individual’s employment; or
- Submission to or rejection of such conduct by an individual is used as the basis for employment decisions affecting that individual; or
- Such conduct has the purpose or effect of unreasonably interfering with an individual’s work performance or creating an intimidating, hostile, demeaning, or offensive working environment.

Sexual harassment may include a range of subtle and not so subtle behaviors and may involve individuals of the same or different gender. Depending on the circumstances, these behaviors may include, but are not limited to: unwanted sexual advances or requests for sexual favors; sexual jokes and innuendo; verbal abuse of a sexual nature; commentary about an individual’s body, sexual prowess or sexual deficiencies; leering, catcalls or touching; insulting or obscene comments or gestures; display or circulation in the workplace of sexually suggestive objects or pictures (including through email); and other physical, verbal or visual conduct of a sexual nature. Sex based harassment—that is, harassment not involving sexual activity or language—may also constitute discrimination if it is severe or pervasive and directed at employees because of their sex.

Truly consensual romantic relationships are not sexual harassment and are not prohibited by The Cooper Union policies. Individuals should be aware, however, that romantic relationships are susceptible to being determined after the fact to have been nonconsensual, and even coercive, whenever there is an inherent power differential between the parties. Therefore, any such relationship with a subordinate employee or a student is strongly discouraged.

Disability Accommodation

Employees seeking an accommodation for a disability should contact the Director of Human Resources, Yvonne Moray, or Vice President for Business Affairs/Equal Opportunity Officer Robert Hawks.

Inquiries About Policy

Inquiries concerning any policy, program or other activity at The Cooper Union may be referred to the following individual who has been designated by The Cooper Union to oversee the continued application of the School's nondiscrimination and Anti Harassment policies:

Robert E. Hawks
Vice President for Business Affairs/ Equal Opportunity Officer
The Cooper Union for the Advancement of Science and Art
Business Office
30 Cooper Square, 7th Floor
New York, NY 10003
Tel. 212.353.4150

Individuals and Conduct Covered

These employee policies apply to all applicants and employees, and prohibit harassment, discrimination and retaliation whether engaged in by fellow employees, by a supervisor or manager, or by someone not directly connected to The Cooper Union (e.g., an outside vendor, consultant or customer). Conduct prohibited by these policies is unacceptable in the workplace and in any work-related setting outside the workplace. Any individual found to have engaged in sexual or any other form of harassment, or other inappropriate conduct, will be disciplined as appropriate, up to and including discharge.

Non-Retaliation Policy

The Cooper Union will not in any way retaliate against an individual who, in good faith, makes a complaint or report of harassment, or participates in the investigation of such complaint or report. Retaliation against any individual for, in good faith, reporting a claim of discrimination or harassment or cooperating in the investigation of same will not be tolerated and will itself be subject to appropriate discipline.

Reports of retaliation should be made in the same manner as complaints reporting discrimination and harassment and such complaints will be investigated.

Complaint Procedures for Faculty and Other Employees and Applicants

Any employee who has witnessed, been subject to, or believes that he or she has been the subject of discrimination, sexual or any other form of harassment or retaliation by anyone at The Cooper Union should, and is encouraged to, bring the matter to the attention of a supervisory staff member or the Vice President for Business Affairs/Equal Opportunity Officer referred to above or to other persons designated to receive complaints as set forth below. Individuals should not feel obligated to file their complaints with their immediate supervisor before bringing the matter to the attention of the other designated representatives.

IMPORTANT NOTICE TO ALL EMPLOYEES: Employees who have experienced conduct they believe is contrary to this policy have an obligation to take advantage of this complaint procedure. An employee's failure to fulfill this obligation could affect his or her rights in pursuing legal action. Also, please note, federal, state and local discrimination laws establish specific time frames for initiating a legal proceeding pursuant to those laws.

The Investigation and Confidentiality

A prompt, thorough and impartial investigation of the alleged incident will be conducted to the extent possible, and appropriate corrective action will be taken if warranted. To the extent consistent with adequate investigation and appropriate corrective action, complaints of discrimination and harassment will be treated as confidential. At the conclusion of the investigation, the complaining party and the accused party will be notified of the outcome of the investigation.

Responsive Action

Misconduct constituting harassment, discrimination or retaliation will be dealt with promptly and adequately. Responsive action may include, without limitation, training, referral to counseling, monitoring the offender, and/or disciplinary action such as warning, reprimand, withholding of a promotion or pay increase, reduction of wages, demotion, reassignment, temporary suspension without pay, or termination, as The Cooper Union believes appropriate under the circumstances.

Grievance Procedure Under The Cooper Union's Nondiscrimination and Anti Harassment Policies

An employee of The Cooper Union who believes that he or she has been discriminated against or harassed in violation of any provision of The Cooper Union's nondiscrimination or Anti Harassment policies may ask the offender to stop his/her behavior. An employee should not feel obligated to confront the offender, however, and may also attempt to resolve such grievance in the following manner.

Step 1. Informal Complaint

Employees with complaints in which the immediate supervisor is not directly involved generally should start at Step 1. Employees with complaints which directly involve the immediate supervisor or in which the employee is not comfortable presenting the complaint directly to his/her supervisor should proceed directly to Step 2.

The complainant should present the complaint, if possible in writing, to his or her immediate superior as soon as possible after the date on which the alleged act of discrimination or harassment took place, and should also forward a copy of any written complaint in a sealed envelope marked "CONFIDENTIAL" to the Vice President for Business Affairs/Equal Opportunity Officer or to the Director of Human Resources.

The complainant's immediate superior or another individual designated by the College shall meet with the complainant for purposes of initiating an investigation. An investigation may involve a review of documents and interviews with witnesses and the alleged offender. Once an investigation is completed, appropriate remedial action will be taken.

If the complaint is not satisfactorily resolved at Step 1, it may be presented as a formal grievance/appeal under Step 2. As stated previously, if the complainant is uncomfortable presenting his/her complaint to his/her immediate supervisor, the complainant may immediately proceed to Step 2.

Step 2. Formal Grievance/Step

In the case where the complainant feels uncomfortable presenting it to his or her immediate supervisor or when the complainant is dissatisfied by the results of Step 1, the grievance may be formally presented by the grievant to the Vice President for Business Affairs/Equal Opportunity Officer or to the Director of Human Resources.

The grievance should be written, if possible, and set forth specifically the facts on which the grievance is based. The Equal Opportunity Officer, or an authorized designee, will investigate the grievance and/or review the investigation already conducted and make a determination on the grievance and appropriate remedial action.

Separate Rights of Faculty and Bargaining Unit Staff

Nothing herein precludes faculty and bargaining unit staff from seeking redress under their collective bargaining agreements. Complaints against persons represented by a labor organization will be handled in a manner that is consistent with the applicable collective bargaining agreement.

Independent Investigation and Review by Trustees

The Cooper Union, in its discretion, may conduct an investigation independent of or in addition to the procedures outlined above at any time. In addition, although the Board of Trustees will not typically be involved in the receipt, investigation and remediation of complaints of discrimination and harassment, the Board of Trustees or a committee authorized by the Chairman of the Board of Trustees is authorized to modify the procedures herein as it deems appropriate under the circumstances, and to take remedial action as it deems appropriate in certain cases.

Compliance with Federal, State and Local Laws Promoting Equal Employment Opportunity, Prohibiting Discrimination and Harassment and Authorizing Affirmative Action

In accordance with all applicable laws and pursuant to its own policies and operating procedures, The Cooper Union provides for equal opportunity, prohibits unlawful discrimination and harassment, and takes affirmative action. The applicable laws include:

Title VI of the Civil Rights Act of 1964, as amended, prohibits discrimination against any person on the basis of race, color, or national origin in programs or activities receiving federal financial assistance.

Title VII of the Civil Rights Act of 1964, as amended, prohibits employment discrimination against any person because of race, color, religion, sex, pregnancy, or national origin.

Title IX of the Education Amendments of 1972, as amended, prohibits discrimination on the basis of sex in the conduct or operation of a school's educational programs or activities, including employment in these programs and activities.

The Equal Pay Act of 1963 prohibits discrimination on the basis of sex in rates of pay. **The Lily Ledbetter Act of 2009** extends this protection.

Executive Order 11246, as amended, prohibits discrimination in employment because of race, color, religion, sex, or national origin and requires affirmative action to ensure equality of opportunity in all aspects of employment.

Section 503 of the Rehabilitation Act of 1973 requires a federal contractor to take affirmative action to employ and advance in employment qualified workers with disabilities. Section 504 prohibits the exclusion of any person solely on the basis of a disability from participation in or access to benefits of any federally financed program or activity; it also prohibits discrimination against any person solely on the basis of disability in any federally financed program or activity.

The Americans with Disabilities Act of 1990 prohibits discrimination in public accommodation and in employment against a qualified person with a disability and requires an employer to provide qualified applicants and employees with reasonable accommodations.

The Age Discrimination in Employment Act of 1967, as amended, prohibits discrimination in employment on the basis of age. **The Age Discrimination Act of 1975** prohibits discrimination on the basis of age in programs and activities receiving federal financial assistance.

The Uniformed Services Employment and Reemployment Rights Act (USERRA) prohibits discrimination in employment based on past, current, or future military obligations.

The Vietnam Era Veterans' Readjustment Assistance Act of 1974 and the **Veterans Employment Opportunities Act of 1998**, as amended, prohibit job discrimination and require affirmative action to employ and advance in employment qualified special disabled veterans, veterans of the Vietnam Era, recently separated veterans, and any other veterans who served on active duty during a war or in a campaign or expedition for which a campaign badge has been authorized.

The Immigration Reform and Control Act of 1986 prohibits employers from discriminating on the basis of citizenship status. The prohibition extends to employers who hire only U.S. citizens or U.S. citizens and green card holders, as well as to employers who prefer to employ unauthorized workers or temporary visa holders rather than U.S. citizens and other workers with employment authorization.

The Small Business Act of 1958, as amended, Section 15(g)(1), requires federal contractors to afford maximum practicable business opportunities to Small Business Concerns, including businesses owned by disadvantaged individuals, disabled veterans and women.

The New York Executive Law, Article 15, Section 296(1), prohibits discrimination against any person in employment because of age, race, creed, color, national origin, sexual orientation, military status, sex, disability, genetic predisposition or carrier status, marital status, or arrest record. Section 296(4) prohibits an educational

institution from denying the use of its facilities to anyone otherwise qualified or permitting harassment of a student or applicant on the basis of color, race, religion, disability, national origin, sexual orientation, military status, sex, age and marital status.

The New York Labor Law, Section 194, prohibits discrimination on the basis of sex in rates of pay.

The New York City Human Rights Law, Chapter 1, Section 8-107, makes it an unlawful discriminatory practice for an employer to discriminate against any person because of their actual or perceived age, race, creed, color, national origin, gender (including gender identity and expression), disability, marital status, sexual orientation, alienage or citizenship status, partnership status or status as a perceived or actual victim of domestic violence.

Any person wanting to file an external complaint under any of these laws should consult the Web site of the relevant government agency listed below:

Office of Federal Contract Compliance Programs

<http://www.dol.gov/esa/contacts/ofccp/ofnation2.htm#NewYork>

U.S. Equal Employment Opportunity Commission

<http://www.eeoc.gov/contact.html>

Office of Civil Rights, U.S. Department of Education

<http://www.ed.gov/about/of.ces/list/ocr/index.html>

**Veterans' Training and Employment Service,
U.S. Department of Labor**

<http://www.dol.gov/vets/aboutvets/contacts/main.htm>

New York State Division of Human Rights

<http://www.dhr.state.ny.us/of.ces.html>

New York State Department of Labor

http://www.labor.state.ny.us/agencyinfo/local_of.ces.shtm

New York City Commission on Human Rights

<http://www.nyc.gov/html/cchr/home.html>

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Application For Admission

Office of Admissions
and Records
The Cooper Union
for the Advancement
of Science and Art
30 Cooper Square
New York, NY 10003

Tel: 212.353.4120
Fax: 212.353.4342
www.cooper.edu
admissions@cooper.edu

CEEB Code: 2097

Please print in ink or use a typewriter. September 2010

A \$65 nonrefundable application fee must be submitted with this application.

Make checks payable to The Cooper Union. Only checks or money orders will be accepted. Your cancelled check is your receipt.

Check one category: First-Year Applicant
 Transfer Applicant
 Master's Degree, Engineering (Deadline: March 1)

Check only one major from the following:

<p>The Irwin S. Chanin School of Architecture¹</p> <p><input type="checkbox"/> Bachelor of Architecture (5-year degree)</p> <p>First-Year Deadline: Jan 5 Transfer Deadline: Jan 5</p>	<p>The School of Art¹</p> <p><input type="checkbox"/> Bachelor of Fine Arts (4-year degree) <input type="checkbox"/> Art Certificate Program</p> <p>First-Year Deadline: Jan 8 Transfer Deadline: Jan 8</p> <p><input type="checkbox"/> Early Decision Deadline: Dec 1</p>	<p>The Albert Nerken School of Engineering</p> <p>Check one of the following (Bachelor of Engineering Programs)</p> <p><input type="checkbox"/> Chemical Engineering <input type="checkbox"/> Civil Engineering <input type="checkbox"/> Electrical Engineering <input type="checkbox"/> Mechanical Engineering or <input type="checkbox"/> Interdisciplinary Engineering Studies (B.S. in Engineering)</p> <p>First-Year Deadline: Feb 2 Transfer Deadline: Mar 12</p> <p><input type="checkbox"/> Early Decision (First-Year only) Deadline: Dec 1</p>
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Social Security # _____

Name Mr. Ms. _____
First Middle Last

Last name while in high school if now different: _____

Date of Birth _____ Birthplace _____
City / State / Country

Are you a U.S. citizen? Yes No

Are you a Permanent Resident? Yes No

If not, what type of visa do you have?
 A B F G H
 I J R L M Other

Do you hold an I-20 from any institution? Yes No

Home Address _____
No. and Street Apt# County City and State Zip Code

Mailing Address² _____
No. and Street Apt#

County _____ City and State _____ Zip Code _____

Telephone () _____ Cellphone () _____ e-mail address _____

¹ Please do not include any support material—i.e., slides, sketchbooks, CDs/DVDs—at this time. We will accept portfolio work which accompanies your hometest. The hometest will be mailed to you in December (Early Decision Applicants) and January (Regular Decision Applicants).

² All applicants must provide a United States address to use for application processing.

Year of H.S. Graduation: _____ Name of Your High School _____

Address of High School _____

No. and Street

City and State

Zip Code

CEEB Code

How did you find out about The Cooper Union? _____

Have you ever attended an Open House or Tour at The Cooper Union? Yes No

Have you ever attended a Portfolio Day? Yes No

If yes, please indicate where and when. _____

Parents', Guardians', or Spouse's Names _____

Home Address _____

No. and Street

City and State

Zip Code

Telephone _____ parent's e-mail address _____

Occupation _____

Employer(s) _____

Are your Parents/Guardians college graduates? Yes No

If so, what college(s)? _____

Is English your first language? _____

Note: All applicants (first-year, transfer and graduate students) **MUST** answer the following questions:

Have you been convicted of a felony? Yes No Have you been dismissed from a college for disciplinary reasons? Yes No

Ethnic Survey Response is voluntary and the information will be kept confidential. Refusal to provide this information will not subject the applicant to any adverse treatment. The information is being collected for statistical purposes only and will not be used in a discriminating manner.

Are you Hispanic/Latino? Yes No

With which ethnic group are you most closely identified?

- | | | |
|---|---|--|
| <input type="checkbox"/> African American | <input type="checkbox"/> Puerto Rican—Commonwealth | <input type="checkbox"/> Caribbean American |
| <input type="checkbox"/> Puerto Rican—Mainland | <input type="checkbox"/> Caucasian | <input type="checkbox"/> Cuban American |
| <input type="checkbox"/> Chinese | <input type="checkbox"/> Other Latino | <input type="checkbox"/> Korean |
| <input type="checkbox"/> Japanese | (please specify) | <input type="checkbox"/> American Indian or Alaskan Native |
| <input type="checkbox"/> Filipino | <input type="checkbox"/> Vietnamese-Laotian-Cambodian | <input type="checkbox"/> Native Hawaiian, Pacific Islander |
| <input type="checkbox"/> South Asian-Indian-Pakistani | <input type="checkbox"/> Mexican American | <input type="checkbox"/> Multi-ethnic |
| | | <input type="checkbox"/> Other |

All applicants should sign below: _____

Signature _____ Date _____

Only transfer and graduate engineering applicants should answer the following:

(If you do not complete this section, you will not be eligible to receive any credit for previous work.)

Colleges attended

Name	Date	Credits Completed	Major
------	------	-------------------	-------

Address

City and State	Zip Code	CEEB Code
----------------	----------	-----------

Colleges attended

Name	Date	Credits Completed	Major
------	------	-------------------	-------

Address

City and State	Zip Code	CEEB Code
----------------	----------	-----------

Do you plan to graduate?

Yes No

If so, when?

Are you in good academic standing?

Yes No

Are you eligible to return to college last attended?

Yes No

If no, please explain.

Reasons for desiring transfer:

If you have been out of college more than four months, indicate what you have been doing since leaving school.

over: Master's Degree Applicants only

**For Applicants to the
Master's Program Only**

Full-Time Employment Record:

Indicate the most recent full-time position and list others on a separate page appended to this application.

From	To
Company	Address
Position	Job Description

Extra-Curricular Activities:

Professional Engineering Societies

Honor Societies

Research Projects (include details of papers delivered or published)

Graduate Engineering

Check major option you intend to follow in the Graduate Engineering Program at Cooper Union:

- Chemical Civil Electrical Mechanical

Please indicate the minor you intend to follow in the Graduate Engineering Program at Cooper Union (optional):

Are you working in any of the fields checked above? Yes No

Have you had your thesis subject approved? Yes No

Who will be your thesis adviser? (optional)

I understand that I am expected to complete the prescribed curriculum for the course in which I am enrolled and that I will be retained only if I comply with the scholastic requirements and the regulations of the School of Engineering Graduate Program.

Signature _____ Date _____