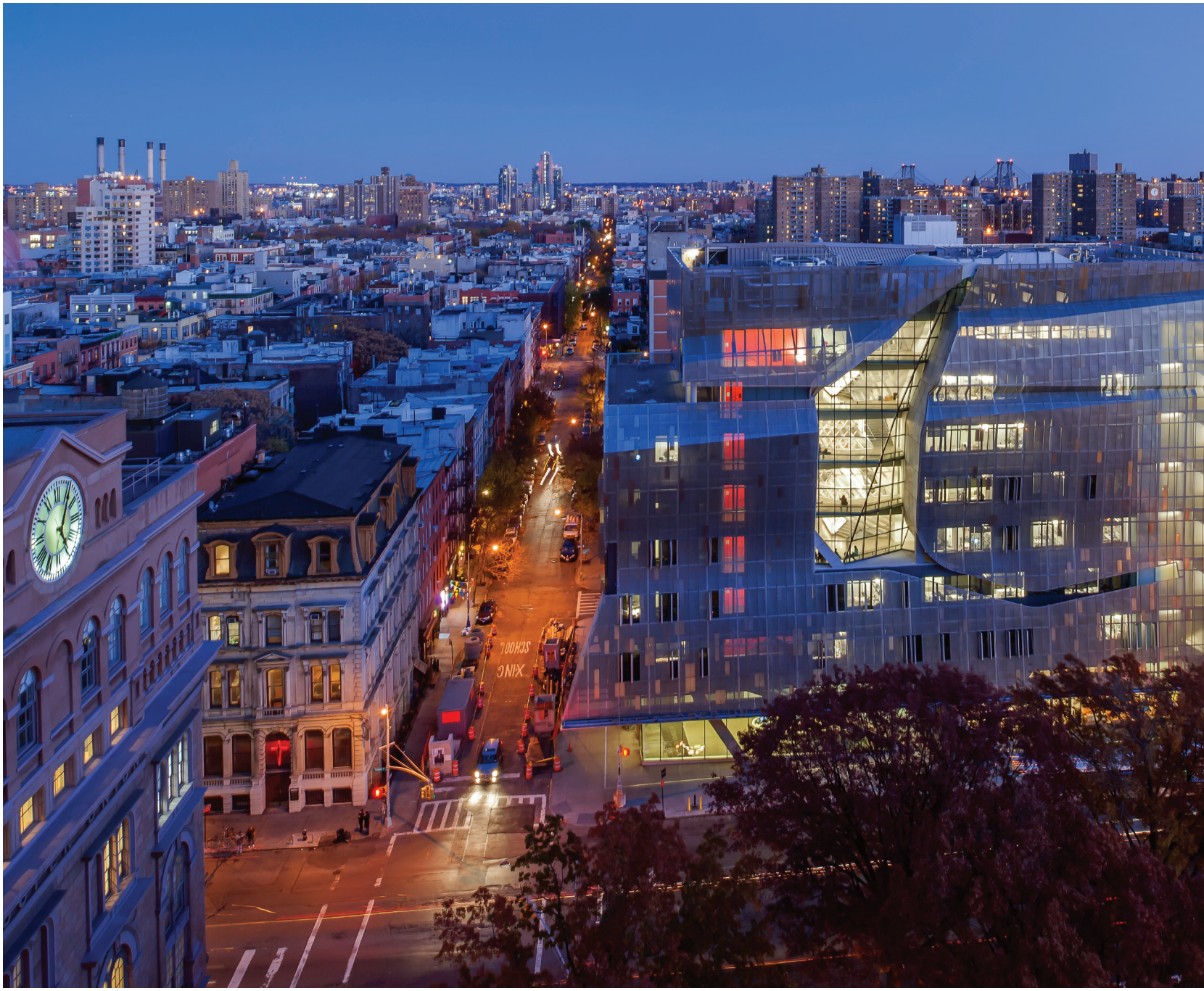
THECOOPERUNION

FOR THE ADVANCEMENT OF SCIENCE AND ART



COURSE CATALOG 2015|16

COOPER.EDU

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FOR THE ADVANCEMENT OF SCIENCE AND ART

COURSE CATALOG 2015|16

2015–16 ACADEMIC CALENDAR AND HOLIDAY SCHEDULE

August 25 Tuesday
Move-in day for Residence Hall

August 25-August 30 Tuesday-Sunday
New student orientation

August 31 Monday
Fall semester classes begin

September 4 Friday
No classes (Staff off for summer hours)

September 7 Monday
Labor Day (Staff Holiday)

September 8 Tuesday
Fall Festival (school in session)

September 14 Monday
There will be a $25 fee for Dropping classes after this date

October 12 Monday
Fall Breather (no classes, administrative offices remain open)

October 13 Tuesday
NOTE: FRIDAY CLASSES MEET

October 14 Wednesday
NOTE: MONDAY CLASSES MEET

November 26-November 29 Thursday-Sunday
Thanksgiving (Staff Holiday)

November 30-December 4 Monday-Friday
Registration for Spring 2016 classes

December 7-11 Monday-Friday
Last HSS/Engineering Classes

December 14-18 Monday-Friday
Last meeting times for all architecture and art classes/crits.
These continue in their regularly assigned rooms/spaces.
Final Exams for HSS and Engineering

December 18 Friday
Last day of Fall 2015 semester

December 19-January 18 Saturday-Monday
Winter recess; all schools

December 23-January 3 Wednesday-Sunday
Staff Holiday

January 4 Monday
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 27 Wednesday
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 12-20 Saturday-Sunday
Spring recess (administrative offices remain open)

April 19-22 Tuesday-Friday
Registration for Fall 2016 classes

April 27 Wednesday
Last HSS/Engineering Wednesday Classes

April 28 Thursday
Last HSS/Engineering Thursday Classes

May 2 Monday
Last HSS/Engineering Monday Classes

May 3 Tuesday
Last HSS/Engineering Tuesday Classes

May 6 Friday
Last HSS/Engineering Friday Classes

May 4, 5, 9, 10, 11 Wednesday, Thursday, Monday-Wednesday
Last meeting times for all architecture and art classes/crits.
These continue in their regularly assigned rooms/spaces.
Final Exams for HSS and Engineering

May 11 Wednesday
NOTE: FRIDAY CLASSES, EXAMS AND CRITS MEET
Last day of Spring 2016 semester

May 12 Thursday
Senior grades due in the Office of Admissions and Records before 4 pm.

May 16 Monday
All non-senior grades are due in the Office of Admissions and Records before 4 pm.

May 23 Monday
Commencement rehearsal; annual student exhibition opens

May 24 Tuesday
Commencement

May 30 Monday
Memorial Day (Staff Holiday)

July 4 Monday
Independence Day Celebrated (Staff Holiday)

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A BRIEF HISTORY

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

Located in New York City's East Village, The Cooper Union is an all-honors college that provides a minimum of a 50% tuition scholarship to all undergraduates accepted. It offers degree programs in architecture, art and engineering and courses in the humanities and social sciences. 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. 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.

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 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. 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 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 the three distinguished schools that make up The Cooper Union for the Advancement of Science and Art.

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, Bill Clinton and Barack Obama also spoke there as sitting presidents. Today, the Great Hall continues as a home for public forums, cultural events and community activities.

Many social and political movements were born in the Great Hall and the Cooper Union: the Red Cross and NAACP were convened here, suffragist Susan B. Anthony had her offices at Cooper, and, recently, students in our school of engineering invented a cardboard box that can be folded and sealed in a single motion.

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.

GENERAL INFORMATION

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.
Mechanical Engineering	0910	B.E.
Fine Arts	1001	B.F.A.
Fine Arts	5610	Certificate*
Master of Engineering	0901	M.E.
Master of Architecture	0202 Architecture II	Master of

Accreditation The Cooper Union is accredited by the Middle States Commission on Higher Education; all of the degree programs are registered with the New York State Education Department. In addition, the program leading to the bachelor of architecture degree is accredited by the National Architectural Accrediting Board, the program leading to the bachelor of fine arts degree 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 bachelor of engineering degree are accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology.

Cooper Union operates on a semester calendar, typically with the fall starting after Labor Day and the spring after Martin Luther King Day. Please refer to our academic calendar for specific term start and end dates. A limited summer term is offered with a small inventory of courses.

Consistent with New York State guidelines, one credit earned at Cooper Union represents a minimum of 750 minutes of instructor supervised class time (50 minutes per week for 15 weeks.) Many courses exceed the 50 minute/week requirement determined as per the needs of each academic department.

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 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, the Office of the President and Office Services (mail, photocopies). 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 Architecture office is open Monday through Friday, 9 am to 5 pm. 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.

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 Typography Design Program.

The Cooper Union Library features one of the finest collections in art, architecture and engineering in New York City. The library also provides resources in related areas of the pure sciences, and in the humanities and social sciences.

Located on the ground floor of the landmark Foundation Building, the library houses over 100,000 volumes of books and periodicals, and provides licensed access to more than 180,000 e-books and over 17,000 e-journals, in addition to thousands more open access titles, including U.S. government reports. The library's electronic resources, including its many specialized databases, are accessible from any computer on campus as well as to authorized users off campus.

Special collections include the Visual Resources Collection, which makes available films, maps, and thousands of digital images, and the Cooper Archives, which preserves materials relating to the history of The Cooper Union, its founder Peter Cooper and the Cooper and Hewitt families.

* Admission to the Certificate in Art is suspended wuntil further notice.

Professional librarians are always available during library hours. The librarians advise users in research techniques and regularly provide individual and group instruction.

The Cooper Library is a member of a consortium of academic libraries that includes New York University's Bobst Library, the libraries of The New School, and the New York School of Interior Design. These libraries share a combined online catalog, and students and faculty of The Cooper Union have access and borrowing privileges at the consortium libraries. Cooper faculty and students also have borrowing privileges at the library of the Polytechnic Institute of New York University and access to the Cardozo School of Law library.

When classes are in session, library hours are as follows: Monday through Thursday 8:45 am to 9 pm, Friday 8:45 am to 6 pm, Saturday noon to 5 pm and Sunday 2 to 8 pm. The Visual Resources Collection is open Monday through Friday 9 am to 5 pm. The Cooper Archives is available by appointment.

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.

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, the 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 Jeannette Brooks Computer Center, the Herb Lubalin Study Center, the Saturday Outreach Program and provides student and teaching studios. In the fall of 2010, the U.S. Green Building Council awarded 41 Cooper Square the LEED Platinum rating, its most rigorous level of certification that acknowledges the building's array of green features which reduce energy use and enhance the environment. 41 Cooper Square is the first academic building in New York City to achieve the LEED Platinum status.

The building is open from 8 am to 2 am Monday through Thursday, 8 am to midnight Friday and Saturday, and noon to 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 midnight Monday through Friday, and noon to 8 pm on Saturday and Sunday.

30 Cooper Square The Business Office, Office of Communication, Admissions & Records and Registrar, Financial Aid, Alumni Affairs & Development, Saturday Outreach Program (Art) and Continuing Education & 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.

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 institution 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.

Stuyvesant-Fish House The historic townhouse at 21 Stuyvesant Street, known as the Stuyvesant-Fish House, was gifted to the institution in the late 1990s. Renovated by Cooper Union architecture alumna Toshiko Mori, it serves as the president's residence.

Student Residence The Cooper Union Student Residence is located at 29 Third Avenue at the corner of Stuyvesant Street. It provides housing for approximately 180 students in apartments consisting of single and double bedrooms with a shared living space, kitchen and bathroom. Building amenities include a laundry room, the Menschel Common Room, and the Peter Torraco Alumni Space. The Office of Student Affairs is located on the third floor. The building is equipped with sprinkler and alarm systems, security cameras and an ID scanner for residents to gain access.

The student residence is overseen by the Office of Residence Life whose purpose is to provide a dynamic yet safe and comfortable residential community through personal development opportunities and programs that acclimate students to independent living in New York City. The office promotes student and community development through targeted programs that help students grow personally and professionally and gain exposure to the cultural opportunities within the city. The student residence is staffed by professionals from the Office of Residence Life, eight resident assistants, 24-hour security guards and a maintenance crew.

The privilege of residing in the student residence is generally extended only to students in their first year of study. New students receive instructions on how to apply when they are admitted to The Cooper Union. Upperclass students are provided housing as space is available.

Housing fees for the 2015–16 academic year are $12,600 per student per single room per year and $11,560 per student per double room per year.

Refund Policy for Student Residence Please refer to Section 10 of The Cooper Union 2015–16 Student Housing Affiliation Occupancy Agreement for a schedule of refunds and penalties imposed for cancellation.

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.

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 an 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 Affairs oversee many aspects of student life outside the classroom, including student clubs and the student government, career counseling, athletics and recreation and the production of the *Campus Safety, Security and Fire 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 dean of athletics. 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. 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 annual ski trips to Mont Sutton, Quebec, during the winter breaks in January and February.

Services for Disabled Students The Cooper Union is an equal opportunity institution that admits students without regard to their disabilities. The Cooper Union makes reasonable accommodations and modifications to policies, practices and procedures and provides auxiliary aids and services necessary to meet the needs of students with disabilities on campus. These aids and services can include, but are not limited to, providing note takers, readers and interpreters.

Students with disabilities seeking any accommodations, modifications or auxiliary aids or services regarding any aspect of the full Cooper Union experience—including anything pertaining uniquely to one of the Cooper Union's distinct schools—should contact the dean of students for assistance, ideally at least six weeks before the beginning of the semester. Such requests may also be given to the vice president for finance, administration & treasurer/equal opportunity officer.

Career Development The mission of the Center for Career Development is to advance personal, educational and professional growth. The Career Center complements The Cooper Union's academically centered tradition by preparing 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 facilitates student inquiry into relevant applications of the education they have received at the institution, strengthening The Cooper Union's historic commitment to science and art.

The Career Center helps both students and alumni to further their professional development by teaching them how to use self-knowledge in relation to career decisions, conduct career-related research, identify and pursue opportunities, prepare competitive application materials, and document and present their accomplishments. The Career Center's staff seeks to achieve these goals while striving to maintain impartiality and refraining from imposing personal biases. The Career Center cultivates positive relationships with employers, experiential-learning sites, graduate-study institutions, and not-for-profit resource organizations; identifies and promotes external grants, fellowships, and scholarships; helps shape and aid institutional goals; provides direction and consultation within the institution on career-development concerns; fosters constructive, reciprocal internal relationships; supports institutional assessment and relevant research endeavors and their publication, especially in relation to accreditation standards; and helps maintain Cooper Union's history through its archival practices.

Students are encouraged to review career-development resources at cooper.edu/career. In addition, students are advised to utilize the Cooper Career Connection, the Career Center's online job and internship board. The Career Center staff hosts events and workshops throughout the academic year and are readily available for student career-counseling appointments.

The Office of Alumni Affairs & Development is responsible for institutional advancement, which is the engagement of The Cooper Union with as many constituents as possible that can be helpful to the school and its plans for the future. Our work includes alumni activities, reunions, communications and productive coordination with the Cooper Union Alumni Association, as well as outreach to government, corporations, foundations and individuals who support us through employment and mentoring opportunities, volunteer involvement, grants and philanthropic giving. A crucial component of our work includes the management of the annual fund, which seeks recurring, unrestricted donations that provide one of the most important components of our institutional budget. In recent years 20% of our alumni have given back through the annual fund. In coming years we look to increase that number competitive with the best Ivy League schools in the country. We also seek partnership with major philanthropic contributors who share our vision for what is possible in higher education.

You may learn more by visiting us on the 8th Floor of 30 Cooper Square, by calling us at 212.353.4269, or by emailing us at alumni@cooper.edu.

First-Year Profile—Fall 2014 In 2014, The Cooper Union received 2,536 first-year applications; 382 students were admitted (15 percent) and 228 of those students accepted our offer (60 percent). The School of Architecture received 604 applications; 32 students were admitted (5 percent) and 24 of those accepted our offer (75 percent). The School of Art received 853 applications; 69 students were admitted (8 percent) and 57 of those students accepted our offer (83 percent). The School of Engineering received 1,079 applications; 282 students were admitted (26 percent) and 147 of those students accepted our offer (52 percent).

Geographically, 33 percent of the first-year architecture students lived in New York State; 32 percent of the first-year art students lived in New York State; and 56 percent of the first-year engineering students lived in New York State. In all, 48 percent of all Cooper Union first-year students came from New York State.

Forty-one percent of all Cooper Union first-year students are Asian; 17 percent are African American, Caribbean or Latino; 2 percent are Native American; 20 percent are international students; and 30 percent are Caucasian, non-Latino. Twenty-seven percent of all Cooper Union first-year students are women.

High School Grades/Test Scores Standardized test scores do not significantly enter the decision-making process for the Schools of Art and Architecture, but are important components of the engineering admissions criteria. The middle 50 percent of architecture freshmen achieved a high school average between 85 and 93 and SAT scores of 1150–1330. The middle 50 percent of art freshmen achieved a high school average between 82 and 92 and SAT scores of 1040–1230. The middle 50 percent of engineering freshmen achieved a high school average between 92 and 98 and SAT scores of 1390–1500. Overall, the average ACT composite score is 30–34.

Retention and Graduation Rate Ninety-six percent of the fall 2013 School of Architecture first-year students returned for fall 2014 and 74 percent of first-year students entering the School of Architecture in fall 2008 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. (See page 24) for information about Leave of Absence/Interim Year.) Ninety-seven percent of the fall 2013 School of Art first-year students returned for fall 2014 and 75 percent of first-year students entering the School of Art in fall 2009 graduated within five years. Ninety-seven percent of the fall 2013 School of Engineering first-year students returned for fall 2014 and 84 percent of first-year students entering the School of Engineering in fall 2009 graduated within five years.

ADMISSION PROCESS

The Cooper Union seeks students with a strong desire to study a professional curriculum and typically attracts applicants who are highly motivated and passionate about furthering their education in an intense, hands-on, mentored environment. The student body and faculty share an excitement and drive that advances the academic disciplines of architecture, fine arts and engineering.

The admissions process varies for each of the three schools and is outlined in more detail in the following sections of the catalog. Information about deadlines, campus tours and academic programs may also be found at cooper.edu.

The Cooper Union offers a half-tuition scholarship education to admitted undergraduates, regardless of their race, religion, sex, color, age, national and ethnic origin or disability. Admission requirements and procedures are not the same for all curricula taught at The Cooper Union. (See the application calendar and subsequent pages for details.)

Cooper Union is a member of The Common Application. The application may be accessed online at either *commonapp.org* or at *cooper.edu*. A $75 non-refundable application fee[1] is required when the application is filed. The admissions office is open for public service from 9 am to 5 pm, Monday through Friday. Information is readily available at cooper.edu.

GENERAL APPLICATION PROCEDURE

Each candidate must:

1. Complete and return or electronically file an acceptable application and the $75 application fee (no cash).[1]
2. Submit official high school and college records before the specified deadlines.[2]
3. Take all the required tests and submit official scores before the specified deadlines.[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 deposit.
2. Submit a final transcript before July 15.
3. File medical (including vaccination/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 regular admission is sought as the deadline for students who are accepting our offer of admission. This is known as the candidate's reply date.

[1] 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).
[2] 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.
[3] Applicants should visit collegeboard.org for test dates and registration information.

APPLYING TO
THE IRWIN S. CHANIN SCHOOL OF ARCHITECTURE

FIRST-YEAR REQUIREMENTS— BACHELOR OF ARCHITECTURE DEGREE

Submit first-year application before:	**January 11**
Submit high school records before:	**January 18**
SAT I/ACT[1] test taken by:	**January 25**
Official test scores must be received by:	**March 1**

Applications for first-year admission must be submitted before January 11.

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

High school records must show graduation with a minimum of 19 units[2] before July 15 of the year for which admission is sought, with required and elective subjects as follows:

Subject for Architecture	Units Required
English	4
History and Social Studies	3
Mathematics (including Trigonometry, Algebra II and Pre-calculus)	3
Science	3
Other Electives	6
Total Units Required	**19**

Calculus is a required first-year course for all architecture students. Entering first-year students must have completed Mathematics (including Trigonometry, Algebra II and Pre-Calculus). Any student who has not completed Pre-Calculus in high school must do so during the summer before enrollment.

[1] Applicants should visit collegeboard.org for test dates and registration information.
[2] A unit represents a year's study in a subject, with classes meeting at least four times a week in a secondary school.

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 January 18 if supporting a freshman application. Each candidate should make certain that the high school subjects required for his or her major are completed prior to graduation since The Cooper Union will not be able to verify the candidates 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. Students who have not fulfilled their application requirement may have their offer of admission recinded. 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 January 25 of the year for which admission is sought is not acceptable; results must reach The Cooper Union before March 1. Applicants are required to have completed mathematics through Trigonometry, Algebra II and Pre-calculus. Students who have not demonstrated an appropriate level of mathematics achievement will be required to complete a pre-calculus course in the summer prior to their enrollment, in preparation for 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 (see page 119 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 must submit documentation of their English language proficiency. 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).

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

TRANSFER REQUIREMENTS— BACHELOR OF ARCHITECTURE DEGREE

Submit transfer application before:	**January 11**
Submit college records before:	**January 18**
SAT I/ACT* test taken by:	**January 25**
Official test scores must be received by:	**March 1**

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 11 for September classes. Transfer applicants will be required to complete and submit a home test. Details will be sent 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, the studio test and portfolio work. Special instructions concerning the content and form of transfer portfolios are sent 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. Placement in the design sequence is a condition of the offer of admission and not subject to further review or appeal. By accepting the offer of admission, the transfer student agrees to this placement and acknowledges his/her anticipated graduation date. 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 his or her degree requirements. There is no opportunity for transfer students to accelerate through the required design sequence. Transfer applicants from programs other than accredited architecture programs will likely be placed in the first-year design studio (Architectonics). 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 37 for more information on transfer credit evaluation by the School of Architecture.)

*Applicants should visit collegeboard.org for test dates and registration information.

APPLICATION REQUIREMENTS— MASTER OF ARCHITECTURE II DEGREE

Submit application and all materials before:	**February 16**
Recommended GRE test date before:	**January 1**

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

- hold the professional degree of Bachelor of Architecture (B.Arch.), the professional Master of Architecture I (M.Arch. I) or an equivalent accredited professional degree in architecture from a foreign institution.
- have completed a minimum of one year of work experience after obtaining their first professional degree and before beginning the application process.

All applicants must submit the following:

- A completed application form (available at cooper.edu).
- Application fee of $75.
- Official academic records (transcripts) from all colleges and universities from which they have received credit.
- Recent GRE scores.
- Recommendation letters (three are required).
- Resume/CV.
- Written essay: The essay should succinctly explain your interest in the Master of Architecture 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). Applicants should not submit DVDs, 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 Master of Architecture II (graduate) program is not permitted.

APPLYING TO
THE SCHOOL OF ART

FIRST-YEAR REQUIREMENTS— BACHELOR OF FINE ARTS DEGREE

Submit first-year application before:	**January 11**
Submit high school records before:	**January 18**
SAT I/ACT[1] test taken by:	**January 25**
Official test scores must be received by:	**March 1**
Art Early Decision information: see this page	

Applications for first-year admission must be submitted before January 11.

Applicants for freshman admission in art will be required to complete and submit the home test and a portfolio of their (completed) work. Details will be sent to applicants in late January or early February.

High school records must show graduation with a minimum of 16 units[2] before July 15 of the year for which admission is sought, with required and elective subjects as follows:

Subject for Art	Units Required
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 January 18 if supporting a freshman application. Each candidate should make certain that the high school subjects required for his or her major are completed prior to graduation since The Cooper Union will not be able to verify his or 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. Students who have not fulfilled their application requirements may have their offer of admission recinded. 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 January 25 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 (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). Admission decisions will be made in early April; candidates are expected to reply before May 1, the candidate's reply date.

Early Decision (for Art Applicants only) A select number of potential School of Art students seen at portfolio reviews are invited to complete their application and home test for admission before the application deadline. In addition, if the School of Art is a first-year applicant's first choice, he or she may choose the Early Decision option. Application, test scores and high school record must be received by the Office of Admissions and Records by December 1. 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 agree to enroll in the School of Art at Cooper Union and withdraw all other college applications. Early Decision is an option for both first-year and transfer art applicants.

Submit Early Decision application before:	**December 1**
Submit high school records before:	**December 1**
Official test scores must be received by:	**December 1**
Home test sent to applicant	**Mid-December**
Completed home test submission	**Mid-January**
Notification of admission decision	**Late-February**
Early Decision candidate's reply date	**April 1**

Rolling Admission (for Art Applicants only) 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 11), 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.

[1] Applicants should visit collegeboard.org for test dates and registration information.
[2] A unit represents a year's study in a subject, with classes meeting at least four times a week in a secondary school.

TRANSFER REQUIREMENTS— BACHELOR OF FINE ARTS DEGREE

Submit transfer application before:	**January 11**
Submit high school records before:	**January 18**
SAT I/ACT[1] test taken by:	**January 25**
Official test scores must be received by:	**March 1**
Art Early Decision information: see page 12	

Transfer applicants for the art degree 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. Transfer applicants must not have completed more than 60 credits at another institution. (See also page 53.) All other applicants are freshman candidates. Transfer applicants must apply before January 11 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 home test. Special instructions concerning content and form of transfer portfolios are sent 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). 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.

Gainful Employment Regulations Periodically, The Cooper Union enrolls a student in our Certificate of Fine Arts Program.* Standard of Occupation Codes attributed to this program include: 27-1013.00 (onetonline.org/link/summary/27-1013.00 for more information) The Cooper Union is not currently accepting applications for this program for the 2015–16 academic year.

The 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). All foundation studio courses must be completed and students must complete 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.

As of Fall 2015, all incoming undergraduate students will receive a half-tuition scholarship. The additional costs a certificate student can be expected to incur are the following (see page 16 for more information on fees and expenses):
Application Fee: $75
Annual Student Fee: $800/semester
General Lab and Studio Materials Fee: $125/semester
Health and Insurance Fee: $1,200/year
International Student Fee: $3,010/year
Graduation Fee: $250/year
Estimated Books, Supplies, Materials: $1,800/year
Estimated Personal and Transportation Expenses: $2,325/year
Estimated Room and Board Expenses: $1,600/year (commuter), $15,560/year (residence hall double), $16,600/year (residence hall single), $16,245/year (living off-campus)

* Admission to the Certificate in Art is suspended until further notice.

APPLYING TO THE ALBERT NERKEN SCHOOL OF ENGINEERING

FIRST-YEAR REQUIREMENTS— BACHELOR OF ENGINEERING DEGREE

Submit first-year application before:	**January 11**
Submit high school records before:	**January 18**
SAT I/ACT[1] test taken by:	**January 25**
Math I or II and Physics or Chemistry SAT Subject tests taken by:	**January 25**
Official test scores must be received by:	**March 1**
Engineering Early Decision information: see page 15	

Candidates should file their applications before January 11 of the year for which admission is sought and their official high school transcripts before January 18.

High school records must show the following:[2]

Subject for Engineering	Units Required
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 January 18 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 or 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. Students who have not fulfilled their application requirements may have their offer of admission recinded. 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 January 25 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 2010 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 (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) Admission decisions will be made in early April; candidates are expected to reply before May 1, the candidate's reply date.

Advanced Placement Credit and Credit by Examination The School of Engineering may grant 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[3]	Ma 111	4
Chemistry	4, 5	Ch 110	3
Physics, Mechanics (c)	5[3]	Ph 112	4
Physics, Electro (c)	5[3]	Ph 213	4

All students seeking credit for high school work in mathematics and physics must successfully place out in placement exams administered by those departments before credit is granted.

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

[1] Applicants should visit collegeboard.org for test dates and registration information.
[2] Including calculus.
[3] Students who earn a grade of 5 must take a Department of Physics examination in order to receive the 4 credits. In addition, students receiving a 4 or 5 on the AP Calculus BC exam must take a Department of Mathematics placement exam to receive credit for Ma III.

Early Decision 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.

Submit application and high school records before:	**December 1**
Official test scores (SAT I/ACT and SAT Subject Tests*) must be received by:	**December 1**
Candidate's reply date	**January 23**

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 or her state regulations in this regard.

TRANSFER REQUIREMENTS— BACHELOR OF ENGINEERING DEGREE

Submit transfer application before:	**January 11**
Submit high school and college records before:	**January 18**
SAT I/ACT* test taken by:	**January 25**
Math I or II and Physics or Chemistry SAT Subject tests taken by:	**January 25**
Official test scores must be received by:	**March 1**

Transfer applications should be submitted before January 11 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). Special emphasis is placed on college-level grades in calculus, chemistry and physics.

All students seeking credit for courses in mathematics and physics may be required to successfully place out in placement exams administered by those departments before credit is granted.

APPLICATION REQUIREMENTS— MASTER OF ENGINEERING DEGREE

Students must submit graduate applications before:	**April 1**

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). Undergraduate students are not guaranteed admission to the program. Master of Engineering applicants must apply by April 1.

Cooper Union Undergraduates must have a minimum 3.0 grade point average in their 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 Bachelor and Master of Engineering and no more than six years. That grade point average will be calculated using courses with the prefixes ChE, CE, ECE, ME, EID and ESC. Furthermore, there must be a sufficient number of these engineering courses in a student's record for the grade point average to be meaningful. Cooper Union undergraduates will be required to pay the non-refundable $75 application fee when applying to the Master of Engineering program.

Depending on the availability of faculty and facilities, the engineering departments will admit 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 engineering 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 received by the Office of Admissions and Records by April 1. The application form is available to be downloaded at cooper.edu.

*Applicants should visit collegeboard.org for test dates and registration information.

International Students At The Cooper Union we value a diverse student body. We attract and enroll students from around the world. Please read below for important information pertaining to international students:

- International students are those who do not hold U.S. citizenship or permanent residency.
- International students are ineligible for Federal or State Financial Aid.
- International applicants with less than three years of English study are required to take the Test of English as a Foreign Language (TOEFL) to show English proficiency. A minimum TOEFL score of 600 (paper format), 250 (computer format) or 100 (internet-based format) is required.
- All applicants to The Cooper Union are required to submit scores from the SAT exam (collegeboard.com) or ACT exam (act.org).
- Make sure the name on your passport matches your name on the application, TOEFL and SAT/ACT scores exactly.
- All high school and college transcripts must be translated into English, notarized and sent to The Cooper Union.
- Students who are non-U.S. citizens or who are not permanent U.S. residents and who are admitted to The Cooper Union will be required to demonstrate they have the financial resources to live and study in New York City prior to obtaining an I-20 form and eventually obtaining an F-1 student visa.
- All international students are also assessed a fee of $2,010 per year.

TUITION, FEES AND EXPENSES

TUITION

Undergraduate The Cooper Union tuition charge for undergraduate students for 2015–16 is $20,400 per semester. Each registered undergraduate student who entered prior to Fall 2014 receives a full-tuition scholarship. As of Fall 2014, all incoming students receive a half-tuition scholarship. Additional aid is available to help cover the cost of tuition, fees, living and personal expenses for those students who demonstrate financial need.

Graduate

The Irwin S. Chanin School of Architecture 2015–2016
Tuition for the Master of Architecture II program is $20,400 per semester, for the three semester program. Graduate fellowships may be available for accepted students of exceptional merit and/or need.

Albert Nerken School of Engineering 2015–2016
Students in the Master of Engineering program are charged $1,200 per credit; 30 credits total. Any admitted Cooper Union alumnus entering the graduate program in Fall 2015 is eligible for a half-tuition scholarship for two years of study. Merit-based scholarships will be available to a select group of highly accomplished applicants in every degree-granting department. In order to be considered for merit-based scholarships, applications for Fall 2016 must be submitted by April 1, 2015.

FEES AND REFUNDS

Application Fee A nonrefundable application fee of $75 is paid by all candidates for admission.

Student Fee Each student enrolled in a degree program pays a student fee of $800 per semester. For new students, this fee is payable on acceptance of admission and is not refundable. For continuing students, the $800 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 $125 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.

Student Residence Fee Students electing to live in the student residence will be responsible for paying the regular housing fees. The fees for the 2015–16 academic year are $11,560 for a double (two students per bedroom) and $12,600 for a single (one student per bedroom). The fees cover residence for the fall and spring semesters and may be paid in two installments. A student can expect to spend approximately $4,000 per academic year for food.

Refund Policy for Student Residence Please refer to Section 10 of The Cooper Union 2015–16 Student Housing Affiliation Occupancy Agreement for a schedule of refunds and penalties imposed for cancellation.

Health Service and 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 August 15 will be billed $1,200 for the Health Service and Insurance Fee for the 2015–16 academic year.

International Student Fee Students who are non-U.S. citizens or who are not permanent U.S. residents must pay a fee of $2,010 per year payable by August 15.

Graduation Fee A graduation fee of $250 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 For students beginning their Master of Engineering program Fall 2014 onwards, the requirements for the 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. Graduate students are assessed a key/access fee of $150 per year. For students admitted to the Master of Engineering program prior to Fall 2015 and who receive approval to extend their studies beyond two years will be assessed a maintenance of matriculation fee of $3,000 per semester.

Books, Materials and School Supplies Each student must supply, at his or 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 website can be accessed through the Financial Aid for Students home page at studentaid.ed.gov.

For the most current information on financial aid at Cooper Union, please visit our web site at http://cooper.edu or contact the Financial Aid Office.

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 fafsa.ed.gov. 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. 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 website 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 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 Direct 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.

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 Center for Career Development 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 50% tuition scholarship. Therefore, second- degree students are referred to the various loan programs for financial assistance.

Rights and Responsibilities Students who receive financial aid in their first year at The 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.

Our three schools of Architecture, Art and Engineering each have an Academic Standards Committee that is responsible for meeting with students who have not made satisfactory progress toward degree completion. Each committee is comprised of a group of faculty, students and deans.

The committees meet after the conclusion of the fall and spring semesters (often mid-January and early June) at which point the students who are placed on academic probation have an opportunity to discuss their academic performance with the members of the committee.

The requirements to maintain satisfactory progress toward degree completion vary for each school. More information can be found in the Academic Standards section of the respective school.

In addition, students must also make satisfactory academic progress by completing degree requirements on a timely basis. Federal regulations require students who receive federal financial aid to complete degree requirements within 150% of the published length of the program. Failure to complete degree requirements within this time frame will result in a suspension of federal student aid.

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 2015–16

Architecture & Art*
(includes an average of $1,800 for supplies)

Commuter	$27,975
Residence Hall Resident	$41,885
Off-campus Resident	$42,620

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

Commuter	$27,175
Residence Hall Resident	$41,085
Off-campus Resident	$41,820

* Students without health insurance should add a Health Service and Insurance Fee of $1,200

International Student Budget Guide for 2015–16

Schools of Art and Architecture
Full-Time Matriculating

Fees	$ 3,860
Room and Board	$16,245
**Other	$ 4,125
Total:	**$24,230**
**Books and Supplies	$ 1,800
Transportation	$ 750
Personal Expenses	$ 1,575
Total:	$ 4,125

School of Engineering
Full-Time Matriculating

Fees	$ 3,860
Room and Board	$16,245
**Other	$ 3,325
Total:	**$23,430**
**Books and Supplies	$ 1,000
Transportation	$ 750
Personal Expenses	$ 1,575
Total:	$ 3,325

All incoming students receive a 50%-tuition scholarship. The value of this scholarship is approximately $20,000 per year ($10,000 per semester). Additional financial aid will be provided to the neediest students to help cover tuition, housing, food, books, supplies etc. The amount of additional aid will be based upon a student's demonstrated financial need. Students must file both a FAFSA and CSS profile form to be considered for additional financial aid. Please note that for exceptional students, Cooper Union may also offer merit scholarships.

SCHOLARSHIPS, FELLOWSHIPS, AWARDS AND PRIZES

NAMED SCHOLARSHIPS

The Irwin S. Chanin School of Architecture Estate of Francis Black; Gus J. & Helen Condaris; Ismar David; Manuel & Flora Fernandez; John Q. Hejduk; George and Selma Klett; Beth and Arthur Kramberg; John Loeb & Frances Loeb; Fred Metzger; Mari Souval Spacedrafting Foundation

School of Art Danny Arje; Alice Noble Ball & Francis M. Ball; Ruth Light Braun; William & Mary Jane Brinton; Caroline Fund; Frank Chesek Memorial; Mary Walter Cooper; Joseph and Robert Cornell Memorial Foundation; Paul Dandwerth Family; Ismar David; Lillyan deCaro Santo; Jane E. and Donald W. Deed; Pearl Dorn; James Trimble and Alice Trimble DuBois; Antonya Eisen; Loring Eutemey; Roberta Strauss Feuerlicht & Herbert A. Feuerlicht; Evelyn Graber; Amy Hewitt Green; Yip Harburg Foundation; William Randolph Hearst Foundation; Abraham Hersh; Eleanor G. Hewitt Memorial; Charles Ingraham; Elizabeth D'Hauteville Kean; George and Selma Klett; Mollie Levenstein; John Loeb & Frances Loeb; Laura Miller Margolius; Sylvia Drucker Mavis; Alphonse Normandia; Rosemary Okun; Peter Ostuni; Hazel A. Robinson; Marvin A. Schwam; Harrold Sosnow; Russell G. and Elsie K. Sweet; Henry Wolf Foundation; Womens Centennial Union

Albert Nerken School of Engineering Abdul Azimi Memorial; Edward J. Barlow; Robert W. Bassemir; Leonard Beck; Meredith B. Blaustein; Helen Janet Bliss; Grace, Bruna, Lutfi Celkupa and Marie Hudak Celkupa; Leon Chernick; Tunny Chin; John and Fedora Chironna; Horacio Cundari; Jane E. and Donald W. Deed; Franklin W. Diederich; Frank J. Donovan; Margaret and Frederick Dornheim; Herbert E. Ennis; Margaret Lappin Finch; Samuel & Sally Gilman; Roger Gilmont; Charles Greenfield; Robert Greenwald; William Grimshaw; Dr. Michael S. Gross; Elizabeth and Robert Hammond; Edward I. Hawthorne; The Hewitt Eightieth Birthday Scholarship; Fanny & Irving Katz Memorial; Laudy Scholarship; Seymour D. Lester; Leonard R. Luke; Henry Mankin; Vincent C. Morrone; Robert P. Muhlsteff; Pio Nardone; O'Rourke Scholarship; Emil J. Pansky; Emil Parente; William F. Partridge; Norman L. Perry Internship; John F. & Olga Petrowsky; Michael F. Roberti; Emanuel Salma Memorial; Dr. Walter L. Schwartz; Etta Spater and Meryl Spater; The Starr Foundation; Sol Tanne; Jesse & Nina Tegethoff; Peter Torraco; Ralph Torraco; Federick Urban; Dale & Charlotte Zand

General Financial Aid Scholarships David Ackerman; Irwin & Lillian Appel; Bank of New York Minority Scholarship; H. Carl Bauman; Frances & Max Birnbaum; Robert C. Bosch; Catherine E. Campbell; Maria L. Campbell; Chubb; Myron Coe; Julius Dingenthal; Abraham Drabkin; Edward Durbin; Kathleen Gerla; Estate of Joseph N. Golding; Salvatore & Tina Guzzardi; Robert Hawkes; Julian Hirsch; Benedict A. Joffe '12; Dr. Peter Kabasakalian; Alice Keteltas; John Marion Liptay; Arthur Loewe Trust; Estate of Charles E. Luffman; Estelle & Daniel Maggin; William H. Okun; Michael A. Rampino; Benjamin Reich; Charles Lowery Robertson; Louis Roeth; Charles Ruby; William H. Sandholm; Rudolph H. Schultz; Emil Schweinberg; The Starr Foundation; Solon E. Summerfield Foundation; Arlene and Irving Tashlick; Leonard E. Trentin; Clyde Walker Family;Clifford Warren; Bert Weinstein

FELLOWSHIPS

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. Palmer Hayden Travel Fellowship, travel Abroad For African-American Students in Art and Architecture

School of Art Rhoda Lubalin Fellowship, honors Herb Lubalin and is awarded to a rising senior who has excelled in graphic design; Helen Dubroff Dorfman Travel Fellowship; Palmer Hayden Travel Fellowship, for travel abroad for African-American students in art and architecture; the O'Brien Fellowship for Study Abroad; Martin Rothenberg Travel Fellowship; James Craig and Irene Scala Designing with Type Award, for students interested in design to travel abroad

Albert Nerken School of Engineering Henry C. Enders Fellowship, for students wishing to pursue graduate study in engineering; The Maxwell Lincer Fellowship, for excellence in the engineering field

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

AWARDS AND PRIZES

The Irwin S. Chanin School of Architecture The Toni and David Yarnell Merit Award of Excellence in Architecture, presented to a graduating student who demonstrates exceptional ability and outstanding merit; 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 or her school or department and who gives promise of real professional merit; The Cooper Union Service to the School Award, to a graduating student for outstanding service to the school; Abraham E. Kazan Award for Urban Design, to a graduating student for outstanding performance in urban design; George Ledlie Prize, to a graduating student as selected by the dean; Peter 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 Sylvia Appelman Award; for outstanding third year painting student; The Jacques and Natasha Gelman Foundation Award, presented to a graduating student who demonstrates exceptional ability in the field of painting or sculpture; The Toni and David Yarnell Merit Award of Excellence in Art, presented to a graduating student who demonstrates exceptional ability and outstanding merit; The Cooper Union Alumni Association Annual Award, to a graduating student for high academic achievement and outstanding service to the school; Richard Lewis Bloch Memorial Prize for Excellence in Art; Vena T. Carroll Award, for excellence in art; Ethel Cram Memorial Prize, for excellence in art; Henry Dropkin Award, for excellence in graphic design; Betty Morton Goldin Memorial Prize; Robert C. Goodhue 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; Laura Miller Margolius Memorial Prize, to a distinguished painter in the graduating class; 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; Robert Breer Film Award; Tam Prize in Fine Arts

Albert Nerken School of Engineering The Harold S. Goldberg Prize, 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 IT Department; Abraham Pletman Memorial Fund Prize, for excellence in electrical engineering

Chemistry: CRC Press Freshman Chemistry Achievement Award, to an outstanding freshman Chemistry student; Elmer J. Badin Chemistry Award, for students having the highest grade-point average at the end of the junior year and having the highest recommendation of the chemistry faculty; Robert Spice Fund Prize, for the best record in Instrumental Analysis and Electronics; American Institute of Chemists Undergraduate Student Award, for a graduating senior majoring in chemical engineering, in recognition of demonstrated ability, leadership, and professional promise.

Chemical Engineering: 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; Howard M. Siegel Memorial Prize, for scholastic excellence in chemical engineering; Lewis Gleekman Memorial Prize, for demonstrated professional interest in materials, metallurgy or corrosion engineering

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

Electrical Engineering: 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; Jesse Sherman Book Award, for an excellent academic record and superior electrical engineering laboratory work; Howard Flagg Memorial Prize, for undergraduate electrical engineering research; Dale E. Zand Prize, for outstanding achievement in electrical engineering

Mechanical Engineering: 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 Class of 1907 Prize, for excellence in calculus; Irvin Leon Lynn Prize, for excellence in mathematics; Harry W. Reddick Fund Prize and Medal, for meritorious work in mathematics

Bachelor of Science 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 Humanities and Social Sciences Prize; 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 History Prize, for an outstanding essay in history; 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

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 register during one of the scheduled dates 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 and studios 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 or 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 in the studio 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 or 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.

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 issued directly to students or to alumni in a sealed envelope.

Current students have access to their transcript and registration information on the portal to the school database, once they receive a password and a login at the Computer Center.

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

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 37, 53, 76 and 118 for more detailed information about transfer credit.

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—temporarily or permanently—any student whose physical or emotional condition is such that, in the opinion of an appropriate medical officer, attendance would endanger the health or welfare of other students and/or members of the Cooper Union community or otherwise disrupt the educational environment. A student whose attendance at the Cooper Union has been interrupted by a dismissal or extended leave of absence—for any reason—needs to submit new medical records before he or she resumes attendance. Likewise, students continuing on to the graduate program at Cooper Union must 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 August 15 will billed for the Cooper Union Student Accident and Sickness Insurance at a cost of $1,200 for the 2015–16 academic year.

LEAVE OF ABSENCE

Discretionary Leave of Absence Students who have completed at least one year of study may request an interruption of their studies for a Discretionary Leave of Absence. The request must be submitted, in writing, to the student's academic dean or associate dean. A Discretionary Leave of Absence for up to one year (2 semesters) with an automatic guarantee of reinstatement may be granted to students in good academic standing who are making satisfactory progress toward their degree.

A request for a Discretionary Leave beginning in the fall semester must be made before April 15th. A request for a Discretionary Leave beginning in the spring semester must be made before November 15th. Approval for a Discretionary Leave is neither automatic nor guaranteed. Before taking such a leave, all financial obligations to the Cooper Union must be satisfied. Students on academic leave are considered inactive and do not have access to the facilities of The Cooper Union.

Returning from a Discretionary Leave Students on a Discretionary Leave must notify, in writing, their academic dean of their intention to return at least four (4) weeks prior to the registration period for the semester of their intended return. The dean must notify the registrar to reactivate the student record.

Medical Leave of Absence A student who must interrupt his/her studies for medical reasons must submit a written request for a Medical Leave of Absence to his/her academic dean along with supporting documentation, which must include a letter from the treating health care provider.

Returning from Medical Leave A student on a Medical Leave of Absence must notify his/her academic dean of his/her intention to return at least eight (8) weeks prior to the semester of the student's intended return. The student must also provide a letter from his/her treating health care provider to the Dean of Students that he/she is ready and able to return to school. The academic dean must notify the registrar to reactivate the student record.

Compulsory Medical Leave of Absence The Cooper Union seeks to foster a safe and peaceful campus environment (including, but not limited to its classrooms, laboratories, studios, shops, and dormitories) that nurtures its students' well-being and allows them to focus on their studies.

The professional degree programs at The Cooper Union are exceptionally rigorous courses of study that require a student's full commitment of time and effort and involve collaborative work in shared studios and laboratories. Additionally, in light of the highly specialized technical skills needed to run equipment in its shops and laboratories, The Cooper Union has the highest concern for safety on its premises and has appointed staff and faculty to supervise these facilities. Such concerns are carefully balanced with the institution's historic commitment to student rights.

If a staff or faculty member notifies the student's academic dean that a student's conduct, actions or statements indicate that the student: (i) poses a threat of harm to the safety of others (either directly or through an inability to safely perform any necessary functions as a student); and/or (ii) is engaged (or may engage) in behavior or conduct that is disrupting the academic experience of others on campus, the dean will promptly assess such concerns and determine whether there is a problem, the nature, duration and severity of the problem, and the probability that such harm or disruption may occur. The academic dean or the dean of students will promptly meet with the student to analyze the situation. If a medical situation is involved, the student may be asked to provide medical information from a healthcare provider in order to clarify the situation as necessary. Considering all the information, the dean will determine if a problem exists and, if so, whether a reasonable modification of policies, practices or procedures or the provision of auxiliary aids or services can appropriately mitigate the problem. If so, following such an accommodation/modification, the student will be permitted to continue with his/her studies. At any point during the investigative process, the student will have the right to take voluntary medical leave of absence following the procedure stated above.

If an accommodation/modification cannot sufficiently alleviate the risk/disruption to allow the student to remain actively enrolled, and the student is not able or willing to take a voluntary medical leave of absence, the academic dean may recommend to the Academic Leadership Team that the student be placed on compulsory medical leave of absence. The student will be sent a letter notifying him or her of the dean's recommendation for a compulsory medical leave of absence, the basis for such a recommendation, and inviting the student to a hearing on this matter. This hearing—granting the student the opportunity to respond to this recommendation—will be conducted by one member of the Academic Leadership team and one other officer of The Cooper Union and will be held no sooner than five (5) days after the letter is sent to the student. If necessary, the student may request accommodations (e.g., modifications to policies, practices, or procedures; the need for an auxiliary aid or service) to participate in the hearing. At this hearing, the student may submit additional medical records and/or other appropriate information/documentation. The hearing officers will decide whether to accept the recommendation, reject it, or modify it and will inform the student within 24 hours of their decision, in writing. The hearing will be digitally recorded.

A student may be temporarily suspended from the institution prior to this hearing.

A student may be placed on compulsory medical leave for either a semester or a year, depending on the nature of the circumstances of the leave, submitted medical documentation, and the student's academic program. Students placed on compulsory medical leave will be asked to provide an evaluation from a physician of Cooper Union's choosing attesting to their medical readiness to resume their studies, with or without accommodation.

Appeal Process A student who has been the subject of a hearing under these procedures may appeal the decision of the hearing committee within 3 business days by writing a letter to the vice president for finance, administration & treasurer/equal opportunity officer or academic dean setting forth the reasons why the appeal is being made. The vice president will convene an Appeal Board within 3 days of receiving the appeal letter. The board will consist of the vice president or her designee and one member of the Presidential Leadership Team who was not involved in any way in the prior hearing. The Appeal Board shall limit its review to these issues:

- does the record show that the party had a full and fair opportunity to present his or her case?
- does the solution imposed achieve the proper balance between maintaining a safe and peaceful campus environment and respecting the rights of the student to continue his or her education?

After considering the record and the letter of appeal, the Appeal Board may:

- Accept the decision of the hearing committee;
- Order a new hearing in keeping with the Appeal Board's instructions;
- Reverse the hearing committee's decision in its entirety;
- Accept the hearing committee's decision but modify the solution.

If the Appeal Board accepts the decision of the hearing committee, whether or not it modifies the terms of the compulsory medical leave, the matter shall be deemed final.

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:
uspto.gov/web/offices/dcom/olia/copyright/copyrightrefresher.htm
deanofstudents.utexas.edu/lss/spot_illegalfilesharing.php
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: copyright.gov/fls/fl102.html

Code of Conduct In addition to the sanctions for copyright infringement provided by federal law, The Cooper Union's Code of Conduct 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 any 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.

Bicycle Policy As of September 27, 2010 Cooper Union has 24 indoor bicycle parking spaces (for non-folding bicycles) for faculty, staff and students of the Cooper Union only. The parking facility is located in the lower level of the Foundation building. Access to the parking facility is as follows:

• To determine if there are spaces available, check the sign at the entrance to the Foundation Building. The security desk in the Foundation Building will have serial-numbered tags equal to the number of spaces available in the parking facility at that time.

• To obtain a tag you must show valid Cooper ID and sign in.

• The security guard will give you the tag which must be locked or chained to your bicycle at all times the bicycle is in the building.
• You must return the tag and sign out when you leave the building.
• When there are no more tags at the security desk, there is no more indoor parking and your bicycle must remain outside.
• You must use the square elevator to reach the lower level and to return to street level. You may not use the stairs or the round elevator.
• No more than three bicycles may be in the elevator at the same time.
• You must lock your bicycle and tag to the bike rack.
• No overnight parking—bicycles must be removed when the building closes. (Except when there is 24 hour building access.)
• Failure to follow these guidelines will result in termination of an individual's access to indoor bicycle parking.
• If a bicycle is found in any other part of the building, or in any other building on campus, it will be removed without prior notice to the owner.
• Harassing security or any other Cooper employee regarding access to the facility will result in termination of an individual's access to indoor bicycle parking.

THE BICYCLE POLICY IMPLEMENTED IN SEPTEMBER 2009 REMAINS IN EFFECT FOR ALL OTHER 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 was implemented 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. Nor are loose bicycle tires permitted in these buildings. 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. Violations by persons represented by a labor organization will be handled in a manner consistent with the applicable collective bargaining agreement.

Bicycles may be parked outdoors 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.

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. Complaints against persons represented by a labor organization will be handled in a manner that is consistent with the applicable collective bargaining unit.

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 *The Code of Conduct*. 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 opening should consult the appropriate academic dean for the policies and procedures to follow, including ordering a guard. The following rules apply to all exhibitions where alcohol is served.

1. The serving of hard liquor is not permitted.
2. Alcohol service will be permitted at student receptions only when the student presenters are over 21 years of age. In the case of a group presentation the majority of students must be over 21.
3. 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 exhibitors. There are no exceptions to this requirement.
4. Such events must include the serving of food, in sufficient amount for the number 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.
6. 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.
7. 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.
8. The amount of alcohol served at a student reception shall not exceed 48 (12 oz.) cans or bottles of beer or 12 (750 ml.) bottles of wine.

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 in room 111, 41 Cooper Square.

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 Safety, Security and Fire Safety Report* available on the Cooper Union website and from the Office of Student Services, 29 Third Avenue, 3rd floor, New York, NY 10003. Crime statistics are available online at http://opc.ed.gov/security.

CODE OF CONDUCT

Preamble: As an educational community, The Cooper Union affirms the freedom of its students to pursue their scholarly, artistic and intellectual interests. The Cooper Union has developed policies 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 any violation of law may result in disciplinary action being taken by The Cooper Union.

In addition to the Standards of Conduct defined below, students are bound by the rules of their individual school or program, and any rules regarding the use of the facilities or equipment at The Cooper Union, including, but not limited to, classrooms, the library, the Great Hall, the Student Residence, the Computer Center, laboratories, shops, studios, and other facilities.

The Cooper Union has established separate policies, published elsewhere, to adjudicate claims of academic dishonesty, and claims of discrimination or harassment against a protected class (e.g., race, sex, and disability).

The Cooper Union reserves the right to modify and/or amend this Code at any time it deems necessary and in accordance with applicable laws.

Part One: Student Rights

Students have certain rights established by federal, state or local statutes or under 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, disability, sexual orientation, ethnicity, national origin, or any other legally protected characteristic.
Freedom from discriminatory or sexual harassment.
Freedom from improper academic evaluation.

Part Two: Standards of Conduct for Students

Category A The Cooper Union finds the following violations extremely serious and subject to the highest penalties:

1. Physical assaults resulting in injury, including sexual assaults.
2. The sale of drugs in a manner that violates federal or state law.
3. Possession of drugs, as defined as a felony, under state or federal law.
4. Undermining campus safety by setting off false fire alarms, discharging fire extinguishers, tampering with security systems, or ignoring the instructions of security guards or studio monitors.
5. Possessing or introducing dangerous weapons to campus in the manner prohibited in the Weapons Policy.
6. Violations of campus alcohol policy that result in injury or damage to property or undermine the safety and security of the campus community, including acts of hazing.
7. Acts of fraud. Some examples of these acts, but not limited to the following, are: misrepresentation, falsifying records or documents, assuming the identity of another person, or furnishing fraudulent information.
8. Acts of theft or vandalism (including graffiti) against the property of another student, guest, staff or faculty member or against the property of Cooper Union itself.
9. Reckless behavior involving the interior or exterior structures of campus buildings. Some examples of these acts, but not limited to the following, are climbing the grid of 41 Cooper Square, hanging over terrace balustrades, and accessing the roof of the Student Residence.

For these categories of violation, the sanction will ordinarily be suspension or dismissal. In some cases, the Presidential Right of Summary Suspension will 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 interests of maintaining an orderly atmosphere.

1. At all reasonable times, a student shall comply with a request for identification from an employee or security guard of The Cooper Union.
2. Students will respect the building hours and will leave the premises at the appropriate time.
3. Students will cooperate with the staff supervising the facilities of The Cooper Union.
4. Except for actions protected under state or federal law or the 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.
5. A student may not engage in libel or slander.
6. A student may not be involved in acts that cause physical or psychological harm.
7. 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 a violation of any local, state or federal law or the institutional alcohol policy.

8. When a student has a guest on campus, the appropriate guest procedures must be followed, and the student is responsible for the conduct of his or her guest and for any damages caused by that guest.

9. 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 or copyrighted 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.

10. A student may not gamble for money or other valuables while on the campus of The Cooper Union.

11. A student may not threaten members of the Student Judicial Committee or attempt to tamper with witnesses to the Student Judicial Committee.

12. A student may not smoke within any Cooper Union building or within 20 feet of the entrance to any Cooper Union building.

Category C: Other Complaints. The Student Judicial Committee may also consider complaints that are not delineated under Category A or Category B above, provided that the person against whom the complaint is made is notified in writing as to whether the proceeding will follow the rules of Category A or Category B, delineated below.

Part Three: 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 student's academic dean prior to such action, if time permits. Any person so suspended shall have all the rights as outlined in *The Code of Conduct*. Summary Suspensions must be reviewed by a judicial panel within seven regular business days of the suspension. Until and unless the accused 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, to excused absences from all classes and examinations during the suspension period.

Part Four: The Cooper Union Student Judicial Committee

1. Jurisdiction. The Student Judicial Committee of the Joint Student Council shall have jurisdiction of all matters involving an alleged violation of the Standards of Conduct stated above.

2. Membership. Each student council shall elect two representatives and two alternates to the Student Judicial Committee and one representative and one alternate to the Judicial Appeals Committee. Student Judicial Committee members must be elected to the Joint Student Council with plurality and cannot be on probation for academic reasons or have been issued a sanction by the Student Judicial Committee. Judicial panels shall ordinarily be chosen from members of the Student Judicial Committee; however, any member of the Joint Student Council eligible to serve on the Student Judicial Committee can serve on a judicial panel if necessary.

3. General Rules. Proceedings conducted by the Student Judicial Committee are completely independent of any civil or criminal proceeding and may occur simultaneously with such court action. The Student Judicial Committee is administrative, rather than criminal or civil, in nature. The standard of proof applied by the Student Judicial Committee shall be "preponderance of the evidence." Judicial Panels do not use technical rules of evidence. Committee members may take notice of any matter in the common experience of Cooper Union students.

Before calling a Judicial Panel, the dean of students shall review the list of eligible panelists for possible prejudice with the complainant and the person being accused. The dean of students shall notify the members of the Judicial Panel as to the time and date of the hearing. This does not preclude the dean of students from acting as witness, if necessary.

Representatives to the Student Judicial Committee may also serve as mediators in informal hearings.

All hearings shall be considered confidential except when applicable law mandates disclosure to the community; the complainant, however, shall have the right to be notified as to the result of the hearing.

Every student charged under *The Code of Conduct* shall be presumed not to have violated *The Code of Conduct* until the Judicial Panel arrives at its decision.

If, because of a disability, a student participating in the any stage of the hearings (or subsequent appeals process) in any capacity requires a modification to policies, practices, or procedures, and/or an auxiliary aid or service the student should submit such a request in writing to the dean of students at least five days prior to the scheduled start of the hearing so that the request can be appropriately assessed prior to the start of the hearing.

4. Judicial Panels for Category A Violations. For a Category A offense, the Judicial Panel shall be a subcommittee of the Student Judicial Committee drawing one representative from each student council plus any two administrative officers of The Cooper Union. The associate dean of the school in which the student charged in the complaint is registered shall ordinarily be invited to participate as one of the administrative officers on the Judicial Panel in the Category adjudication. Persons charged with a Category A offense have the right to a representative of his or her choice at his or her expense, but the representative's role will be limited to providing support to the person being charged. Cooper Union may also appoint a lawyer to such committee to serve as an adviser to the committee members.

5. Judicial Panels for Category B Violations. For a Category B offense, the Judicial Panel shall be a subcommittee of three from the Student Judicial Committee, generally one representative from each school.

A Judicial Panel formed under the rules of Category B has the right to stop the hearing and request that the case be heard instead under Category A Rules, so long as the parties are notified and the Category A hearing is scheduled within 7 days.

Part Five: Procedures for Filing Charges

1. Any member of the Cooper Union community may file a written complaint about an infraction of the Standards of Conduct by a student. Such complaint should be addressed to the Student Judicial Committee and delivered to the Office of Student Services, 29 Third Avenue, 3rd floor, New York, NY 10003, Attention: Dean of Students.

2. A complaint must be made within 30 days of the alleged infraction.

3. The complaint must set forth the basic facts of the alleged infraction, including the date, time, and place in which the incident occurred.

4. The dean of students will meet with the complainant to determine if the complaint can be resolved informally or through mediation. The penalties of warning, probation or loss of privileges may be meted out in these cases by the dean of students, with the agreement of all parties concerned.

5. Absent a successful resolution, the dean of students will schedule a hearing within 10 business days. S/he will notify the student being charged by letter of the charges, place and time of the hearing, and whether it will be conducted as a Category A or B hearing.

Part Six: Procedures for Conducting Hearings

1. The Judicial Panel shall elect one of its members to be chairperson and to preside over the 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 who disrupts a hearing, including the parties to the complaint, may be excluded by the person presiding.

2. The failure of the student charged to appear at the stated time and place shall constitute a waiver of the right to a hearing. The complainant shall have the option of not appearing at the hearing; however, a complainant cannot selectively attend portions of the hearing but must follow the instructions of the chairperson.

3. Any person being charged, having appeared at the hearing, shall have the right to contest the acceptance into the record of any evidence presented in support of the charges.

4. Each party shall have the right to summon witnesses, provided that a list of these is presented to the dean of students 72 hours prior to the hearing. The chairperson of the hearing shall have the right to exclude witnesses who appear to offer redundant testimony.

5. Each party may question the other party's witnesses, under the supervision of the chairperson.

6. The chairperson shall summon witnesses into the hearing room and ask them to withdraw once they finish testifying.

7. Hearings shall be taped on an audio recorder. Tapes shall be destroyed at the expiration of the appeal process.

8. After testimony is concluded, the panel shall come to a decision and present the decision in writing to the person being charged, either by hand or by mail to the last address given by the student.

9. In the event of a disciplinary dismissal, the president shall review the recommendation before it is put into effect.

Part Seven: Disciplinary Sanctions

By majority vote, the Judicial Panel may impose any of the following sanctions. The Student Judicial Committee will retain a written copy of the sanction in its file until the student permanently separates from The Cooper Union.

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.

2. Loss of Privilege. 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 or have the hours of their use restricted.

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

3. Behavioral Probation. A letter of censure given in instances of more serious violations of the Standards of Conduct. Behavioral probation is a trial period in which a student who has been in difficulty has the opportunity to demonstrate that he or she can be a responsible member of the community. The terms of the probation may be varied to fit the individual circumstances.

4. Suspension. Given in cases where it is judged that the student should be removed from the college community. This penalty is for a stated period of time, either one semester or one year. A suspended student is prohibited from being on any Cooper Union premises during the period of the suspension without written authorization from the Office of the President. A notification of the suspension will be sent to the Office of Admission and Records, the Office of the President, and the Office of Buildings and Grounds as well as to the student's academic dean.

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 proposed dismissal. The dismissal will be a permanent part of the student's file and will be noted on his or her transcript.

6. Other Actions. The Judicial Panel may impose other penalties that it deems appropriate to the infraction. Examples of such penalties are: financial restitution for damages or for medical expenses, letters of apology, community service work, etc.

7. 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. Cooper Union or its designee may, at its discretion, depending on the gravity of the violation, file a criminal or civil complaint. Filing an action under this Code does not preclude the complainant from also filing a civil or criminal complaint.

Part Eight: Appeal Process

1. Filing an Appeal. Any student found to have violated any of the Standards of Conduct may appeal the decision of the Judicial Panel within 4 business days by writing a letter to his or her academic dean setting forth the reasons why the appeal is being made. The dean will convene an Appeal Board within 5 days of receiving the appeal letter.

2. Composition of the Appeal Board. The board will consist of two students and one academic dean. Ordinarily, the academic dean and one of the students shall come from the same school as the appellant. The remaining student shall be from one of the other schools. Alternates may replace student representatives and have full rights to vote on the appeal board.

3. Limitations of the Authority of the Appeal Board. The Appeal Board shall limit its review to these issues:

—does the record show that the party had a full and fair opportunity to present his or her case?

—was the sanction imposed fair and proper in light of the infraction proved?

4. Decision of the Appeal Board. After considering the record and the letter of appeal, the Appeal Board may:

a. Accept the decision of the Judicial Panel;

b. Return the case to the Student Judicial Committee for a further hearing in keeping with the Appeal Board's instructions;

c. Reverse the Judicial Panel's decision and dismiss the case;

d. Accept the Judicial Panel's decision but reduce the sanction. The sanction may not be increased.

If the Appeal Board accepts the decision of the Judicial Panel, whether or not it reduces the sanction, the matter shall be deemed final.

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 which is accredited by the National Architectural Accrediting Board. The architecture curriculum is designed to prepare students for a breadth 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 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 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 A-B Architectonics	4	4
Arch 114 A-B Freehand Drawing	3	3
Arch 115 A-B History of Architecture I	3	3
Arch 118 A-B Computer Applications and Descriptive Geometry	2	2
FA100R A-B Introduction to Techniques	1	1
Arch 103-4 Calculus and Analytic Geometry	3	3
Freshman Seminar	3	-
Texts and Contexts: Old Worlds and New	-	3
Total Credits First Year	19	19
Second Year		
Arch 121 A-B Design II	5	5
Arch 122 A-B Structures I	2	2
Arch 125 A-B History of Architecture II	3	3
Ph 165-6 Concepts of Physics	2	2
The Making of Modern Society	3	-
The Modern Context: Figures and Topics	-	3
Total Credits Second Year	15	15
Third Year		
Arch 131 A-B Design III	5	5
Arch 132 A-B Structures II	2	2
Arch 133 Introduction to Urban History and Theories	-	2
Arch 134 A-B Environmental Technologies	3	3
Arch 135 A-B Building Technology	2	2
Electives*	4	2
Total Credits Third Year	16	16
Fourth Year		
Arch 141 A-B Design IV	5	5
Arch 142 A-B Structures III	2	2
Arch 143 A-B Construction Management	1	1
Electives *	7	7
Total Credits Fourth Year	15	15
Fifth Year		
Arch 151 A-B Thesis	6	6
Arch 152 Structures IV	2	-
Arch 154 A-B 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 bachelor of architecture curriculum includes 32 credits of *required* coursework in general studies (non-professional coursework outside the discipline of architecture). In addition to general studies, students also complete 30 *elective* credits. The elective component can be fulfilled by elective courses in subject areas such as architecture, humanities and social sciences, visual arts, mathematics, engineering, science and languages. Among the elective credits, at least six elective credits must be completed in humanities and social sciences. Additionally, a minimum of seven elective credits must be completed outside the discipline of architecture for a total of thirteen elective credits in general studies.

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 information be included in catalogs: In the United States, most 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 professional degree programs in architecture offered by institutions with U.S. regional accreditation, recognizes three types of degrees: the Bachelor of Architecture, the Master of Architecture, and the Doctor of Architecture. A program may be granted an eight-year, three-year, or two-year term of accreditation, depending on the extent of its conformance with established educational standards.

Doctor of Architecture and Master of Architecture degree programs may require a preprofessional undergraduate degree in architecture for admission. However, the preprofessional degree is not, by itself, recognized as an accredited degree.

The Irwin S. Chanin School of Architecture of The Cooper Union offers the following NAAB-accredited degree programs: Bachelor of Architecture (160 undergraduate credits). The next accreditation visit for this program will be in 2016.

The NAAB Conditions for Accreditation, Student Performance Criteria, Procedures for Accreditation as well as additional information about the School of Architecture's professional accreditation is available on The Cooper Union website via the link below:

http://cooper.edu/architecture/curriculum/professional-accreditation

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 50% tuition scholarship for all admitted undergraduate students, brings with it important 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 year and sequence 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; the approved course will be taken at the student's 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. It is in the best interest of each student to complete their coursework here at Cooper Union in conformance with the approved curriculum.

A student must pass a sufficient number of credits each semester to complete his or her 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 15–19 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 Students When admitted, transfer students are offered admission into a specific year of the five-year Design sequence. Placement in the Design sequence is a condition of the offer of admission and not subject to further review or appeal. By accepting the offer of admission, the transfer student agrees to this placement and acknowledges his/her anticipated graduation date. There is no opportunity for transfer students to accelerate through the required Design sequence.

Placement in the Design studio sequence is the only transfer credit evaluation made at the time of the offer of admission. Independently of Design studio placement, transfer students must fulfill all of their B.Arch degree requirements either through transfer credit or by completing required and elective coursework here. Transfer credit evaluation for required and/or elective coursework in the B.Arch curriculum, other than the Design studio, is the responsibility of the individual transfer student. Transfer students are required to have all other previous courses individually evaluated for transfer credit. It may not be possible for transfer students to complete all academic coursework simultaneously with their Design studio requirements. It will be necessary for the matriculating transfer student to successfully complete the design studio to which he or she is admitted, as well as all subsequent studios, as part of his or her 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.

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.

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, page 39.) Students are not permitted to withdraw from required classes.

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.39.)

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 Probation/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.

The Academic Standards Committee meets following the end of the Fall and Spring semesters to review the academic records/status of students on automatic probation and, as necessary, final probation. These students will be informed of the meeting in order to have the opportunity to appear before the Committee.

A student who receives a grade of **C-** or below in Architectonics, Design or Thesis may be required by the Academic Standards Committee to repeat the studio. The student may also be removed from automatic probation as determined by the Academic Standards Committee.

A student who receives a grade of **D+**, **D** or **D-** in Architectonics, Design or Thesis will be placed on automatic probation and will be required to repeat the studio. The Academic Standards Committee may place the student on final probation. The Academic Standards Committee may also set further academic and/or grade requirements for the student.

A student who receives an **F** in Architectonics, Design or Thesis will be placed on final probation and will be required to repeat the studio. The student will be required to receive a grade of **C+** or better in the repeated class. A student who fails to meet this condition may be dismissed by the Academic Standards Committee.

A second probation may result in final probation or the dismissal of the student as determined by the Committee. 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 or her academic career in the School of Architecture will be 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 dismissed on final probation (or permitted to withdraw on final probation) cannot apply or petition for readmission to the School of Architecture.

A student on probation may not be registered for more than 18 credits a semester.

Each student is responsible for his or her total accomplishment and for being continuously aware of the standards defined in the preceding paragraphs. Students whose work by mid semester indicates possible failure to meet the minimum standards of a course, including excessive absences, may be so informed and should arrange to meet with their respective faculty to address the matter in detail.

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

A student may not repeat any Design studio (or Architectonics and Thesis) more than once.

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

Additional credits for any repeated Design studio (including Architectonics or Thesis) do not count towards the 160 credits required for the B.Arch degree.

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 calendar year has elapsed from the completion of the course.

Change of Program

Adding a Course A student is permitted to add a course only during the first week of a semester, during the drop/add period, and only with the dean's approval.

Adding a course after the drop/add period is not permitted even if the student has been attending the class.

Dropping a Course A student may drop a course during the first week of the semester, during the drop/add period, with the dean's approval. A student who wishes to drop a course may be required to add equivalent credits in another course as needed to maintain satisfactory progress towards the degree.

A course dropped during the first week of the semester will be deleted from the transcript.

Withdrawing from a Course After the drop/add period a student may withdraw from a course through the sixth week of the semester, with the dean's approval. If the student is passing the course at the time of withdrawal, a grade of **W** will appear on the transcript. 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 notify the instructor in order to withdraw from a course.

Failure to attend a class does not constitute withdrawal; a student who fails to attend a class without formally withdrawing will earn a grade of **F** in the course. A student may not withdraw from a course to avoid receiving a failing grade.

A student is not permitted to drop or withdraw from a course necessary to maintain satisfactory progress towards the degree.

LEAVE OF ABSENCE

Mandatory Leave of Absence A student's academic record will be reviewed by the Academic Standards Committee if it meets any of the criteria for Academic Probation/Final Probation (see page 38 for more information).

If the student is permitted to continue, the student will do so as per the instructions of the Academic Standards Committee. A student who is required to repeat studio (Architectonics, Design or Thesis) may also be required to meet 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 or 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.

Leave of Absence—Other See pages 24-25 for The Cooper Union's regulations governing Discretionary Leave of Absence, Medical Leave of Absence and Compulsory Medical Leave of Absence.

Readmission Students who have withdrawn from the School of Architecture after having completed at least one year of study at The Cooper Union must reapply to the school to be considered for readmission as a transfer applicant.

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 by the Academic Standards Committee or to whom the Academic Standards Committee has given permission to withdraw in lieu of dismissal and are eligible for readmission must apply within two years to the chair 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 by the Academic Standards Committee or to whom the Academic Standards Committee has given permission to withdraw in lieu of dismissal 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 and in residence during the entire academic year immediately preceding the granting of the degree.

Graduation To be eligible for graduation, a student must complete all curriculum requirements for the bachelor of architecture degree program and must spend a minimum of four semesters in full-time resident study at The Cooper Union. To be eligible for graduation with the Master of Architecture II, a student must complete all curriculum requirements for the degree while in residence during three contiguous and consecutive semesters of study (Fall, Spring, Summer).

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 The Master of Architecture II post-professional degree program was launched in 2009 to 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. It is 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 serves professionals who wish to continue in practice with higher research and design skills in those areas in which the program offers specialization. It additionally prepares 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.

Applicants are required to complete a minimum of one year of work experience after obtaining their first professional degree before applying to the program. The design studio serves as a major component of the program. Seminars address issues particular to the concentrations as well as other topics making use of the interdisciplinary resources offered by The Cooper Union.

Concentrations in one or a combination of three areas are offered: theory, history and criticism of architecture, urban studies and technologies. Prospective students will declare their area(s) of concentration during the application process.

Theory, History and Criticism of Architecture Considers 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, the development of critical projects and a written thesis.

Urban Studies Addresses 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 Focuses 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 focuses 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 applicants to the Master of Architecture II program must 1) hold the professional degree of Bachelor of Architecture (B.Arch.), the professional degree of Master of Architecture (M.Arch. I) or an equivalent accredited professional degree in architecture from a foreign institution; and 2) have completed a minimum of one year of work experience after obtaining their first professional architectural degree. The program is structured to be completed in two full-time consecutive semesters with a final thesis semester during the subsequent summer session. See the Academic Calendar and Holiday Schedule on page 2 for information on the Fall and Spring semesters. The Summer semester runs from June-early September (after Memorial Day until the date of the Master of Architecture II final Thesis review and exhibition opening during the second week of September). Final thesis presentations will take place during the second week of September at the end of the student's year of study. Graduate students must complete all 30 credits of the Master of Architecture II degree requirements in full-time contiguous resident study at The Cooper Union.

Courses	Credits	
Semester I (Fall)		
Arch 411	Graduate Research Design Studio I	6
Arch 401	Proseminar	2
FA100R	Introduction to Techniques	0
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
FA100R	Introduction to Techniques	0
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 Master of Architecture 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 or her thesis topic and program for review and acceptance by the faculty. Final thesis presentations will be made during the second week of September at the end of 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.

Graduate courses in the Albert Nerken School of Engineering as well as select upper level undergraduate elective courses could be made available to Master of Architecture 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.

NCARB/IDP The Cooper Union's Master of Architecture II degree program is an NCARB-approved advanced degree program that qualifies for IDP supplemental experience. http://www.ncarb.org/Experience-Through-Internships/IDP2-Experience-Settings/IDP2-Supplemental-Experience-Elective/Post-Professional-Degrees-Overview/Post-Professional-Degree-Programs.aspx

ACADEMIC INTEGRITY

Built upon Peter Cooper's vision of education, The Cooper Union 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 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 extremely serious violations, 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/Studio Culture 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. Students must be aware of and observe all policies and conditions for the use of the studios (which are distributed at the beginning of each academic year). Students are required to be present in studio for all hours that their design studio meets and to develop their work in the studio.

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.

As articulated by our Architectonics (first-year Design studio) faculty: Educational institutions are the stewards of discipline, they are the crucibles in which the living form of a discipline is transferred through the generations. Many forms of resource are marshaled toward animating this stewardship; the primary resource, in fact the meaning and purpose of education, lies in the community of teachers and students at the heart of an institution. Young minds filled with endless possibilities come searching for a sanctuary in which they can be inspired, strengthened and tempered by listening to and working with voices of wisdom, knowledge and experience. There is no higher calling for an educational institution than the stewardship and advocacy of this community. The particular modes of knowledge that form the discipline of architecture are to a large extent embodied knowledge; they are acquired through a combination of intense study and present tense creativity. The education of an architect requires a studio culture that encourages the faculty and students to explore their creativity in teaching and learning, it requires crafting and maintaining an evolving studio environment that cultivates the personal imagination. Individual creativity within a willing community is a profoundly transformative act. As each moment contains the potential for reinvention, "school" is not a means to a predetermined end, but rather it is a place for significant works, for research and exploration, a place of creative urgency, for people and their works to listen to each other. Great educational institutions are great communities: physically, geographically and intellectually, the studio is the center of the community at the School of Architecture. The myriad personal and public exchanges that form our studio culture lead to new ideas, new forms of expression and movements of thought that ultimately enrich our discipline and our humanity.

Annual Exhibition of Student Work The End of Year Show is an essential part of the pedagogy of the school, exhibiting student work developed during the 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 School of Architecture exhibition covers approximately 10,000 square feet of space. Preparation of exhibition spaces—lobbies, halls and classrooms of the third and seventh floors, and the Houghton Gallery—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. All students must make requested projects available for the exhibition and are expected to fully participate in the installation.

In addition to 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. While student work is to be available for these purposes, work produced by students as part of their coursework remains their property.

Students are required to sign a release form at the start of their studies granting the school permission to use, copy, publish or distribute, perform or publicly display, create derivative works, and incorporate into compilations or collective works the works of authorship created during their enrollment as a student at Cooper Union in any form, format or media now known or later developed or created in the future, for educational purposes and for promoting, marketing and advertising Cooper Union and its educational services worldwide, without compensation. The student retains the copyright to the work.

FACILITIES AND RESOURCES

The facilities of the School of Architecture are housed on the second, 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 great monuments. In 1974, John Hejduk, the first dean of the School of Architecture, completed a major alteration of the interior. In 2002, the restoration of the brownstone exterior was completed after two years of work.

The Studios All students in the School of Architecture are provided 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 and graduate students in smaller studio spaces, a unique environment fostering cross-fertilization between classes and individual students is maintained. Students are provided with individual studio workspace with individual and shared tables for drawing, work, study, reference, model building, etc. The school does not support the principle or practice of continual 24-hour studio access. Studios are generally open Monday–Thursday 7:30 am–2 am, Friday 7:30 am–midnight, Saturday 8 am–midnight, and Sunday noon–2 am.

Computer Studio The School of Architecture Computer Studio on the seventh floor of the Foundation Building is specifically intended to support a design curriculum that recognizes the use of computing as an instrument of investigation and practice and which urges students to explore its formal and cultural implications. The facility utilizes both Macintosh and Dell Precision PCs (including high-end multiple-processor rendering stations), 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, the computer studio is generally open whenever the design studios are open, giving students access an average of 17 hours a day. A student monitor 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.

The School of Architecture Computer Studio also supports a 3D printer and laser-cutter; other three-dimensional output capabilities include a laser-cutter in the School of Art and CNC and rapid prototype machines in the School of Engineering.

Computing facilities designed to serve the specific needs of the Schools of Art and Engineering are open for use by students of the School of Architecture.

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 is located on the fourth floor. Integral to both the program and pedagogy of the School of Architecture, the art and architecture shop is equipped for projects in wood, metal, plastics, plaster and clay, and includes a bronze casting foundry. For a complete description of the shop facility, please refer to the School of Art section (page 56).

Study Collection The School of Architecture has fostered the growth of a non-circulating Study Collection of books and periodicals 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 is also used for seminar classes and meetings.

School of Architecture Archive The School of Architecture 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 1965. This provides an invaluable record of the pedagogy of the school that can be used for exhibitions, publications and student research. In addition, the Archive's Blueprint Collection, Lantern Slides, New York Postcard Collection, Stanley Prowler Slide Collection, New York City Waterfront Archive, Limited Edition Books and rare books 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 other photographic equipment for student use on class projects.

Arthur A. Houghton Jr. Gallery Named for Arthur A. Houghton Jr., former trustee and chairman of The Cooper Union, this 1800 square-foot gallery supports the pedagogy of the School of Architecture through public exhibitions and events. Over the years, the works of architects, photographers, painters, builders and faculty and students of the school have been exhibited, drawing viewers from schools of architecture and the wider professional communities as well as the public at large. The School of Architecture Archive works with other institutions to present jointly sponsored exhibitions, or will curate, design and install original exhibitions. Recent exhibitions presented by the school include *Musikerhaus: Raimund Abraham, Landscapes of Extraction: The Collateral Damage of the Fossil Fuels Industries* (presented with the Institute for Sustainable Design), and *Paul Rudolph: Lower Manhattan Expressway* (presented with The Drawing Center, New York), *Lessons from Modernism* (presented with the Institute for Sustainable Design, with generous support from the Stavros Niarchos Foundation), *Massimo Scolari: The Representation of Architecture, 1967-2012* (organized by the Yale School of Architecture with additional support provided by the Graham Foundation for Advanced Studies in the Fine Arts, the Turner Foundation, and by Elise Jaffe + Jeffrey Brown), *Bernhard Hoesli: Collages.*

The Cooper Union Institute for Sustainable Design The Cooper Union Institute for Sustainable Design seeks to provide the greater Cooper Union community—architects, engineers and artists—with the cross-disciplinary knowledge and skills that are necessary to create a sustainable society. We define a "sustainable society" as one that prospers because its economy, social practices, physical infrastructure and engineering systems all work in harmony with the ecological dynamics and resource limitations of the earth. More detailed information about the Institute for Sustainable Design and its programs, its projects and its activities, is available on The Cooper Union website: cooper.edu/isd

41 Cooper Square In September 2009, The Cooper Union opened its first new academic building in fifty years at 41 Cooper Square, opposite the landmark Foundation Building. This building houses the School of Engineering and the Faculty of Humanities and Social Sciences, studios for the School of Art, classrooms and computing studios for all students, and a shared gallery and auditorium. The first academic building to achieve the LEED Platinum status, 41 Cooper Square provides 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.

Personal Laptops The School of Architecture Computer Studio as well as the Cooper Union Computer Center at 41 Cooper Square are open to all architecture students and are 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 their first year of study before making a purchase in order to fully test a range 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 secure their laptops in their lockers when not in use.

Communication Email is an essential form of communication at The Cooper Union. Each new student is assigned a Cooper Union email address during Orientation. It is the responsibility of all students to actively and regularly check and use their Cooper Union email in order to receive, in a timely manner, official school announcements, important information about registration, messages of general interest about events, exhibitions and programs, safety updates, policy notifications, etc. As The Cooper Union continues its transition to an online administrative system, linked solely to The Cooper Union email address, this line of communication becomes even more vital. In addition, wireless internet access is available throughout The Cooper Union and can only be accessed via a Cooper Union email address and password.

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)

Arch 111 A-B 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 per semester

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

Arch 121 A-B 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 per semester

Arch 131 A-B 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 per semester

Arch 141 A-B 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 per semester

Arch 151 A-B 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 or her method of exposition. Problems are analyzed and studied with the aid of faculty from each discipline and by visiting critics.
6 credits per semester

MATHEMATICS (Required)

Arch 103-104 Calculus and Analytic Geometry
Emphasis on topics that involve the mathematical approach to geometrical and physical relationships and on basic concepts and applications of calculus and functions of one and two variables.
3 credits per semester

STRUCTURES (Required)

Arch 122 A-B 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 per semester

Arch 132 A-B 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 per semester. Prerequisites: Arch 103/104, Ph 165/166 and Arch 122 A-B Structures I

Arch 142 A-B 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 per semester. Prerequisite: Arch 132 A-B 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 A-B Structures III

ENVIRONMENTAL TECHNOLOGIES
(Required)

Arch 134 A-B 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 per semester

BUILDING TECHNOLOGY
(Required)

Arch 135 A-B Building Technology
Materials and methods of architectural construction, lectures, examination and study of historic as well as current building techniques. Field trips may be made to buildings under construction.
2 credits per semester

DRAWING (Required)

Arch 114 A-B Freehand Drawing
Basic drawing skills, composition and color perception. Studio and homework assignments.
3 credits per semester

Arch 118 A-B 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 per semester

HISTORY OF ARCHITECTURE
(Required)

Arch 115 A 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 B History of Architecture I (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 A 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 B History of Architecture II (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.
3 credits

Arch 133 Introduction to Urban History and Theories
An introduction to Urban History and to the principles, concepts, and Theories of Urbanism, from antiquity to the present, with an emphasis on the 20th Century urbanism.
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 A-B History of Architecture I, Arch 125 A-B History of Architecture II or permission of the instructor

PROFESSIONAL (Required)

Arch 143 A-B Construction Management
Introduction to construction management principles, techniques and methods including scheduling, cost-estimating, planning and controlling construction process.
1 credit per semester

Arch 154 A-B 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 per semester

ELECTIVE COURSES

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 per semester

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. Prerequisites: Arch 115 A-B History of Architecture I, Arch 125 A-B 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 A-B, Arch 132 A-B, Arch 142 A-B, 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 A-B Environmental Technologies or permission of the instructor.

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 his or her 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 per semester

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 per semester

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 per semester

FACULTY

Administration

Nader Tehrani
Dean

Elizabeth O'Donnell
Associate Dean

Monica Shapiro
Academic Administrator

Robyn Fitzsimmons
Administrative Assistant

Steven Hillyer
Director, Architecture Archive

Lea Bertucci
Special Projects Assistant, Architecture Archive

Chris Dierks
Collections 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., F.A.I.A.

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

Nader Tehrani
B.F.A., B.Arch., Rhode Island School of Design; Architectural Association;
M.A.U.D., Harvard University

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

Proportional-Time Faculty

Professors

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

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.

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

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)

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

Associate Professor

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

Assistant Professor

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

Adjunct Faculty

Professors

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

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

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., F.A.I.A.

Michael Webb
Diploma, Regent Street Polytechnic

Associate Professors

Tulay Atak
B.Arch., METU (Turkey); Ph.D., UCLA

Steven Kreis
B.S., University of Missouri;
M.S., Hunter College CUNY

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

Markus Schulte
B.Sc., M.Sc., University of Hannover (Germany);
P.E.

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

Assistant Professors

David Allin
Luis Pep Aviles
Dipl.Arch., M.A., ETSAB-UPC (Spain);
M.A., Princeton University, Ph.D. (in progress), Princeton University

Dorit Aviv
B.Arch., The Cooper Union; M.Arch., Princeton University; Certificate in Urban Planning, Woodrow Wilson School of Public Policy

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

John Hartmann
B.Arch., The Cooper Union; The American Academy in Rome; F.A.A.R.

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

James Lowder
B.Arch., Southern California Institute of Architecture;
M.Arch., Princeton University

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

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

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

Gia Wolff
B.F.A., Parsons School of Design;
M.Arch., Harvard University

Lydia Xynogala
B.Sc., Bartlett School of Architecture (U.C.L.); B.Arch., The Cooper Union;
M.Arch., Princeton University

Instructors

Rikke Jørgensen
B.A., Aarhus School of Architecture (Denmark); M.A., Aarhus School of Architecture

Adam Longenbach
B.Arch., M.Arch., Pennsylvania State University; M.Arch., The Cooper Union

Daniel Meridor
Tel-Aviv University;
Venice International University;
B.Arch., M.Arch., The Cooper Union

Matthew Roman
A.B., Princeton University; M.Phil., Cambridge University (England);
M.Arch., Yale University

Savina Romanos
B.Arch., The Cooper Union; MAUD, Harvard University

Wes Rozen
B.Arch, The Cooper Union

Will Shapiro
B.Sc., Brown University; Cambridge University (England); B.Arch, The Cooper Union

Visiting Professor

Joan Ockman
A.B., Harvard University (Radcliffe College); New York University School of Law; B.Arch., The Cooper Union

Previous Faculty Appointments

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, Eduardo Cadava, Susannah Drake, Sverre Fehn, Jay Fellows, Robert Freeman, Remo Guidieri, Janis Hall, Martin Harries, John Hawkes, Christopher Janney, Lydia Kallipoliti, Josef Paul Kleihues, Oliver Kruse, Jana Leo de Blas, James Merrill, Don Metz, Aida Miron, Francesco Pellizzi, Ahmad Rahimian, Gaetano Pesce, John Rajchman, George Ranalli, Aldo Rossi, Lindy Roy, Joseph Rykwert, Antonio Sanmartín, Jürgen Sawade, Massimo Scolari, Catherine Seavitt, Rafi Segal, D. Grahame Shane, David Shapiro, Daniel Sherer, Lee Skolnick, Richard Stapleford, Bernhard Strecker, Anthony Titus, Bernard Tschumi, Hans Tupker, Wim van den Bergh, Tod Williams, Lebbeus Woods and Bruce McM. Wright.

The Cooper Union Institute for Sustainable Design

Kevin Bone
Director

Emma John
Administrative Associate

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;
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 Emeritus 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 Emeritus 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.

Ysrael A. Seinuk*
Professor Emeritus of Architecture
Degree in Civil Engineering, University of Havana;
P.E., F.A.C.I., C.Eng., F.I.C.E.,
F. A. S. C. E.

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

* deceased

THE 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 offered 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 focus their work 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.)

For Students who entered on or after September 2011

Course	Credits
Required Foundation Courses	
Basic Drawing (Analytical and Descriptive)	6[1]
2-Dimensional Design	6[1]
3-Dimensional Design	6[1]
4-Dimensional Design	3[1]
Color	2[1]
Introduction to Techniques	1[1]
Foundation Project	1[1]
Required Art History Courses	
Modern to Contemporary: An Introduction to Art History	4[1]
Art History Electives	10*
Required General Academic Studies	
Freshman Seminar	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	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	10
Total Credit Requirement B.F.A. Degree	**130**

* Including 2 credits in prehistory through 17th century art and 2 credits in global perspectives on art

[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

* Admission to the Certificate in Art is suspended until further notice.

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

* 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 (two required courses and two elective courses, 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, 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 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, normally in the student's final semester, 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 overall, and have no outstanding first- and second-year requirements, may apply for one semester of non-resident study. The student must maintain good academic standing in the semester prior to departure, otherwise permission to participate may be revoked.

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, defined as having a cumulative G.P.A. of 3.0 overall.

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 a discretionary leave of absence for that semester.

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

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.

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, 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 and Off-Campus Programs.

Schools in the metropolitan New York City area are not available for a semester exchange.

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:
Drawing, 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 techniques courses:
Casting Techniques, 2 credits, equals 6 hours of work per week (i.e. 4 hours in class and 2 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 Studio 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 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 that two (2) additional credits in one course and no more that 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 3.0 G.P.A. overall 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 3.0 G.P.A. overall 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 (freshmen with advanced standing and transfer) may apply for transfer credits to be counted toward the B.F.A. degree requirements. These credits must be approved by the dean of the School of Art, after the evaluation by faculty based on official 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 10 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 13.)

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) will have the grades and credits entered on their records. Students are required to register for each semester through the online registration system, 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 or 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 or 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 reexamination, 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

Adding a Course A student is permitted to add a course only during the first week of a semester, during the drop/add period, and only with the adviser's approval.

Dropping a Course A student may drop a course during the first week of the semester, during the drop/add period, with the adviser's approval. A student who wishes to drop a course may be required to add equivalent credits in another course as needed to maintain satisfactory progress towards the degree.

A course dropped during the first week of the semester will be deleted from the transcript.

Withdrawing from a Course After the drop/add period a student may withdraw from a course through the eighth week of the semester, with the dean's and instructor's approval. If the student is passing the course at the time of withdrawal, a grade of **W** will appear on the transcript. A student who stops attending a course without permission of the instructor and the dean of the School of Art will receive a grade of **WU**; however, the instructor is free to record a grade of **F** in such a case.

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.

Academic Probation and/or Dismissal from The Cooper Union

A semester rating of all courses, (i.e., School of Art and Faculty of Humanities and Social Sciences) below 2.5 places students on probation and makes them subject to dismissal by the Academic Standards Committee. Students with unexcused absences and those excessively late to class are also subject to probation or dismissal. Students must maintain normal progress toward the degree (see page 51). Failure to observe this standard is grounds for probation or dismissal.

Appeal Students may appeal to the Academic Standards Committee of the School of Art in person and/or in writing when notified of their unsatisfactory academic performance. Students have on-line access to their grades. Please contact the Registrar's Office for more information.

When students are called to the Academic Standards Committee meeting, they are strongly advised to take this opportunity to communicate/explain/defend their unsatisfactory academic performance. The student should appear in person. If this is not possible the student may address the committee in writing.

After the hearing and deliberation the Academic Standards Committee shall either determine a probationary period or vote for dismissal. The decision of the committee is 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 may be called to the committee and are subject to probation or dismissal from The Cooper Union.

Leave of Absence

See pages 24–25 for Cooper Union's regulations governing leaves of absence.

In the School of Art, discretionary leave is available only upon completion of the first-year Foundation Program. Before taking such a leave, all financial obligations to The Cooper Union must be satisfied.

All requests for leaves of absence should be made through the Office of Academic Advisement. Note that this office is closed between June 10 and August 15 each year.

Students must request all leaves of absence in writing. A written request for reinstatement is also required. A student on leave is inactive and does not have access to the facilities of The Cooper Union.

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

Readmission Students who have been dismissed or who have withdrawn from the school and wish to be considered for readmission must reapply through the normal admissions procedures.

Such applicants may be asked to appear for an interview with a representative of the Admissions Committee as part of this process.

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.

* Admission to the Certificate in Art is suspended until further notice.

FACILITIES AND RESOURCES

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 house Apple iMac workstations and a teaching station, equipped with high-definition video projection, sound and laptop access. In addition, the Computer Studio provides scanners, black-and-white and color printers, and WiFi access. A professional staff of technical assistants is available during posted Computer Studio hours.

A professionally-staffed and well-lit letterpress studio is available to all students. It is equipped with five Vandercook cylinder presses, one tabletop pilot platen press, polymer bases, a foil stamping machine, book presses, binding hand tools, a polymer plate maker, and well-organized foundry and wood type, as well as all necessary spacing material and composing equipment. Skilled technical assistants are available to help students execute all manner of printing and binding projects. Students also have access to the collection of design ephemera, periodicals and books in the Herb Lubalin Study Center, located on the lower level of 41 Cooper Square.

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 offices in both buildings have 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. A staff technician is available during weekend and evening hours.

Photography The traditional/analog photography area includes a spacious, well-ventilated black-and-white communal darkroom with 16 photo enlargers capable of printing negatives ranging from 35mm to 4 x 5 inches. An adjacent accessory darkroom room houses a color/black-and-white enlarger that can print film sized from 35mm to 8 x 10 inches. In addition, there is a large black-and-white film processing area with automatic temperature control and a dedicated alternative-processes room with UV exposure units that can produce up to 30 x 48 inch exposures.

The digital photography lab includes 16 Macintosh workstations with seven 13-inch-wide and two 17-inch-wide inkjet printers. There are also numerous 8.5 x 11 inch flatbed scanners, one Nikon 35mm film scanner, and numerous Wacom tablets. An additional advanced digital lab houses two Macintosh workstations, two 17-inch-wide professional-quality inkjet printers, a Nikon medium-format film scanner, as well as a Hasselblad Flextight film scanner capable of scanning film sized from 35mm to 5 x 7 inches. Students may request prints up to 44 x 90 inches to be made on one of two wide-format inkjet printers.

A well-equipped studio provides space and tools to photograph a wide range of sets using tungsten, electronic flash, or daylight-balanced fluorescent lighting systems. A complete tethered capture system with a Macbook Pro is available for advanced photo students. A variety of large- and medium-format film cameras are available for checkout, as are a range of professional DSLR cameras including the Canon 5D Mark III.

A knowledgeable 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 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 Film students can borrow Bolex 16mm cameras with zoom or prime lenses, a Canon Scoopic, Arri 16BL, or small format Super8 cameras. Camera kits include light meters and complete instructions. Film is sold at the Checkout Office and students can hand-process it onsite or send it to a local lab. Processed film can be converted to digital files with a custom-built 16mm HD transfer machine, or edited on a Steenbeck flatbed editor or Super8 viewers. A JK optical printer is available for contact prints or optical special effects. The screening room is equipped for projection of 16mm and Super 8 film.

Video The Checkout Office provides HD camcorders for students in introductory classes. Advanced classes use professional large-sensor camcorders & HDSLRs with a range of lenses. GoPro action cameras and older formats are also available. Students can borrow fluid-head tripods, shoulder rigs, stabilizers and a variety of halogen & LED lighting kits. Grip equipment, gels and modifiers like umbrellas and softboxes can be added to any light kit.

The primary video editing facility has eight workstations with Adobe Premiere Pro, After Effects and Photoshop, Final Cut Studio, Pro Tools and other audio and video software. Additional outboard equipment includes various analog and digital & audio and video decks, mixers and special effects devices. Other equipment (monitors, speakers, projectors, VCRs, DVD and media players) is also available for multi-media installations. The video lab is networked and equipped with a video/data projector for instruction and viewing student work

Animation Animation students have access to still, video & 16mm cameras for image capture, as well as light tables, peg bars and animation stands for analog cel animation, direct-on-film painting and stop-motion.

The Animation lab has 10 workstations and provides support for two- and three-dimensional animation and stop motion capture. Additional hardware includes DSLR animation stands with Dragonframe Stop Motion software, a digital roto-

scope station, flatbed scanner, vocal isolation booth and various analog and digital audio/video decks. This lab also serves as a supplementary facility for students working with film, video and sound projects, has all of the same software and is networked and equipped with an HD video/data projector with surround sound for instruction and viewing student work

Sound Professional digital audio recorders are available, supported by a complete array of microphones including shotguns, wired and wireless lavalieres, binaural pairs, contact mics, and custom transducers. A dedicated sound editing room is equipped with ProTools HD and Reaper software with surround mixing capabilities and a vocal isolation booth.

Screening Room/Classroom Classes are held in the Screening Room, a theater for large-screen projection of film and HD video with 5.1 surround sound. The projection booth is equipped for 16mm and Super 8, and offers flexible signal-routing with AV ties to the editing facilities. The room doubles as a shooting studio with a permanent green-screen and additional electric service for high wattage lighting.

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

The Computer Studio The Computer Studio, a part of the Department of Information Technology, is located on the eighth floor of 41 Cooper Square. It comprises two Apple iMac classrooms and a central scanning and large-format color output area. The Department of Information Technology supports both PC and Mac technology, and provides students with a wide range of digital media and imaging options. The facility houses Apple iMac computers, which can boot into Mac or Windows operating systems, and Dell PCs; high-resolution reflective and transparency scanners; black-and-white and color laser printers; and large format color printers. The Computer Studio workstations are capable of producing high quality digital video and audio for broadcast, new media and web publishing.

Software available includes complete suites of applications for graphic design, multimedia, 3D design, audio-video production and animation. The fully-networked studio also provides Internet access, CD and DVD production capabilities and printing to many different types of media. Digital video cameras, digital still cameras and microphones are available for loan by students in the lower level 1 A/V Resource Center.

A professional staff of technical assistants is available Monday through Saturday during posted Computer 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 used to exhibit the work of students and outside artists in solo or group shows. In the new academic building at 41 Cooper Square, the 41 Cooper Gallery and the Lubalin Center Gallery feature large windows offering views from the building's entrance and an abundance of natural light. These spaces, often used in conjunction with one another and with the adjacent Rose Auditorium, 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.

In the Foundation Building, a number of lobby galleries present students' artwork in the historical heart of the school, near many of the studios and shops where it was created.

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 graduating 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—referred to colloquially as the End of the Year Show—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 Located at 41 Cooper Square, adjacent to the Lubalin and 41 Cooper Galleries, the Herb Lubalin Center's core collection includes an extensive archive of Herb Lubalin's work, as well as seminal design ephemera by other important graphic designers. It also houses 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 graphic design.

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 two or three hours per week)
TE designates techniques courses (meet four hours per week)

Required Foundation Courses

FA 100.1, FA 100.2
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.
½ 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. Fall only. Ellis/Osinski/Rodman

FA 102.1, FA 102.2
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/Morton/RublTochilovsky

FA 104.1, FA 104.2
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/Masnyj/Morgan

FA 105 Four-Dimensional Design
This course investigates the properties of time and movement and the fundamentals of four-dimensional design. Students explore duration, condensation, expansion, interruption, simultaneity, stillness, action and situation through a wide range of materials.
3 credits. Spring only. Burckhardt/Issa/Lehyt/Raad

FA 109.1, FA 109.2
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 (Sabbatical Fall 2015)/Duerksen/Farmiga/Finley/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. Fall semester only. Morgan/Rockhill

Elective, Prerequisite and Advanced Courses

Students may enroll in advanced studio classes with the same course number multiple times. Instructors and syllabi in these courses will vary. In addition, the content of advanced studio classes changes with the mix of students in each class. Consequently, the development of individual students' work varies with the interchange of ideas among these students and their instructor.

The School of Art believes that the ability to work with the same instructor in the same discipline multiple times (even as the course content changes) can foster a valuable mentoring relationship between an instructor and an advanced student.

CALLIGRAPHY

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 Techniques in Photoshop
This course explores techniques and projects in Photoshop. Students will complete projects that demonstrate their skill and understanding of digital image creation. Students will apply the software to projects that they are engaged in or planning. A structured series of projects/problems will be presented to help students master the various techniques and tools as well as the application of the software to real world situations.
2 credits. One-semester course. Cannot be repeated. Free elective credit. TBA

TE 304 Techniques in After Effects
This course explores techniques and projects in Adobe After Effects. Students will complete projects that demonstrate their skill and understanding of visual effects and motion graphics. Projects will be faculty and student generated.
2 credits. One-semester course. Cannot be repeated. Free elective credit. Garrett

TE 305 Techniques in HTML and Programming
This course explores techniques that take advantage of the Internet as an artistic medium. Students will demonstrate their skills and understanding of HTML, CSS, Javascript and APIs through designing and building interactive projects, using open source software.
2 credits. One-semester course. Cannot be repeated. Free elective credit. Sparling

CONTEMPORARY ART ISSUES

SE 401A&B Contemporary Art Issues
Topic for Fall 2015:
Collective Power
The increasing number of college degree programs termed "Social Practice," and recognized art collectives illustrate the normalization of collective work as a mainstream artistic strategy. Yet collaboration in art is frequently political by nature, or, at least, claims this status. The group dynamic allows for a certain kind of anonymity that often translates into a high degree of open confrontation and criticality. But, in war rhetoric, to collaborate can mean " to work with the enemy." To collaborate can also connote neo-liberal, creative entrepreneurialism. This is to say, there are many ways to engage the other. Through this course we will concertrate on collective efforts in contemporary practices in the U.S. and abroad. Students taking this course are expected to present a short paper as well as to prepare assigned texts for group discussions. We will also develop a collective project that will bring notions of antagonism and solidarity into action,
2 art history credits. One-semester course. May be repeated once for art history credit. Herrera-Prats

DRAWING

PREREQUISITE COURSE

FA 240A, FA 240B 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/Lawley/Leary

ADVANCED COURSES

FA 341A, FA 341B
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 342A, FA 342B
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 (Sabbatical Fall 2015)

FA 343A, FA 343B 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. Masnyj

FA 344A, FA 344B 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 345A, FA 345B Advanced Drawing: 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. One-semester course. Gleeson

FA 346A, FA 346B
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. Goldberg

FA 347A, FA 347B 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

Advanced Drawing/Visiting Artists
Course description varies according to the instructor.

For Spring 2016 and later semesters, please see course schedule and registration materials for course descriptions specific to Visiting Artists teaching that semester.

FA 449A, FA 449B
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 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. Perlin

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

FA 375 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 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; Jemison/McWreath

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

FA 209 Video II
Students develop shooting and editing skills with an emphasis on using digital camcorders and digital non-linear editing and compositing systems. A sequence of short assignments introduces students to specific digital techniques and a range of software. Students will also begin developing their personal conceptual orientation and vocabulary. Students will complete a series of short videos, as well as explore both mainstream and experimental approaches to the moving image.
3 credits. May not be repeated. Prerequisite: Video I. Liu

ADVANCED COURSES

FA 376A Animation I
Students will learn an arsenal of physically-based film animation techniques from line animation, direct-on-film and roto-scoping 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, hands-on animation work and critiques.
3 credits. May not be repeated. Reeves

FA 376B Animation II
Students will create and complete individual advanced animations, utilizing and building upon techniques learned in Animation I. Through presentations and critique, screenings of classic and inventive animations, and in-class work, students will broaden their perception and command of animation language and practice. Several animation techniques will be introduced. Projects begun in Animation I may be expanded in Animation II. The class will have a screening at the end of the semester to exhibit their completed projects.
3 credits. Prerequisite: Animation I or permission of the instructor. Reeves

FA 377A, FA 377B
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. Joskowicz/Perlin

FA 380A, FA 380B
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. Joskowicz/Perlin

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 corequisite: Film I or Video I or Motion Graphics. May not be repeated. Burckhardt

FA 382A, FA 382B
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 corequisite: One advanced studio course. May be repeated with a different instructor TBA

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

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

GRAPHIC DESIGN

PREREQUISITE COURSES

FA 211 Graphic Design I
An introduction to the techniques and visual language of graphic design. Weekly projects explore fundamental concepts in form, composition, and typography. Presentations and readings in graphic design history will complement weekly assignments. Students will explore basic image-making processes as well as be instructed in digital production techniques.
3 credits. Fall only. Gasparska/Joel

FA 212 Graphic Design II
The complex relationship between, provides a rich historical and intellectual base for experimental projects combining verbal and pictorial information. Weekly projects reflect a broad range of disciplines within the field of design. Computer instruction will be provided as it relates to specific projects.
3 credits. Spring only. Prerequisite: Graphic Design I. Gasparska/Joel

FA 215 Typography
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. Prerequisite: Graphic Design I. Pre-or corequisite: Graphic Design II. Tochilovsky

ADVANCED COURSES

FA 310 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. Prerequisites: Graphic Design I and II. Pre- or corequisite: Typography. Glauber

FA 311 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. Pre- or corequisite: Typography. Corbitt

FA 312 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: Graphic Design I and II. Pre- or corequisite:Typography. Famira

FA 313 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 315A, FA 315B Advanced Design
Topic and instructor vary.
Fall 2015: Type Design
In this hands-on class students will go from the fundamentals of writing and hand drawn type to contemporary digital type design. By the end of this class every student will have created their own, original digital font.
3 credits. Prerequisite: Graphic Design II. Pre- or corequisite: Typography I. Famira

FA 317A, FA 317B Advanced Design: Open Studio
In this course students will complete two fully realized independent projects. Emphasis will be placed on contemporary graphic design practices and developing a personal aesthetic. Visiting lecturers, readings, and individual meetings with the instructor will complement group critiques.
3 credits. Prerequisites: Graphic Design I and II. Pre- or corequisite: Typography. Essl

FA 320 Visual Identities Design
The class will concentrate on innovative solutions to graphic identity systems. Students will increase their proficiency in developing symbols and typography to build a visual language that amplifies the narrative of a company, organization or product.
3 credits. Prerequisites: Graphic Design I and II. Pre- or corequisite: Typography. TBA

FA 322A, FA 322B
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. Pre- or corequisite: Typography. 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: Techniques in HTML and Programming or permission of the instructor. Essl

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 Protools.
3 credits. One-semester course. Prerequisites: Graphic Design I and II. Pre- or corequisite: Typography. Vondracek

FA 429A, FA 429B
Independent Study
in Graphic Design
1-3 credits. Requires approval of instructor and the dean of the School of Art

TECHNIQUES

TE 306 Techniques in Letterpress
This course explores techniques and projects in typesetting. Students will complete projects that demonstrate their skill and understanding of typographic composition and letterpress printing techniques.
2 credits. One-semester course. Cannot be repeated. Free elective credit. TBA

INTRADISCIPLINARY SEMINAR

SE 403A, SE 403B
IntraDisciplinary Seminar
This course is a hybrid between a lecture series and discussion seminar. It is intended to provide a stimulating and rigorous forum between students' artistic concerns and those of twelve visiting speakers in a public lecture series of the School of Art. Class discussions will center on diverse presentations by artists, theorists, activists, designers, writers, curators, gallerists and other practitioners involved in the arts from positions that embody an interdisciplinary approach or that imply new uses for disciplinary traditions. Accordingly, the course is designed to introduce students to some of the debates currently driving contemporary art and the larger social context it embodies. Members of the class are expected to be active participants and will therefore be asked to respond with some intellectual invention to a variety of topics with weekly discussions, readings, and written or oral presentations.
2 credits. Free elective credit. Raad

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 130A, FA 130B 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 (Sabbatical Fall 2015)/Naess/Treib/True

ADVANCED COURSES

FA 331A, FA 331B
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 334A, FA 334B
Advanced Painting
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 (Sabbatical Fall 2015)

FA 337A, FA 337B
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. TBA

FA 338A, FA 338B
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. TBA

FA 339A, FA 339B 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 (Sabbatical Fall 2015)

Advanced Painting/Visiting Artists
Course description varies according to the instructor. For Fall 2015:

FA 332A Advanced Painting
The course takes as its starting point the dissolution of the category of painting through the works of Lygia Clark and Piet Mondrian. We will work together to reconstruct this particular narrative of development and collapse. To this end, we will generate questions and responses through our coursework that could address the issues surrounding painting after the breakdown of medium-specificity that these artists helped to enact. Research, collaboration, and critical inquiry will be used to elaborate our understanding of these historical models, alongside attempts at clarifying the possible methodological parameters of our own practices. The aim of the course is to sufficiently historicize our own work and to reflect on the material and ideological forces that shape it.
3 credits. One-semester course. Visiting Artist Cheney Thompson

FA 334A Advanced Painting
This class will consider the value of life outside the studio and how those experiences are filtered and assimilated into practice. Time spent in the studio and in review will be balanced with readings, trips and visits. Individual studio and group discussions will focus on the students'methodology, their critical voice and the play of material problem solving. Through continuing dialogue students will examine within the pluralism of today's painting practice their own positions and opinions. The course will encompass painting, sculpture and architecture. Students will question the ways in which space is made and perceived. There will be 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 Alex Kwartler.

FA 335A Advanced Painting
This course is a seminar designed for students working independently on their own projects. Students should possess an eagerness to expand upon existing skills as well as a desire to advance their own artistic vision. Assignments are designed to encourage this individual search and bridge ideas examined in class to further develop a studio practice. The course will mainly consist of scheduled studio visits with individual students, who will be expected to meet weekly in class for group discussions of current museum and gallery exhibitions, presentations, and critique. Students will be required to coherently present their ideas and work vigorously in the studio, demonstrating progress throughout the semester. Process and experimentation will be emphasized and fostered by the instructor, as each student works towards a personalized intention for Painting.
3 credits. Visiting Artist Amy Feldman

FA 336A Advanced Painting
The course will emphasize attention in equal parts to art-making and analytical thinking in students' studio practices. We will work at consistently defining the language and terminology used in class discussions, individual meetings and group critiques so that students will leave the course with a solid understanding of crucial concepts in the field. Discussions will be focused around readings, artist interviews, assigned exhibition visits, student presentations and class trips to galleries, museums and artists' studios. The aim of the course is to prioritize critical engagement, both in and out of the studio.
3 credits. One-semester course. Visiting Artist Mark Gibson

For Spring 2016 and later semesters, please see class schedule and registration materials for course descriptions specific to Visiting Artists teaching that semester.

FA 439A, FA 439B
Independent Study in Painting
1-3 credits. Requires approval of instructor and the dean of the School of Art

PERFORMANCE

FA 290 Elements of Performance
This course examines the elements that unify the diverse set of practices gathered as "performance art." Engaging concepts of time, movement, voice, text and body in performance-based work, the course addresses both the historical development of performance practices within the field of contemporary art, as well as their current manifestations. Lectures, screenings, readings and discussions support the development of individual and collaborative studio work.
3 credits. One-semester course. May not be repeated. Monforte

FA 395 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. Visiting Artist Yves Laris Cohen (Fall 2015)

PHOTOGRAPHY

PREREQUISITE COURSES

FA 106 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. Hatleberg/Mickey/Osinski

**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 360 Advanced Photography: Printing Images
This course will focus on the materiality of the photographic print, both analog and digital. Options in silver-gelatin printing including toning, bleaching and plating, as well as advanced options in digital printing will broaden students' understanding of the photographic image. Issues involving photographic representation will be addressed through discussions, group and individual critiques, hands-on demonstrations and field trips. Students will produce a finished set of printed images by the end of the semester.
3 credits. Prerequisite: Photo I. Osinski

FA 361 Advanced Photography: Topics
Topic varies. For Spring 2016: The Constructed Image. This studio art course will enable students to produce a body of work based upon the physical construction of images. Pre-camera, post-capture, and printing techniques, both analog and digital, will be explored. Individual and group critiques will be supplemented by discussions, readings, presentations and technical instruction.
3 credits. Prerequisite: Photo I. Williams

FA 362A, FA 362B
Advanced Photography: Lighting on Location
This critique-based studio course explores the use of light on location in photography. Topics explored by this course will include the use and modification of available light as well as the use of portable light sources such as flash (both single and multiple), portable battery powered strobes, remote light triggers and other tools.
The emphasis of this course will be on using lighting techniques outside the studio in order to gain an understanding of how light effects the way we interpret our world.
3 credits. Prerequisite: Photo I. Vahrenwald

FA 363A, FA 363B 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. Prerequisite: Photo I. Osinski)

FA 365A, Advanced Photography: Digital Workflow
In this critique-based studio class, students will advance their work by focusing on the digital color workflow. Technical instruction will include: a dvanced digital camera controls, high-end scanning techniques, Lightroom, color management through Photoshop and the use of color profiles as well as inkjet printing. Students will advance their work through individual and group critiques, discussion and workshops.
3 credits. Prerequisite: Photo I. Fall only. Vahrenwald

FA 365B Advanced Photography: Studio Photography
The course will primarily address lighting, including the use of hot lights, flash, and strobes, with specific studio equipment such as sweeps, diffusers, backdrops, tethered shooting, Lightroom, and Capture One. Retouching and color correction in Photoshop will be covered.
3 credits. Prerequisite: Photo I. Spring only. Vahrenwald

FA 366 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. Prerequisite: Photo I. Williams

FA 367 Advanced Photography: Cameras
Contemporary photographers employ a variety of technologies. This studio class will consist of a series of demonstrations and assignments to explore how the history and aesthetics of photography are inextricably linked to the technological developments of the medium. A wide spectrum of 'cameras' will be introduced, specifically the camera obscura, analog and digital camera formats and the panorama. Students will make analog, digital or hybrid prints of their choosing.
3 credits. Prerequisite: Photo I.TBA

FA 368A, FA 368B
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. Prerequisite: Photo I. Osinski

FA 369A 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. Prerequisite: Photo I. Fall only. Raad

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. Prerequisite: Photo I. Spring only. Morton

Advanced Photography/ Visiting Artists
Course description varies according to the instructor.

For Fall 2015:

FA 364A Advanced Photography
This course is for students who have an active, technically proficient practice. It is a critique class in which students must present six excellent photographs every two weeks. Students will be asked to do research pertinent to the work they show, which they will then present to the class. Students will assemble a final group of their ten best pictures bolstered by a solid understanding of their context and meaning.
3 credits. Prerequisite: Photo I. Visiting Artist Dana Hoey

FA 469A, FA 469B
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/Davis

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. Powell

ADVANCED COURSES

FA 350A, FA 350B
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/ Nobles

FA 351A, FA 351B
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 352A, FA 352B
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. TBA

FA 354A, FA 354B
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. Clayton/Gleeson/Nobles

FA 355A, FA 355B
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 356A, FA 356B
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. TBA

FA 459A, FA 459B
Independent Study in Printmaking
1-3 credits. Requires approval of instructor and the dean of the School of Art

TECHNIQUES

TE 353 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

PROJECTS

FA 349 Senior Presentation Project
This project class seeks to mentor students in the development of their senior presentations. The class presents and explores traditional and alternative curatorial and exhibition models, including one-person and group exhibitions, collaborative and curatorial projects, site- and institution-specific installations, interventions and performance. Class discussions and individual meetings with the instructor will allow for a full range of critical interaction. A written component is an intrinsic part of this project whether towards the writing of project proposals, artist statements, power point lectures, or artist talks and performances. Each student is required to make a presentation to the class outlining the parameters of his or her artistic theses. Three recent graduates of the School of Art representing different artistic practices and goals, ranging from those who attend(ed) graduate school, to those in the process of developing individual or collaborative artistic practices, will be invited to give artist talks and to join in class discussions as a further articulation of the senior presentation experience within the extended Cooper community.
3 credits. One-semester. Bordo (Sabbatical Fall 2015)

FA 384A Projects
This course is open to all third and fourth year students who intend to initiate or pursue a longer term (longer than a semester) art project. Students are expected to present their work-in-progress weekly, to research the works of other artists, writers, and thinkers, and to participate actively in class discussions.
Open to all 3rd and 4th year students. May be repeated with instructor's permission. Raad

SCIENCE

RS 201 Science Topics vary.
3 general studies credits. Required science course. To be taken during the sophomore, junior or senior year. Davies/Jorgensen

RS201a Earth Science
The course will cover a broad range of Earth Science topics including understanding rocks and the stories they tell, the vast scale of geological time, dynamic plate tectonic processes, climate change, and what makes the planet habitable for life. It will inspire wonder and a deep appreciation for the Earth. The course will present to students a different way of looking at the Earth: not as something that is constant and static but rather dynamic and constantly changing, a place with a broad and exciting history of which we are only a small part.

RS 201f Introduction to Biomaterials
From the time of cave paintings, artists have been depicting living organisms. But what happens when the art consists of the organism itself or its products? Living material is dynamic by nature, and so the artwork changes with time, perhaps in unpredictable ways. In this class we will explore various biomaterials, including organisms such as bioluminescent plankton and plants that respond to touch, fermentations that create color pigments or cellulose mats, and the DNA that controls it all. The class will be part lecture, part hands-on experience.

RS 201g Astronomy
This course begins with an historical overview and then introduces the contemporary understanding of the universe. Students learn about the key elements of the universe, including motion, energy, gravity and light. Topics include; the solar system and its origins; the sun; stellar evolution including white dwarfs, neutron stars, and black holes; galaxies beginning with the structure of the Milky Way; dark matter, dark energy and the Big Bang theory. Labs and field trips to an observatory augment class discussion.

RS 201h Topics in Physics: Space, Time, Light, and Matter
The course provides an overview of discoveries in physics over the past two millenia, focusing on the development of modern theories. Topics include nature of light and matter, relativity, quantum mechanics, evolution of the universe and the nature of science. Knowledge of basic algebra is assumed. Field trips and computer lab assignments are included in the syllabus.

RS 201i Science, Technology and Societal Impact
This course explores the ramifications of the latest scientific discoveries and technological breakthroughs. How will they affect our lives and the planet? What social, moral, and ethical questions have inspired artists to use them in their work? Each class will focus on a different scientific discipline such as genetic engineering, cognitive neuroscience, tissue engineering, synthetic biology, and personal genomics. An explanation of the science will be followed by a discussion examining the utopic/dystopic myths surrounding these technologies, fact vs. hype, and what questions should be raised as we implement them. Guest artists and their work will be featured along with scientists and ethicists.

RS 201j The Climate System
The Earth's climate system is complex and dynamic, and a solid understanding of this system is crucial in order to address concerns about human influences on climate. In this course we examine the basic physical and chemical processes that control the modern climate system, including the role of incoming solar radiation, the greenhouse effect, ocean and atmospheric circulation, and El Niño. We also look at the methods and archives used to reconstruct climate in the past. We explore the possible effects of greenhouse gas emissions caused by humans on modern and future climate by examining the models used in climate prediction, and discuss the challenges of modeling such a complex system. Although this course is taught from a primarily scientific perspective, it includes discussions of the roles policy and economics play in the current dialogue on global climate change. Finally, we look at some of the local impacts of climate change and preparedness planning for New York City.

SCULPTURE

FA 391A, FA 391B 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 (Sabbatical Fall 2015)/Shea

FA 392A/FA 392B Sculpture
This course is based on the development of an in-depth practice that connects to the multiple properties of sculpture. Thematic subjects will be open, based on individual body of work, at the same time, subject positioning, viewer/author relationship, and clarity of reading will be studied. Classes will be guided by the theoretical and affective connections the students have in their engagement with materials and the practice of sculpture as idea and as concrete daily activity. Ideas and mediums will be discussed and analyzed in relation to context, and historical grounding. Texts of different kinds will be used as complementary to the work being produced and as tools for each student. Group critiques will focus on delving deeply into each student's work with special emphasis on connecting what the student wants the work to be, how it functions, is experienced and read.
3 credits. Lehyt

FA 393A/FA 393B 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. Lins

FA 394A, FA 394B
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. Farmiga

FA 396A, FA 396B
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 (Sabbatical Fall 2015)

FA 397A, FA 397B
Sculpture: Open Studio
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 (Leave of Absence Spring 2016)

FA 398A, FA 398B
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. Issa

Sculpture/Visiting Artists
Course description varies according to the instructor.

For Fall 2015:
FA 398A Sculpture
3 credits. Visiting Artist Lucy Raven

Spring 2016 and later semesters, please see class schedule and registration materials for course descriptions specific to Visiting Artists teaching that semester.

FA 499A, FA 499B
Independent Study in Sculpture
1-3 credits. Requires approval of instructor and the dean of the School of Art

TECHNIQUES

TE 390 Casting Techniques
Casting Techniques is a process intensive course covering the methods of translating a wax positive into bronze or other non-ferrous metals. All associated techniques from beginning a plaster or rubber mold to casting, chasing, finishing and patination of metal sculptures will be covered. Students will explore a variety of approaches to casting, as well as engage in discussions involving the history of bronze casting, and its place in contemporary art.
2 credits. One-semester course. May not be repeated. Free elective credit. Wilhelm

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. May not be repeated. Poff

FACULTY

Administration

Saskia Bos, *Dean*

Stamatina Gregory, *Associate Dean*

Judith Cantor Bernstein
Coordinator of Academic Operations

Emmy Mickelson
Coordinator of Student Exhibitions

Tia Jeung, *Budgets Coordinator*

TBA, *Assistant to the Dean*

Christine McCann
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, *Coordinator,*
Office of Academic Advisement

Full-Time Faculty

Professors

Dennis Adams (Sabbatical Fall 2015)
B.F.A., Drake University;
M.F.A., Tyler 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 (Sabbatical Fall 2015)
McGill University;
New York Studio School

Mike Essl
B.F.A., The Cooper Union;
M.F.A., Cranbrook Academy of Art

Day Gleeson
B.F.A., Rhode Island School of Design

Walid Raad
Rochester Institute of Technology;
M.A., Ph.D., University of Rochester

Proportional-Time Faculty

Associate Professors

Douglas Ashford
(Leave of Absence Spring 2016)
B.F.A., The Cooper Union

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

Warren Corbitt
B.A., Vassar College;
M.F.A., Cranbrook Academy of Art

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

Beverly Joel
B.F.A., The Cooper Union

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

Jeremy Mores McWreath
B.F.A., The Cooper Union;
M.F.A., University of Southern California

Yuri Masnyj
B.F.A., The Cooper Union

Scott Nobles
B.F.A., The Cooper Union;
M.F.A., Hunter College (CUNY)

Zach Poff
B.A., University of Maryland

Jennifer Todd Reeves
B.A., Bard College;
M.F.A., University of California, San Diego

Zach Rockhill
B.F.A., University of Kansas; M.F.A., Rutgers University

Yasuyuki Shibata
B.F.A., Kyoto Seika University, Japan

Erin Sparling
School of the Art Institute of Chicago

Alexander 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

Andrew Wilhelm
B.F.A., Kutztown University;
M.F.A., Virginia Commonwealth University

Jennifer Williams
B.F.A., The Cooper Union;
M.F.A., Goldsmith's College (London)

Instructors

Rondi Davies
B.S., University of Sydney (Australia)
PhD., Macquarie University (Australia)

Luther Davis
B.F.A., Grinnell College; M.F.A., Ohio State University

Trenton Duerksen
B.F.A., The Cooper Union

Hannes Famira
B.A., KABK, Royal Academy of Fine Arts, The Hague (Netherlands)

Adriana Farmiga
B.F.A., The Cooper Union
M.F.A., Bard College

Leon Finley
B.F.A., The Cooper Union;
M.F.A., Yale University

Ryan Garrett
B.F.A., The Cooper Union; M.F.A., University of Southern California;
Whitney Independent Study Program

Agnieszka Gasparska
B.F.A., The Cooper Union

Curran Hatleburg
B.F.A., University of Colorado
M.F.A., Yale University

Carla Herrera-Prats
B.F.A., National Center of the Arts (Mexico)
M.F.A., California Institute of the Arts
Whitney Independent Study Program

Iman Issa
B.F.A., American University in Cairo (Egypt)
M.F.A., Columbia University

Steffani Jemison
B.S., Columbia University; M.F.A., School of the Art Institute of Chicago

Ellen Jorgensen
B.A., New York University; M.A., M. Phil, Columbia University; PhD., New York University

Claudia Joskowicz
B.Arch, Univeristy of Houston
M.F.A., New York University

James Leary
B.F.A., The Cooper Union

Cristobal Lehyt
Universidad Catolica de Chile;
Hunter College; Whitney Independent Study Program

Jen Liu
B.A., Oberlin College
M.F.A, California Institute of the Arts

Darin Mickey
B.F.A., The School of Visual Arts

Ivan Monforte
B.A., University of California, Los Angeles
M.F.A., New York University

Nyeema Morgan
B.F.A., The Cooper Union; M.F.A., California College of the Arts

Sophie Naess
B.F.A., The Cooper Union
M.F.A., Rutgers University

Jenny Perlin
B.A., Brown University; M.F.A., School of the Art Institute of Chicago; Whitney Independent Study Program

Freya Powell
B.A., Bard College; M.F.A., Hunter College of CUNY

Halsey Rodman
B.A., Univeristy of California Santa Barbara; M.F.A., Columbia University

Roy Rub
B.F.A., The Cooper Union

Judith Shea
B.F.A., Parsons School of Design

Patricia Treib
B.F.A., The School of the Art Institute of Chicago; M.F.A., Columbia University
Skowhegan School of Painting and Sculpture

John Vondracek
B.F.A., The Cooper Union

Visiting Artists (Fall 2015)

Yves Laris Cohen
B.S., Universiy of California, Berkeley
M.F.A., Columbia University

Amy Feldman
B.F.A., Rhode Island School of Design
M.F.A., Rutgers University

Mark Gibson
B.F.A., The Cooper Union;
M.F.A., Yale University

Dana Hoey
B.A., Wesleyan University
M.F.A., Yale University

Alex Kwartler
B.F.A., The Cooper Union

Lucy Raven
B.F.A., University of Arizona
M.F.A., Bard College

Cheney Thompson
B.F.A., School of the Museum of Fine Arts (Boston)

Staff

Zeljka Gita Blaksic
Technical Assistant, Film/Video

Amy Buckley
Technical Assistant, Photography

Ian Burnley
Painting Office Coordinator, Painting/Drawing

Lea Cetera
Technical Assistant, Art and Architecture Shop

Lorenzo Clayton
Technical Assistant, Printmaking

David Derish
Technical Assistant, Painting/Drawing

Pablo Diaz
Technical Assistant, Type Shop

Cara DiEdwardo
Technical Assistant, Printmaking and Head Technician, Type Shop

Andrew Fillmore
Technical Assistant, Photography

Saredt Franco
Technical Assistant, Printmaking

Amanda Friedman
Technical Assistant, Painting/Drawing

Pedro Gonzalez
Technical Assistant, Film/Video

Vanesa Gully
Technical Assistant, Painting/Drawing

Anna Hostvedt
Senior Coordinator, Painting/Drawing

Haisi Hu
Technical Assistant, Film/Video

James Kendi
Technical Assistant, Photography

Frank Kurtzke
Co-Head Technician, Art & Architecture Shop

Heidi Lau
Technical Assistant, Printmaking

Kevin Leonard
Co-Head Technician, Art & Architecture Shop

Ross McLaren
Technical Assistant, Film/Video

Eric Monasterio
Technical Assistant, Art & Architecture Shop

Alex Musto
Technical Assistant, Film/Video

Scott Nobles
Digital Specialist Print Technician, Printmaking

Zach Poff
Technical Assistant, Film/Video

Daniel Porvin
Lab Supervisor, Film/Video

Joseph Riley
Technical Assistant, Type Shop

Garret Rosenblum
Technical Assistant, Film /Video

Dax Sommerfield
Technical Assistant, Art & Architecture Shop

Michael Stickrod
Technical Assistant, Art & Architecture Shop

Maggie Sullivan
Night Monitor, Painting/Drawing

Colin Todd
Technical Assistant, Photography

Ryan Toth
Night Monitor, Painting/Drawing

Andrew Wilhelm
Technical Assistant, Art & Architecture Shop

Jennifer Williams
Co-Head Technician, Photography

Bryan Zimmerman
Co-Head Technician, Photography

The Herb Lubalin Study Center of Design and Typography

Alexander Tochilovsky
Curator

Laura Mircik-Sellers
Archive Coordinator

The Saturday/Outreach Program

Marina Gutierrez
Co-Director

Stephanie Hightower
Co-Director

Karma Mayet Johnson
Saturday Program Writing Liaison

Charles Fambro
Saturday Program Curriculum Coordinator

Pablo Diaz
Outreach Program Manager

Aisha Tandiwe Bell
Saturday Program General Coordinator

Mary Valverde
Saturday Program Office Manager

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. *cooper.edu/engineering*

OVERVIEW

With an average enrollment of about 450 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 ABET*.

In addition, the school offers a general 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, computer science, invention, entrepreneurship, biomedical, energy, sustainability, infrastructure, environmental, mechatronics, 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.

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. Others have gone on to study in fields such as medicine, law or business. Many 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 this 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 to mathematically model and 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 collaborate on these projects. 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 study abroad and international programs). Others may involve collaboration with industry or hospitals.

Diverse 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 on research and mentoring and to give unique insights into contemporary problems and social issues confronting modern engineers. Many of these professionals serve as adjunct faculty members who lend a dynamism to the classroom.

Students benefit from an uncommonly close interaction with devoted faculty, many of whom are loyal alumni, in a conservatory-style environment. Our faculty bring their diverse experiences to the classroom and laboratory setting and serve as role models to our students. 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 professional societies, many of which have chapters at The Cooper Union. Students are inspired to qualify for membership in national engineering honor

*ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012

societies; many join before graduation. 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 advances and social change, students are exposed to and challenged in the fields of social science, humanities and other general studies.

The School of Engineering strongly encourages undergraduate research activities and permits juniors and seniors to register for graduate level courses, when deemed appropriate. This enrollment does not guarantee admission to the master's program however. A Cooper Union undergraduate may declare the intent to complete an integrated degree in the second semester of the junior year or apply to the graduate program (Master of Engineering) in one of the degree-granting departments during the second semester of the senior year

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. Workstations are concentrated in computer classrooms, offices, laboratories, the residence hall and special centers.

The Department of Information Technology provides a wired and wireless network resulting in 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 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 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 multidisciplinary 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 supports 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, the National Science Foundation, the National Institutes of Health, Albert Einstein, STRYKER. 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 pursues groundbreaking biomedical research in such fields as orthopedic biomechanics, medical imaging, minimally invasive surgery, tissue engineering, medical device design, ergonomics and injury rehabilitation. The center has established collaborative relationships with several hospitals and medical research institutions in the New York City area.

The Center for Innovation and Applied Technology is an interdisciplinary research and educational resource that provides answers to our technological and productivity challenges. Bold and innovative concepts are linked with successful planning and practical implementation strategies.

Innovation is the result of creative conceptualizations that are developed and brought to market. Inventors, innovators and entrepreneurs are needed to make lasting societal contributions. The center enables collaborations between the Cooper Union community and distinguished mentors from industry and other educational institutions, who contribute their time, insights and resources.

Applied skill sets are required to develop, fund and ultimately bring to market a successful product. The center provides a supportive, flexible research and learning laboratory based upon real-world problem solving.

Technology depends upon the skills of numerous disciplines and lateral thinkers. CIAT will make a difference by solving some of today's challenges and providing a forum where the disciplines can be merged.

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 engages in research in composite materials, fire-resistant and blast-resistant materials, robotics, mechatronics, nano-technologies and nano-biosensors. The center is also active in innovative product design and automation.

The Center for Signal Processing, Communications and Computer Engineering (S*PROCOM²) engages in 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), SEA²M³ seeks to develop an awareness of solutions to engineering problems that preserve the integrity of the commons; it is a space where true cross-disciplinary conversation and reciprocal learning generate real solutions that can be imagined, created and implemented. Using their ability to communicate and infused with an understanding of the world, its people and cultures, students create and disseminate designs suited to, and in harmony with their place of use. SEA²M³ provides a forum within which students from the schools of engineering, art and architecture come together to develop new design criteria that yield materials, manufacturing techniques, habitats and lifestyles that are sustainable, and that, ultimately, reduce the chasm between the rich and the poor.

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 junior year). It is the responsibility of the student to maintain normal and reasonable progress toward the degree.

Courses may be taken at other institutions for credit with prior appropriate adviser(s) approval only. The student is responsible for all costs incurred. As a general matter, many courses simply may not be taken elsewhere (e.g., Physics I). In order to get a course pre-approved, bring as much course documentation as possible to the Chair of the appropriate department to have the course assessed. These materials must include at least the syllabus and textbook. The course must be judged to be equivalent to one taught at Cooper. Note that only grades "B" or better can be transferred (not B-) and the grade will not be factored into your G.P.A.

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.

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 can only be made with approval of the adviser(s).

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 which are shown in "Departments and Programs" starting on page 81. From time to time, changes are made to these programs following curricular developments authorized by the faculty. Advances in technology and new technologies are closely monitored and are reflected by adjustments in all the engineering programs.

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 Chemical Engineering Department does not permit the substitution of any courses.

The number of academic credits for each course generally is based on the following relationship:

- 1 credit per contact hour in class
- ½ 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.

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.

MASTER OF ENGINEERING CURRICULUM AND REQUIREMENTS

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. The school offers master's degrees in chemical engineering, civil engineering, electrical engineering and mechanical engineering.

Admission Procedure Please refer to the "Application and Admission Information" section, page 9.

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. Students are accepted into the graduate program in their major either with a "thesis" or "undeclared" classification. Undeclared students have to declare whether they plan to pursue the thesis or non-thesis option by the time they complete 9 credits. Students may complete the degree requirements as part-time or full-time students in consultation with their adviser.

Cooper Union Undergraduates A Cooper undergraduate degree does not guarantee admission to the graduate program. To be considered for admission to the master's program, one must be a currently enrolled Cooper Union undergraduate, with a minimum 3.0 grade point average according to the major. A Cooper Union undergraduate may declare the intent to complete an integrated degree in the second semester of the junior year or apply to the graduate program (Master of Engineering) in one of the degree-granting departments during the second semester of the senior year.

Students should consult the respective departments regarding specific policies or requirements for admission into the graduate program.

Graduates of Other Colleges The School of Engineering may admit outstanding students or qualified practicing professionals, on a tuition basis, into the master's degree programs. 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 register for advanced engineering courses to make up for any deficiencies.

DEGREE REQUIREMENTS

Credit Requirements A minimum of 30 graduate level credits beyond the baccalaureate degree must be completed at The Cooper Union (in addition to possible undergraduate deficiencies) for both the thesis requiring M.E. Program and the non-thesis M.E. Program. All graduate level credits, including possibly cross-listed upper level undergraduate credits, must be approved by a student's academic adviser(s).

The 30 credits offered for the thesis program degree must satisfy the following distribution:

- **Major** minimum 12 credits: A coherent concentration of graduate-level courses in the chosen field.
- **Complete a minimum of 12 further credits** of graduate level courses.
- **Thesis Project** 6 credits

The 30 credits offered for the non-thesis program degree must satisfy the following distribution along with a special project requirement:

- **Major** minimum 18 credits: A coherent concentration of graduate-level courses in the chosen field.
- **Complete a minimum of 12 further credits** of graduate level courses.
- **Special Projects requirement can be fulfilled in one of two ways:**

– Complete a graduate level independent study course (up to 3 credits)

– Submission to the Dean's office a report that has already satisfied requirements for a graduate level course in which a grade of "B" or higher was received. This report will have to meet structure and formatting requirements specified by the Dean's office.

Each of the engineering departments may have more specific guidelines for the distribution for the M.E. degree.

Grade Requirement A minimum overall grade point average of 3.0 is needed in all courses used to satisfy the 30 credit 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 cross-listing requirements and advisory approval.

Time Limitation For students that began their program prior to the Fall 2014 semester, 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 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 $3,000 per semester.

Program of Study A complete program of study 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.

Thesis/Project

- Each student is required to submit a thesis or project in their 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 presented 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.

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**).*

Course Overload An overload in the first year consists of a credit total greater than the standard load for that semester in a student's respective program. 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 21.5 credits also 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. Requests for overloads must be submitted to the dean/associate dean during the add period of that semester, and only after all grades from the previous semester(s) have been entered.

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.

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. It may be affected by the student's grades and availability of program resources. Students who request a change in major must consult with the policies of the department they wish to transfer into. It becomes effective when the required petition form, approved by 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*** or better is required. An exception may be granted in special circumstances only upon formal appeal to the Academic Standards Committee.

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 Center for Professional Development to strengthen the non-technical attributes required of its engineering undergraduates. The program, which is mandatory for engineering freshmen and sophomores, provides a range of experiences and training through a zero-credit program of seminars, workshops events and activities under the course number ESC000.1-000.4 with a PASS/FAIL grade. Each workshop, seminar or activity is assigned a points score and successful completion of the course is based on accumulating a minimum number of points.

Because this is a zero-credit course, failure to accumulate enough points will not affect a student's GPA, his or her ability to graduate or inclusion on the Dean's List. However, successful completion will result in a note on the transcript stating: "ESC000.X Engineering Professional Development Seminars and Workshops—Successfully Completed."

The course is designed to introduce students to the profession of engineering, as well as aspects of their professional development. A wide range of topics are covered in ESC000 including ethics, environmental awareness, lifelong learning, career development, interpersonal skills, workplace issues, professional societies, professional licensure, teamwork skills, etc. These topics are dealt with using methods such as case studies, role-playing and interactive activities—"learning by doing" all provided by a diverse team of people ranging from students to alumni to professional experts. For example, extensive career development opportunities are provided by the Center for career Development, the Engineering Student Council moderates several seminars and Q and A sessions with alumni and upperclassmen and The Cooper Union's CONNECT Program provides intensive training in communication skills and awareness of the importance of effective communication in engineering.

These experiences help to make students aware of the importance of the non-technical skills needed for professional success. The course introduces engineering students to a number of the topics required for student outcomes (a–k) by ABET. Through this program students are given significant help in navigating their career at The Cooper Union as well as easing the transition into the workplace and ensuring professional success.

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.

* Students may petition the dean/associate for reconsideration in the Dean's List after the Incomplete (I) has been made up.

ACADEMIC STANDARDS AND REGULATIONS

Academic Integrity

Faculty at Cooper Union are committed to preserving an environment that challenges every student to realize his or her potential. You are expected to provide your best effort and will be supported to produce original work of the highest caliber. 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 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 reference book, periodical, 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/ smartphone/ 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.

*A grade of B- cannot be transferred

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 in a memorandum. If documentary evidence of the incident exists, it should be attached. 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 incidents will be kept in the dean's office and considered for second-time offenders. 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 an 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 Academic Standards Committee 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 one week 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.

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, except in cases when content does not 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 AND 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 Academic Standards Committee.

- The records of all students will be reviewed by the associate dean of engineering for recommendations to the Academic Standards Committee for appropriate action at any point in the student's career.
- Students may be required to withdraw or resign from The Cooper Union based on a single semester's academic performance, a cumulative GPA lower than 2.0, and/or infractions of the academic integrity policies.
- The Academic Standards Committee reserves the right to determine probation and/or dismissal at any point in the student's career for appropriate academic issues.
- A student whose semester grade point average is below 2.0 is on automatic probation and is 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."
- For information about leaves of absence, please refer to pages 24–25.
- Students who believe that a modification of their status should be made because of extenuating circumstances may petition, in writing, the Academic Standards Committee.

CHANGE OF PROGRAM

Adding a Course A student is permitted to add a course only during the first week of a semester, during the drop/add period, and only with the adviser's approval.

Adding a course after the drop/add period is not permitted even if the student has been attending the class.

Dropping a Course A student may drop a course during the first week of the semester, during the drop/add period, with the adviser's approval.

A course dropped during the first week of the semester will be deleted from the transcript.

Withdrawing from a Course A student anticipating inability to continue an assigned program should immediately see his or her adviser. A student's program may be adjusted at the discretion of and after conferring with the adviser and the dean or associate dean of engineering, but only in cases where scholastic performance is impaired by conditions beyond the control of the student, such as health or home conditions. After the drop/add period a student may withdraw from a course through the eighth week of the semester. A grade of **W** will appear on the transcript. A student who stops attending a course without permission of the instructor and the dean or associate dean will receive a grade of **WU**; however, the instructor is free to record a grade of **F** in such a case.

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, and the dean or associate dean. It is the policy of the faculty and the Office of the Dean not to approve any withdrawal after the eighth week of classes except under extreme, extenuating circumstances.

A student is not permitted to drop or withdraw from a course if doing so would impede satisfactory progress towards the degree.

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.

COURSE DESIGNATION

Course Prefix

Biology	Bio
Chemical Engineering	ChE
Chemistry	Ch
Civil Engineering	CE
Computer Science	CS
Electrical Engineering	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 and seniors.
• 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.

DEPARTMENTS AND PROGRAMS

CHEMICAL ENGINEERING

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 lifelong learning and research.

Program Objectives

- Our graduates will attain professional careers where they apply their abilities to solve problems and meet challenges in engineering an non-engineering fields.
- Our graduates will join professional societies and/or attain professional licensure.
- Our graduates will grasp the concept of lifelong 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, modeling, scale-up and control problems. A thorough knowledge is required of chemical structures, together with the energetic and kinetic relationships predicted in chemical reactions and molecular transport. 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 science. 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.

The chemical engineering department does not make use of the 12-credit rule; see "Course Substitutions and Credits" under "Bachelor of Engineering Curriculum."

Minors

A minor can be obtained by a student in chemical engineering taking any four (4) courses in one of the fields below. The courses require permission of the student's adviser and the department chair. The courses listed are examples currently in The Cooper Union catalog. Note that some may require prerequisites or permission of the instructor. Additionally, note that it is not necessary to obtain a minor in any field in order to graduate with a bachelor of engineering in chemical engineering.

Upon completion of the minor a student should submit a list of courses that he or she wishes to be considered for certification to the department chair. Successful completion of the minor will be acknowledged by a certificate from the department accompanied by a letter listing the minor achieved and the courses taken.

Environmental Engineering

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
Che 447/Sustainability and Pollution Prevention

Biomedical Engineering

ECE 343/Bio-instrumentation and Sensing
EID 121/Biotransport Phenomena
EID 122/Biomaterials
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
EID327/Tissue Engineering
Ch 340/Biochemistry (also Bio 102)
Bio 101/Molecular and Cellular Biology
EID 424/Bioengineering Applications in Sports Medicine
Ch 440/Biochemistry II

Energy Engineering

ME 130/Advanced Thermodynamics
ME 131/Energetics (also EID 131)
ME 330/Advanced Engine Concepts
ChE 421/Advanced Chemical Reaction Engineering
ChE 430/Thermodynamics of Special Systems
ChE 434/Special Topics in Combustion (also ME 434)

Graduate Program

In the Thesis M.E. degree graduate students in chemical engineering must complete a minimum of 30 credits beyond their baccalaureate degree. Of those 30 credits 9 credits must come from the following courses:

ChE 421 Advanced Chemical Reaction Engineering

ChE 430 Thermodynamics of Special Systems or ChE 431 Advanced Chemical Engineering Thermodynamics and Molecular Theory

ChE 441 Advanced Heat and Mass Transfer

Of the remaining 21 credits, 3 credits must be from Chemical Engineering graduate courses, 12 credits may be from graduate engineering or science electives, and 6 credits from a thesis project on an approved topic.

A thesis 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 microcirculation, mathematical modeling of whole-body heat integrated gasification processes 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, particle technology, multiphase flow and fluidization, pharmaceutical engineering and processes, nanomaterials and energy systems and processes.

Chemical 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
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
Fall Semester:	
ESC000.3 Professional Development Seminar	0
ChE 170 Material and Energy Balances	3
Ma 223 Vector Calculus	2
Ph 213 Physics II: Electromagnetic Phenomena	4
ESC 110.1 Materials Science for Chemical Engineers	3
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	19.5
Spring Semester:	
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
ChE 130 Chemical Engineering Thermodynamics I	3
HSS 4 The Modern Context: Figures and Topics	3
Total Credits Spring Semester	16

Junior Year	Credits
Fall Semester:	
Ma 224 Probability	2
ESC 121 Basic Principles of Electrical Engineering	2
Ch 251 Instrumental Analysis Laboratory	2
Ch 261 Physical Chemistry I	3
ChE 131 Chemical Engineering Thermodynamics II	3
ChE 140 Fluid Mechanics and Flow Systems	3
Engineering Elective	3
Total Credits Fall Semester	18
Spring Semester:	
Ch 262 Physical Chemistry II	2
ChE 121 Chemical Reaction Engineering	3
ChE 141 Heat and Mass Transfer	4
ChE 151 Process Simulation and Mathematical Techniques for Chemical Engineers	3
Engineering or Science Elective	3
Free Elective	3
Total Credits Spring Semester	18

Senior Year	Credits
Fall Semester:	
ChE 162.1 Chemical Engineering Laboratory I	1.5
ChE 161.1 Process Evaluation and Chemical Systems Design I	3
ChE 142 Separation Process Principles	3
ChE 152 Chemical Process Dynamics and Control	3
Engineering or Science Elective	3
Humanities/Social Sciences Elective	3
Total Credits Fall Semester	16.5
Spring Semester:	
ChE 162.2 Chemical Engineering Laboratory II	1.5
ChE 161.2 Process Evaluation and Chemical Systems Design II	3
Engineering or Science Elective	3
Free Elective	3
Humanities/Social Sciences Elective	3
Total Credits Spring Semester	13.5

Total credits required for degree	**135**

CIVIL ENGINEERING

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 society in leadership positions.

Program Objectives

• Our civil engineering graduates will engage in lifelong 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.
• Our graduates will have a strong commitment to professional and ethical responsibility during their careers.
• Our graduates who pursue careers in engineering will seek and successfully achieve professional licensure in their chosen fields.

Student Outcomes

The Civil Engineering Department has established the following set of outcomes that our undergraduate students are expected to achieve by the time of graduation:
1. An ability to apply knowledge of mathematics, science and engineering
2. An ability to design and conduct experiments, as well as to analyze and interpret data
3. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability
4. An ability to function on multidisciplinary teams
5. An ability to identify, formulate, and solve engineering problems
6. An understanding of professional and ethical responsibility
7. An ability to communicate effectively
8. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
9. A recognition of the need for, and an ability to engage in life-long learning
10. A knowledge of contemporary issues
11. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice
12. A broad fundamental knowledge to qualify for and pass the New York State FE Exam administered in April of the year of their graduation.

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. 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.

Civil 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
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**
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 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**
Fall Semester:	
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
Spring Semester:	
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**
Fall Semester:	
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
Spring Semester:	
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

FACULTY

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

- Our graduates will have positions where they function as first-class project engineers.
- Our graduates will have positions that require exceptional technical knowledge and professional design skills.
- Our graduates will engage in activities that involve professional-level written and oral expression.
- Our graduates will engage in activities that require demonstrating leadership skills.
- Our graduates will engage in activities that demonstrate a commitment to lifelong learning, research, independent thinking and innovation.

Program description

Basic courses in electronic circuits, signal processing and 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 courses in three areas:

- Electronic Systems and Materials
- Signal Processing and Communications
- Computer Engineering

There is overlap among the courses in the three tracks, and all students are exposed to a broad range of areas within electrical engineering, while being given the opportunity to study areas of interest in significant depth. The track designations are advisory in nature, and students may change their identified track as long as, by the time they graduate, they have fulfilled all the requirements in a selected track.

By the junior year, students are taking required advanced undergraduate courses (with a 300-level designation) that include material at the graduate level. The only required courses in the senior year are the capstone senior design project courses (ECE195/196). Undergraduate students with a strong background are encouraged, as part of the Integrated Master Program, to take graduate level electives once they have the proper prerequisites.

The curriculum interweaves strong theory, grounded in mathematics and science, with extensive use of CAD tools and practical projects. A broad education is supported by taking non-technical electives, including in humanities and social sciences. 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.

Students plan their courses with the assistance of a faculty adviser. Through extensive experience working on team projects and proper selection of courses, students obtain a well-rounded, diverse and challenging educational experience.

Graduate Program

The candidate must choose a full-time Cooper Union faculty member from the electrical engineering department as one of his or her thesis advisers. In addition, that adviser, in consultation with the other faculty in the department, approves the set of courses used to fulfill the requirements for the Master's program. Possible areas of concentration or thesis topics are numerous and reflect the diverse interests of the faculty. Some examples are: digital signal processing (including speech, audio, image, video and biomedical signals); wireless communications and networks; big data, machine learning, NLP, reconfigurable and distributed computing; electronic materials and integrated circuit engineering; sustainable engineering.

Web Site

The Electrical Engineering department maintains a website at ee.cooper.edu.

Electronic Systems and Materials Track in Electrical Engineering

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
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
Fall Semester:	
ESC000.3 Professional Development Seminar	0
ECE 140 Circuit Analysis	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
Spring Semester:	
ESC000.4 Professional Development Seminar	0
ECE 110 MATLAB Seminar: Signals and Systems	0
ECE 111 Signal Processing & Systems Analysis	3
ECE 141 Electronics I	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
Fall Semester:	
ECE 142 Electronics II	3
ECE 193 Electrical & Computer Engineering Projects I	1.5
ECE 300 Communication Theory[1]	3
ECE 310 Digital Signal Processing[2]	3
ECE 320 Control Systems[3]	3
Ma 326 Linear Algebra	3
Humanities/Social Sciences Elective	3
Total Credits Fall Semester	19.5
Spring Semester:	
ECE 194 Electrical & Computer Engineering Projects II	4
ECE 303 Communication Networks[4]	3
ECE 335 Engineering Electromagnetics[5]	4
ECE 341 Integrated Circuit Design	3
Humanities/Social Sciences Elective	3
Total Credits Spring Semester	17

Senior Year	Credits
Fall Semester:	
ECE 195 Electrical & Computer Engineering Projects III	4
Non-technical Elective	3
Engineering or Science Electives	7
Total Credits Fall Semester	13
Spring Semester:	
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
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
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
Fall Semester:	
ESC000.3 Professional Development Seminar	0
ECE 140 Circuit Analysis	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
Spring Semester:	
ESC000.4 Professional Development Seminar	0
ECE 110 MATLAB Seminar: Signals and Systems	0
ECE 111 Signal Processing & Systems Analysis	3
ECE 141 Electronics I	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
Fall Semester:	
ECE 142 Electronics II	3
ECE 193 Electrical & Computer Engineering Projects I	1.5
ECE 300 Communication Theory[1]	3
ECE 310 Digital Signal Processing[2]	3
ECE 320 Control Systems[3]	3
Ma 326 Linear Algebra	3
Humanities/Social Sciences Elective	3
Total Credits Fall Semester	19.5
Spring Semester:	
ECE 194 Electrical & Computer Engineering Projects II	4
ECE 302 Probability Models & Stochastic Processes	3
ECE 303 Communication Networks[4]	3
ECE 335 Engineering Electromagnetics[5]	4
Humanities/Social Sciences Elective	3
Total Credits Spring Semester	17

Senior Year	Credits
Fall Semester:	
ECE 195 Electrical & Computer Engineering Projects III	4
Non-technical Elective	3
Engineering or Science Electives	7
Total Credits Fall Semester	14
Spring Semester:	
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**

[1] Formerly ECE 101
[2] Formerly ECE 114
[3] Formerly ECE 121
[4] Formerly ECE 103
[5] Formerly ECE 135

Computer Engineering Track in Electrical Engineering

First 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 Experessions	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
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
Fall Semester:	
ESC000.3 Professional Development Seminar	0
ECE 140 Circuit Analysis	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
Spring Semester:	
ESC000.4 Professional Development Seminar	0
ECE 110 MATLAB Seminar: Signals and Systems	0
ECE 111 Signal Processing & Systems Analysis	3
ECE 141 Electronics I	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
Fall Semester:	
ECE 142 Electronics II	3
ECE 165 Data Structures and Algorithms II	2
ECE 193 Electrical & Computer Engineering Projects I	1.5
ECE 300 Communication Theory[1]	3
ECE 310 Digital Signal Processing[2]	3
Ma 352 Discrete Mathematics	3
Humanities/Social Sciences Elective	3
Total Credits Fall Semester	18.5
Spring Semester:	
ECE 194 Electrical & Computer Engineering Projects II	4
ECE 302 Probability Models & Stochastic Processes	3
ECE 303 Communication Networks[3]	3
ECE 361 Software Engineering & Large System Design	3
Humanities/Social Sciences Elective	3
Total Credits Spring Semester	16

Senior Year	Credits
Fall Semester:	
ECE 195 Electrical & Computer Engineering Projects III	4
Non-technical Elective	3
Engineering or Science Electives	6
Total Credits Fall Semester	13
Spring Semester:	
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**

[1] Formerly ECE 101
[2] Formerly ECE 114
[3] Formerly ECE 103

MECHANICAL ENGINEERING

FACULTY

Baglione, Delagrammatikas, Lima, Luchtenburg, 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 and
- 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, vibrations and 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, robotics and biomedical engineering systems.) 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, vibrations and 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
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
Fall Semester:	
ESC000.3 Professional Development Seminar	0
Ma 223 Vector Calculus	2
Ma 240 Ordinary and Partial Differential Equation	3
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	19.5
Spring Semester:	
ESC000.4 Professional Development Seminar	0
ESC 121 Basic Principles of Electrical Engineering	2
Ma 224 Probability	2
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	18

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[1]	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[1]	3
Humanities/Social Sciences Elective	3
Total Credits Spring Semester	18

Senior Year	Credits
Fall Semester:	
ME 163 Mechanical Engineering Projects	3
ME 312 Manufacturing Engineering	3
Electives:	
ME 300- or 400-level Lecture Course	3
Free Electives[2]	4
Total Credits Fall Semester	13
Spring Semester:	
ME 164 Capstone Senior Mechanical Engineering Design	3
Electives:	
ME 300- or 400-level Lecture Course	3
Free Electives[2]	6
Total Credits Spring Semester	12

Total credits required for degree	**135**

[1] Courses with prefix BIO, Ch, ChE, CE, CS, ECE, EID, ESC, Ma, ME, Ph

[2] Any course, except foreign languages, offered at The Cooper Union

BACHELOR OF SCIENCE IN ENGINEERING CURRICULUM

General Engineering

The School of Engineering offers a bachelors of science degree in General Engineering. 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 adviser'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 Science and Computer Science (over and above the core courses)	minimum 44
Free Electives	30
Total credits	**135**

The program is administered by an interdepartmental committee. Each student is assigned an adviser from the committee: other faculty may also act as co-advisers. Choice of electives is closely monitored for academic rigor and coherence by the interdepartmental 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 professional licensure.

Core Curriculum of the Bachelor of Science Program

Freshman Year	**Credits**
Fall Semester:	
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
Spring Semester:	
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**
Fall Semester:	
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
Spring Semester:	
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

NON-DEGREE DEPARTMENTS

Chemistry

Faculty: Lay, Newmark (Chair), Savizky, Topper

The Department of Chemistry offers a wide range of courses that are necessary for the understanding of the various engineering disciplines. All first-year engineering students enroll in General Chemistry (a general quantitative and descriptive overview of chemistry), Physical Principles of Chemistry (a quantitative discussion of chemical thermodynamics, electrochemistry and kinetics) and General Chemistry Laboratory (chemical preparation and analysis, 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 areas of analytical chemistry, biochemistry, organic chemistry and physical chemistry.

In addition, advanced elective courses in biochemistry, inorganic chemistry, theoretical chemistry and nanoscience are available, and are suitable for students interested in bioengineering, chemistry, materials engineering, nanotechnology, or pre-medical studies. Research at the undergraduate and master's levels can be conducted under the supervision of the chemistry faculty. Interested students should meet with the department faculty to discuss possible research areas.

The Department operates laboratories in general chemistry, organic chemistry, instrumental analysis, bioorganic chemistry, computational chemistry and nanochemistry for instruction and research projects.

Mathematics

Faculty: Agrawal (Chair), Bailyn, Hopkins, Mintchev, Smyth, Vulakh

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.

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 Mathematical Analysis 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), Yecko

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.

COURSES

Students should consult official schedules for courses offered in a given semester. There is no assurance that a course 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
Course designations use an alphabetical prefix and a three-digit numbering system.

The first digit usually denotes:

(1, 2)	Lower level undergraduate
(3)	Advanced undergraduate
(4)	Graduate courses

Bio	Biology
ChE	Chemical Engineering
Ch	Chemistry
CE	Civil Engineering
CS	Computer Science
ECE	Electrical Engineering
ESC	Engineering Sciences
EID	Interdisciplinary Engineering
Ma	Mathematics
ME	Mechanical Engineering
Ph	Physics

Chemical Engineering

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: ChE 170 and ChE 140

ChE 130 Chemical Engineering Thermodynamics I
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 thermo-dynamics; introduction to concepts of entropy. Gibbs free energy and Helmholtz free energy; derivation and application of equations describing the auxiliiary thermodynamic functions and conditions of equilibrium in imperfect gasses.
3 credits. Prerequisites: Ch 160 or ChE 170

ChE 131 Chemical Engineering Thermodynamics II
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: ChE 130

ChE 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. Prerequisites: none

ChE 141 Heat and Mass Transfer
Introduction to heat and mass transfer. Steady-state and unsteady-state heat transfer. Steady-state and unsteady-state mass transfer. Interphase transport and transfer coefficients. Convective heat and mass transfer. Internal and external forced convection. Heat transfer equipment. Natural convection. Boiling and condensation. Radiation heat transfer.
4 credits. Prerequisite: ESC 140.

ChE 142 Separation Process Principles
Application of thermodynamic and transport concepts to the design of continuous-contact and staged mass transfer processes common in the chemical process industries. Separation by phase addition, phase creation, by barrier, by solid agent and by external field or gradient. Examination of the limitations of theory and empiricism in design practice.
3 credits. Prerequisites: ChE 131 and ChE 141

ChE 151 Process Simulation and Mathematical Techniques for Chemical Engineers
In this course, numerical methods will be applied to chemical engineering problems in mass and energy balances, thermodynamics, fluid flow, heat transfer, separations, and chemical reactor analysis. Topics include: computer calculations and round-off error, algorithms and convergence, finding roots by bisection or Newton's method, curve fitting and interpolation/extrapolation, numerical integration and differentiation, numerical solution of initial value problems, stiffness, matrices and determinants, matrix properties, special matrices, methods of solution for systems of linear equations by matrices, eigenvalues, eigenvectors, solving systems of non-linear equations, and applications to unit operations. We will use series methods and numerical methods applied to various chemical engineering models, including the following specific methods: Euler's method, Runge-Kutta methods, the Finite difference method, and Newton-Raphson for vector systems.
3 credits. Prerequisite: ChE 140

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; corequisite: ChE 142

ChE 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

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 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 430 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 433 Rocket Science (same as ME 433)
3 credits. Prerequisites: ChE 130 and ChE 140

ChE 434 Special Topics in Combustion (same as ME 434)
3 credits. Prerequisite: ESC 130/ChE 130

ChE 440 Advanced Fluid Mechanics (same as EID 440 and ME 440)
Introduction to the energy equation. Steady and transient heat transfer by conduction. Convective heat transfer. Energy transport in flowing media. Free convection. Conservation of species equation. Fisk's law of binary diffusion. Mass transfer with simultaneous homogeneous or heterogeneous reaction. Multicomponent heat and mass transfer. Stefan-Maxwell equations for multicomponent diffusion. Simultaneous heat and mass transfer. Transport in electrolyte solutions. Special topics may include: membrane separation processes, drug delivery and controlled release, turbulent heat and mass transfer, boundary layer heat and mass transfer, and chemically reacting flows.
3 credits. Prerequisite: ESC 140

ChE 441 Advanced Heat and Mass Transfer (same as EID 441)
Introduction to the energy equation. Steady and transient heat transfer by conduction. Convective heat transfer. Energy transport in flowing media. Free convection. Conservation of species equation. Fick's law of binary diffusion. Mass transfer with simultaneous homogeneous or heterogeneous reaction. Multicomponent heat and mass transfer. Stefan-Maxwell equations for multicomponent diffusion. Simultaneous heat and mass transfer. Transport in electrolyte solutions. Special topics may include: membrane separation processes, drug delivery and controlled release, turbulent heat and mass transfer, boundary layer heat and mass transfer, and chemically reacting flows.
3 credits. Prerequisite: ChE 440 or ME 440 or EID 440

ChE 445 Particle Technology
Introduction to particle technology and multiphase flow. Particle properties and characterization. Granular materials and flow. Gas-solid flows. Flow through packed beds. Fluidization. Gas-solid separations. Slurry transport. Pneumatic transport. Powders and bulk solids. Mixing and segregation. Particle size reduction and enlargement. Aerosol dynamics. Industrial petrochemical and pharmaceutical processes: fluid catalytic cracking, gas cyclones, hoppers, granulation, coating.
3 credits. Prerequisite: ESC 140

ChE 447 Sustainability and Pollution Prevention (same as EID 447)
The first part of this course discusses in detail a methodology for defining and assessing the sustainability of an entity. The course then proceeds with more traditional topics in pollution prevention for chemical processes, outlining concepts on the macroscale, (life-cycle assessment) and mesoscale (pollution prevention for unit operations). By the end of this course, you should be able to use a fuzzy-logic-based methodology to define and assess sustainability, perform a sensitivity analysis which identifies the most critical components of sustainability for a given corporation, perform a life-cycle assessment on a product or process, identify and apply chemical process design methods for waste minimization, energy efficiency, and minimal environmental impact and design, size, and cost a simple waste-treatment process.
3 credits. Prerequisite: permission of instructor

ChE 460 Process Heat Transfer Equipment
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 is usually the case, science does not give a complete answer, it is necessary to use experience and judgment. 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 process heat transfer operations. Attempts will be made to emphasize modern technologies used in these operations.
3 credits. Prerequisite: permission of instructor

ChE 461 Principles of Design and Analysis of Reactors
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 is usually the case, science does not give a complete answer, it is necessary to use experience and judgment. 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 process reaction operations. Attempts will be made to emphasize modern technologies used in these operations.
3 credits. Prerequisite: permission of instructor

ChE 462 Design and Operation of Distillation Systems
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 is usually the case, science does not give a complete answer, it is necessary to use experience and judgment. 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 process distillation operations. Attempts will be made to emphasize modern technologies used in these operations.
3 credits. Prerequisite: permission of instructor

ChE 475 Pharmaceutical Engineering
Introduction to pharmaceutical engineering. Overview of the pharmaceutical industry and drug discovery and development. Clinical trials, regulation, and validation. Scientific principles of dosage forms including solutions, disperse systems, dissolution, stability, and surface phenomena. Biopharmaceutical principles of drug delivery. Pharmacodynamics, pharmacokinetics, and biopharmaceuticals. Unit operations for solid and liquid dosage forms. Pharmaceutical plant design.
3 credits. Prerequisites: ChE 121, ChE 142, and ChE 262, or permission of instructor

ChE 488 Convex Optimization Techniques (same as EID 488)
This course discusses in detail different methods for the optimization of systems of engineering and economic interest using the techniques of linear and nonlinear programming. The focus is on convex optimization, which is the solution of problems with only one best cost, design, size etc. We will consider problems such as least squares, supply chain management, batch process networks, network flow, dynamic programming, portfolio optimization and other examples across all engineering disciplines. Students will learn about optimization theory and problem formulation, with some computational component. By the end of the course, students should be able to: create optimization problems from a physical situation, identify whether a problem can be solved or not, transform problems into equivalent forms, list optimality conditions for problems, find the dual of a problem and identify its relation to the primal, and use at least one method to solve a convex programming problem using a computer.
3 credits. Prerequisites: ChE 151 or ESC 161, Ma 326 (co-enrollment is fine)

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

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 corequisite: ESC 140

CE 141 Environmental Systems Engineering (same as EID 141)
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; corequisite: 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. Prerequisite: permission of instructor

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. Prerequisite: permission of instructor

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/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: ESC 140, CE 122 or ME 100 and permission of instructor

CE 391 Laboratory Testing of Building Materials
Laboratory testing of common building materials such as concrete, steel, and laminated glazing. Concrete mix design. Casting, curing and strength testing of concrete cylinders at 7, 21 and 28 days. Casting, curing and testing of a reinforced concrete beam for stress, strain and deflection. Casting, curing and strength testing of a reinforced concrete column. Deflection testing of a steel beam. Buckling of slender steel columns. Vibrations of a steel beam and a steel frame. Control of deflections through bracing and stiffeners. Impact testing of laminated glazing panels.The course will consist of 3-hr. weekly laboratory sessions for 15 weeks.
3 credits. Prerequisite: This course is open to third-year architecture and third-year civil engineering students. Art students and engineering students of majors other than civil engineering require permission of instructor.

GRADUATE

CE 414 Solid Waste Management (same as EID 414)
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 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 Structural Dynamics (same as EID 425)
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 (IAC) 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 retro-fit of existing structures.
3 credits. Prerequisite or corequisite: 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 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 Geo-Environmental Engineering
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, closure and improvement of waste facilities. Utilization of waste for engineering purposes. Reuse and recycling of contaminated soil.
3 credits. Prerequisites: ESC 140, CE 131, CE 141 and permission of *instructor.*

CE 436 Forensic Geotechnical Engineering
Types of damage—architectural, functional and structural. Investigate problems the forensic geotechnical engineer encounters: settlement of structures, damage to soil expansion, lateral movement of buildings, damage due to seismic energy of earthquakes, slope erosion, deterioration due to sulfate attack and frost, seepage. Development of repair recommendations and presentations of case studies.
3 credits. Prerequisite CE131 or permission of instructor

CE 440 Industrial Waste Treatment Design (same as EID 438)
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 (same as EID 439)
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 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 446 Pollution Prevention or Minimization (same as EID 446)
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 (same as EID 449)
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 460 Innovations in Urban Infrastructure Design
Innovations in the design, delivery, monitoring and rehabilitation of urban infrastructure. Recent advances in methods and technologies such as remote sensing, visualization, data acquisition systems, non-destructive testing, data mining, geographical information systems (GIS), and building information modeling (BIM). Emphasis will be placed on applications relating to real-world projects in large urban centers in the United States and the world.
3 credits. Prerequisite: CE 121 or ME 101

CE 470 Urban Security (same as EID 470)
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 481 Bridge Engineering
Codes and Applicability. General forms and components—trusses, segmental, cable-stayed and suspension. Primary loads and load combinations. Serviceability vs. strength. Consideration of extreme events. Design of super-structures—deck design, girder design, floor-beam design. Design of substructures-piers, abutments, frames and foundations. Scour and other adverse considerations. Wind, seismic and pushover analyses. Bearings, expansion joints and barriers.
3 credits. Prerequisite CE 122 or permission of instructor.

CE 482 Resilient Civil Infrastructure
Hazard mitigation including quantification of resilience. Multi-scale and/or multi-hazard risk assessement. Smart/adaptive systems to protect against natural and human-created hazards. Predictive science toward forecasting infrastructure response to climate change or extreme events. Development of frameworks for optimization of infrastructure networks. Complex systems approaches to the analysis of the interconnected nature of civil infrastructure and its interdependencies.
3 Credits. Prerequisite: permission of instructor

CE 483 Building Information Modeling
Introduction to Building Information Modeling (BIM). Generation and management of digital representations of physical and functional characteristics of a facility. Extensive use and programming of BIM as a shared knowledge resource among the various stakeholders to support decision-making about a facility from earliest conceptual stages, through design and construction, and through its operational life and eventual demolition.
3 credits. Prerequisite: permission of instructor

CE 484 Civil Engineering Project Management
This course provides an overview of the guiding principles of civil engineering project management. Five groups of project management processes will be considered: initiating, planning, executing, monitoring and controlling, and closing. The focus will be on developing the core competencies and skill sets required for planning and controlling civil engineering projects and understanding interpersonal issues that drive successful project outcomes.
3 credits. Prerequisite: Permission of instructor

CE 485 Green Sustainable Cities
Design and modeling of green streets green walls, green roofs, blue roofs, and green parking lots; concepts and practical considerations. Study of evapotranspiration, radiation, and drainage of vegetative systems. Sustainable management and reuse considerations of urban storm water; sustainable and positive environmental impact design concepts. Management and reuse/recycle considerations for urban gray water. Examples of international projects and case studies. Team design projects with class powerpoint presentations.
3 Credits. Prerequisite: permission of instructor

CE 486 Urban Megaprojects and Environmental Impacts
The political embrace of city competition internationally has combined with the globalization of banking, real estate development, and architecture to make Urban Megaprojects seemingly inevitable. With the world economy slowed, it is time to delve into the motivation for and consequences (including environmental impacts) of the now-ubiquitous and globally-entrenched Urban Megaprojects. The aim of this course is to understand the causes and consequences of new scales and forms of territorial restructuring in a steadily globalizing world by focusing on Urban Megaproject development. Case studies from cities such as Bilbao, Budapest, Abu Dhabi, New York, Paris, Sao Paulo, Shanghai, Detroit, Philadelphia, and Mexico City will be presented in an interdisciplinary approach including sociology, planning, architecture, and environmental impacts. Individual term papers on case studies will be presented to class with powerpoint.
3 credits. Prerequisite: instructor's approval

CE 487 Alternative Energy Projects
The design parameters and pros and cons of all types of alternative energy production systems currently in use around the world will be presented. Concepts, practical considerations, environmental impacts, and economics will be evaluated. Alternative energy production systems such as solar, wind power, geothermal, hydropower, pumped storage, industrial growth of algae for biodiesel, will be examined and cade studies from around the world will be presented. Individual term papers on case studies will be presented to class by powerpoint.
3 credits. Prerequisite: instructor's approval

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

UNDERGRADUATE

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 ECE 111 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.

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; corequisite: ECE 110

ECE 140 Circuit Analysis
Circuit components, dependent and independent sources, Kirchhoff's laws, loop and nodal analysis. Superposition, Thevenin and Norton equivalent circuits, and other techniques for circuit simplification. Time-domain analysis of RLC circuits, initial conditions, transient response and steady-state. Phasor analysis, complex power. Ideal op-amps.
3 credits. Prerequisite: Ma 113. Ma 240 is a suggested corequisite

ECE 141 Electronics I
Semiconductor physics: band theory, carrier distributions and transport mechanisms. PN-junctions, PN junction devices. Diode circuits. BJTs: current relationships, operating region. Biasing circuits, DC Analysis; small-signal models, AC analysis. BJT amplifier configurations.
3 credits. Prerequisite: ECE 140

ECE 142 Electronics 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: ECE 141 and ECE 111

ECE 150 Digital Logic Design
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
Introduction to the design of computers and computer systems. Topics include: integer and floating-point representations and operations: ALU design; von Neumann and Harvard architectures; accumulator, general purpose register and stack-based processor design; RISC and CISC architectures; addressing modes; vector operations; microprogrammed and hard-wired controllers; machine language and assembly language programming; static and dynamics memory operation, timing and interfacing; cache; virtual memory; I/O systems: bus design and data transfer, DMA; interrupts and interrupt handling, polling; disk operation and organization; pipelined processor design. The course has a substantial project component that includes assembly language programming and the design and construction of systems that contain microcontrollers, programmable logic, and a variety of I/O devices.
3 credits. Prerequisite: ECE 150.

ECE 161 Programming Languages
Examination of the fundamental concepts of practical programming languages, focusing on C and C++ but including additional languages. Topics include binary representations of numbers, operators, static and dynamic memory allocation, arrays, strings, structures, flow control, file I/O, stacks, queues, lists, activation records and recursion. Object oriented programming concepts covered include classes, encapsulation, information hiding, operator and function overloading, constructors, destructors, inheritance and polymorphism.
3 credits. Prerequisite: CS 102

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 or permission of the instructor

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
An introduction to laboratory techniques for electrical and computer engineering. Topics include the use of electronic test equipment (e.g., DVM, oscilloscope, curve tracer, spectrum analyzer); circuit analysis, design and simulation; and the use of discrete and integrated electronic components and circuits. Several projects/experiments of limited scope reinforce concepts learned in previous courses and provide an understanding of the fundamental building blocks employed in the more advanced designs in successive projects courses. Students regularly give oral presentations and demonstrate laboratory proficiency through in-class demonstrations and concise, formal technical reports.
1.5 credits. Prerequisites: ECE 111, ECE 141, ECE 150. Co-requisite: ECE142.

ECE 194 Electrical & Computer Engineering Projects IV
Principles learned in ECE 193 are applied to the design, construction and characterization of electrical and computer engineering projects of significant complexity. Assignments may 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; students participate in design reviews and write technical reports.
4 credits. Prerequisite: ECE 193.

ECE 195 Electrical & Computer Engineering Projects III
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.
4 credits. Prerequisite: ECE 194.

ECE 196 Electrical & Computer Engineering Projects IV
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 a 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.

ECE 300 Communication Theory
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 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, Gausian 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 300 or ECE 310 or permission of instructor

ECE 303 Communication Networks
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.
3 credits. Prerequisites: ECE 150 and Ma 224

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 310 Digital Signal Processing
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 311 Modern DSP Hardware
Advanced modern digital signal processors—algorithm design and implementation for parallel and reconfigurable hardware platforms. Systems to be studied include FPGAs, multi-core processors, GPUs. HDL, validation and performance evaluation. A wide variety of target applications will be considered, selected according to student and instructor interest.
3 credits. Prerequisites: ECE 310 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: ECE 111 and ECE 150

ECE 314 Audio Engineering Projects
An introduction to design, implementation, fabrication and modification of musical and audio electronics and hardware in a laboratory environment. Projects will include analog and digital signal processing for audio signals, with focus on implementation of real-time algorithms in hardware. Additional projects will include design and implementation of electro-mechanical systems and transducers for audio input / output / display. Formal and informal lectures will include examples drawn from standard implementations, safety concerns, audio specific design and construction techniques; participation in oral presentations and technical reports will be required.
3 credits. Prerequisites: ECE 141 and ECE 150, or permission of the instructor

ECE 320 Control Systems
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 321 Control Systems Design
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 320

ECE 323 Embedded System Design
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 320 and ECE 151

ECE 332 Electro-Mechanical Energy Conversion
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: ESC 120 or ECE 140 and Ph 213

ECE 335 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, ECE 140 and ECE 111

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. Prerequisite: ECE 142

ECE 343 Bio-instrumentation and Sensing
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 111 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, 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 151 and ECE 161 or ECE 164

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: ECE 165

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
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

GRADUATE

ECE 401 Selected Topics in Communication Theory
Advanced topics in communications engineering, selected according to student and instructor interest.
3 credits. Prerequisites: ECE 300 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, stochastic systems, financial engineering.
1-3 credits. Prerequisite: ECE 302 or permission of instructor

ECE 405 Advanced Digital Communications
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 300 and ECE 302

ECE 407 Wireless System Design
Hands-on exposure to the design and implementation of modern digital communication systems using software-defined radio (SDR) technology. The prototyping and real-time experimentation of these systems via SDR will enable greater flexibility in the assessment of design trade-offs as well as the illustration of "real world" operational behavior. Laboratory modules for performance comparisons with quantitative analytical techniques will be conducted in order to reinforce digital communication system design concepts. A large course project consisting of original research will be required. Course topics include SDR architectures and implementations, digital signaling and data transmission analysis in noise, digital receiver structures (matched filtering, correlation), multicarrier communication techniques, radio frequency spectrum sensing and identification (energy detection, matched filtering), and fundamentals of radio resource management.
3 credits. Prerequisites: ECE 300 and ECE 310

ECE 408 Wireless Communications
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 300

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: ECE 300 and ECE 310

ECE 411 Selected Topics in Signal Processing
Advanced topics in signal processing selected according to student and instructor interest.
3 credits. Prerequisites: ECE 310 and permission of instructor

ECE 412 Speech & Audio Processing
Selected topics in digital speech and audio processing. Speech analysis, synthesis and recognition. Acoustics and acoustic modeling. Auditory perception. Audio feature extraction including complex cepstrum and LPC coefficients. Hidden Markov models and other speech recognition approaches. Speech and audio coding such as MP3 and CELP. Text to speech. Music synthesis, analysis and retrieval.
3 credits. Prerequisites: MA224 and ECE111. Co-requisite: ECE302.

ECE 414 Machine Learning
Machine learning of structural relationships among variables from empirical data. Decision theory, Bayesian methods. Classification: naïve Bayes, linear discriminant analysis, support vector machines (SVM), boosting. Regression: least-squares, regularization methods, logistic regression. Clustering using k-means and EM algorithms. Model selection: bias-variance tradeoff, cross-validation, over-fitting. Feature selection and dimensionality reduction methods including PCA, ICA, MDS. Kernel methods. Other topics may be covered as time permits.
3 credits. Prerequisities: Ma 223, Ma224; either ECE 111, ChE 151 or ESC 161

ECE 415 Wavelets and Multiresolution Imaging (same as MA 415)
Wavelets and multiresolution signal processing with an emphasis on 2D and 3D cases. STFT, wavelet analysis, wavelet packets, DWT. Multirate filter banks, PR and paraunitary conditions, multidimensional filters, multidimensional sampling lattices. Bases, frames and sparse representations. Image and video applications such as: compression, noise reduction, tomography and other inverse problems, hyperspectral imaging, compressive sensing. Course work includes MATLAB projects and readings in the technical literature.
3 credits. Prerequisites: ECE 310 and MA 326 or permission of instructor

ECE 416 Adaptive Filters
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 111

ECE 417 Design for Custom DSP Hardware
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 310 and ECE 151

ECE 418 Digital Video
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 310

ECE419 Digital Image Processing
This course covers a variety of methods for image representation, analysis, enhancement and compression. Color spaces, geometric projections and transformations. Multidimensional signals and systems: Fourier analysis, sampling, filtering. Transforms (e.g., DCT and wavelet). Gibbs-Markov random fields, Bayesian methods, information theoretic methods. Multiresolution schemes (e.g., pyramidal coding). Morphological and nonlinear methods. Edges, boundaries and segmentation. Applications of PDEs (e.g., anisotropic diffusion). Compressive sensing. Technical readings and projects in MATLAB (or other suitable language).
3 credits. Prerequisites: ECE310 and MA224.

ECE 421 Advanced Control System Design
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 310 and either ECE 320 or ME 151

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. Prerequisite: ECE 320

ECE 431 Microwave Engineering
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 335

ECE 433 Optical Communications Devices & Systems
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 142; Corequisite: ECE 335

ECE 434 Bioelectricity
Electrical behavior of cellular membranes. Ion transport, electrochemical equilibrium, applications of circuit and cable theory, Hodgkin-Huxley model, resting and action potentials. Generation and propagation of signals within the nervous system and the heart. Case studies and consideration of topics of current research interest, such as: developmental biology, regenerative medicine, neural prostheses, tissue engineering.
3 credits. Prerequisites: ECE 141 or ESC 120, PH 213

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: ECE 341

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 300, and ECE 142. Corequisite: ECE 335

ECE 443 Thin-Film Electronics
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 Tc, fabrication and assessment. Superconducting devices: Cooper pairs, Josephson junctions, SQUIDS, Josephson computers.
3 credits. Prerequisite: 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: ECE 142

ECE 446 Low-Voltage, Low-Power Electronic Circuit Design
The physics and modeling of submicron MOS transistors for analog and digital circuit design. Circuit techniques for the design of low-power, low-voltage digital combinatorial logic, multipliers, memory and system design. Circuit techniques for the low-power, low-voltage analog circuits including the design of low-voltage constant g_m differential amplifiers. The use of switched capacitor circuits for analog signal processing. The course will culminate with the design and simulation of a low-voltage low-power mixed signal circuit.
3 credits. Prerequisites: ECE 142, ECE 341 or permission of instructor

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. Prerequisite: ECE 151

ECE 460 Selected Topics in Computer Engineering
Advanced topics in computer hardware or software engineering selected according to student and instructor interest. Prerequisites will depend on the topics to be covered.
3 credits. Prerequisite: permission of instructor

ECE 462 Interactive Engineering Graphics
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. Prerequisite: ECE 164

ECE 464 Databases
Engineering and design of databases. Topics to be covered may include: data models, database and scheme design; schema normalization and integrity constraints; query processing and optimization; distributed and parallel databases; SQL and XML.
3 credits. Prerequisite: ECE 164

ECE 465 Cloud Computing
Critical, foundational technology components that enable cloud computing, and the engineering advancements that have led to today's ecosystem. Students design, build and test representational software units that implement different distributed computing components. Multi-threaded programming in Java. Functional programming (MapReduce). Hadoop: a programmer's perspective; building and configuring clusters; Flume as an input engine to collect data; Mahout as a machine learning system to perform categorization, classification and recommendation; Zookeeper for systems coordination.
3 credits. Prerequisites: ECE151, ECE164.

ECE 466 Compilers
The theory, design and implementation of a practical compiler. Finite automata, LL and LR parsing, attribute grammars, syntax-directed translation, symbol tables and scopes, type systems and representations, abstract syntax trees, intermediate representation, basic blocks, data and control flow optimizations, assembly language generation including register and instruction selection. Students apply tools such as Flex and Bison to writing a functional compiler for a subset of a real programming language such as C.
3 credits. Prerequisite: ECE 164

ECE 467 Natural Language Processing
This course focuses on computational applications involving the processing of written or spoken human languages. Content may vary from year to year. Theoretical subtopics will likely include word statistics, formal and natural language grammars, computational linguistics, hidden Markov models, and various machine learning methods. Applications covered will likely include information retrieval, information extraction, text categorization, question answering, summarization, machine translation and speech recognition. Course work includes programming projects and tests.
3 credits. Prerequisite: ECE 164

ECE 468 Computer Vision
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 and ECE 161, or ECE 164

ECE 469 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: ECE 164

ECE 491 Selected Topics in Electrical & Computer Engineering
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
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.

Mechanical Engineering

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. Prerequisites: ESC 101 and Ma 240

ME 105 Drawing and Sketching for Engineers (same as EID 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. Prerequisites: none

ME 116 Musical Instrument Design (same as EID 116)
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 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 142 Heat Transfer: Fundamentals and Design Applications
One-dimensional steady-state conduction. Two-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. Prerequisites: Ma 240 and 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 introduces and integrated into the final project.
3 Credits. 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. Prerequisites: EID 101 and EID 103

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. Prerequisites: none

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 corequisite: ME 163

ME 165 Sound and Space (same as EID 165)
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 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. Prerequisites: ME 142 and ME 155

ME 322 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 324 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 330 Internal Combustion Engine Design
A broad analytical and experimental review of the governing parameters involved in piston engine design and optimization. Thermodynamics, fluid mechanics, heat transfer, combustion, emissions, thermochemistry, dynamic and static loading, and fuel efficiency, as they apply to different engine cycles and types, are covered. Varied research examples from industry, government, and academia, 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 130

ME 336 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 338 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 336

ME 350 Introduction to Industrial Design
The collaborative relationship between art, engineering and industrial design, academically and professionally, is a pivotal relationship in the development of new ideas. This course serves as an introduction to the world of industrial design and its wide-ranging applications. The students will learn about the history of design and design concepts and methodology through lectures, discussions, and small projects; and will explore, develop, and execute a term design as part of a class project as the course progresses. The main goals of this course are to develop a better understanding of the perspective of an industrial designer and to gain experience in the practice of industrial design.
3 credits. Prerequisite: ME155 or permission of instructor

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. Prerequisites: 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 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 408 Introduction to Computer Aided Engineering (CAE)
Theory and practical applications of computer aided engineering methodologies, and use of multiphysics software, in mechanical engineering practices. Topics include principal modeling and solution techniques, computational geometry applications, modeling of mechanical engineering problems, and non-linear and dynamic problem solving. Students use typical commercial software packages to work on practical case studies.
3 credits. Prerequisite: ESC 101

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 mircoelectromechanical 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, processiong 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 430 Thermodynamics of Special Systems (same as EID 430 and ChE 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: ME 130

ME 432 Introduction to Nuclear Power Plant Technology
Nuclear power provides a high-potential form of alternative energy, with significant safety constraints. The course centers on the study of a typical US commercial nuclear power plant—its design philosophy and analysis of nuclear steam supply system and balance of plant systems (including heat exchangers, pumps, relief valves, etc.) for normal operation and steady state and transient accident analysis, and longer term spent fuel storage. The course utilizes disciplines/methods of thermodynamics, heat transfer and fluid flow, and plant drawings and data. Analysis includes Three Mile Island Accident, a small break loss-of-coolant accident. When feasible, this course includes a tour of an operating nuclear power plant.
3 credits. Prerequisites: ESC 130 and ESC 140

ME 433 Rocket Science (same as ChE 433)
Transient and steady-state control volume balances (mass, momentum and energy) that involve compressible flow phenomena are applied to (primarily) aerospace applications. Fundamental topics include variable mass accelerating control volumes, variable area adiabatic flows, normal and oblique shock waves, expansion fans, friction effects (Fanno flow) and heat transfer effects (Rayleigh flows). Numerical and analytical techniques are developed. Applications include basic trajectories, water rockets, converging/diverging rocket nozzles, RAM and SCRAM jets, supersonic wakes from underexpanded and overexpanded nozzles, gas exchange in reciprocating engines.
3 credits. Prerequisite: ESC130 and ESC140

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: ESC 130

ME 440 Advanced Fluid Mechanics (same as EID 440 and ChE 440)
Introduction to the fundamental constitutive relations and conservation laws of fluid mechanics. Steady and transient velocity distributions of viscous flow. Stream functions, potential flow, and creeping flow. Boundary layer theory. Modeling of turbulent flow. Special topics may include: hydrodynamic stability, vorticity dynamics and mixing, waves in fluids, airfoil theory, lubrication theory, compressible flow, multiphase flow, bubbles and droplets, non-Newtonian flow, and computational fluid dynamics.
3 credits. Prerequisites: ESC 140 and permission of instructor

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: ME 151 or ECE 320

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. Prerequisites: 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.

Chemistry

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. Prerequisites: none

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; corequisite: 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, Ma 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; molal 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, spectroscopy, carbonyl chemistry, amines, and polymer chemistry.
3 credits (3 lecture hours). Prerequisite: Ch 231; corequisite Ch 233

Ch 232.1 Principles of Organic Chemistry II
Selection of topics from Ch 232. This class meets with Ch 232 for the first ten (10) weeks.
2 credits. Prerequisite: Ch 231; corequisite 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) Prerequisites: Ch 111 and Ch 231

Ch 250 Analytical Chemistry
Fundamental principles, operation, and limitations of instrumental methods in scientific research will be covered. This involves determining the best analytical method for analyses, assessing the reliability of the measurements and understanding the meaning of S/N and how to optimize it. Specific instrumental methods include electroanalytical techniques (potentiometry, coulometry, voltammetry), spectroscopic techniques (infrared, and UV-visible molecular spectroscopy, as well as atomic absorption spectroscopy), microscopy methods (atomic force and scanning tunneling microscopy), and analytical separations (high pressure liquid chromatography and gas chromatography).
3 credits. Prerequisites: Ch 110, Ch 111, or permission of instructor.

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, electro-gravimetry 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 and Ch 233

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 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 and Ch 231

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 and Ch 261

Ch 380 Selected Topics in Chemistry
Study of topics related to specialized areas as well as advanced fundamentals.
2-6 credits. Prerequisite: 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 or her own with faculty guidance.
3 credits. Prerequisite: permission of research adviser and student's adviser(s)

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 adviser(s)

GRADUATE

Ch 433 Advanced Organic Chemistry (Previously Ch 333, Advanced Organic Chemistry)
Modern areas of organic chemistry, including synthesis, structure determination, stereo-chemistry 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. (4 laboratory hours) Prerequisite: Ch 232

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

Ch 451 Nanomaterials
Nanoscience is the study and manipulation of matter on an atomic and molecular level. At this scale, materials often exhibit new properties that do not exist in their large-scale counterparts because of the increased importance of surface area/ volume ratios and quantum effects. This course will focus on understanding the physical properties and methodologies for the formation (i.e. molecular self-assembly, photolithographic patterning, scanning probe lithography), and characterization (i.e. optical spectroscopy, atomic force microscopy, scanning tunneling microscopy, and electron microscopy) of nanomaterials.
3 credits. Prerequisites: Ch 160, Ch 231, Ch 250, Ch 251, Ch 261 and Ph 213 or instructor's permission

Ch 452 Electrochemistry
Electrochemistry allows the simultaneous recording of kinetic and thermodynamic information about a chemical reaction. This makes it a powerful tool in a wide variety studies. Since the reactions that define electrochemistry only occur within a few nanometers of the electrode's surface, mass transport coefficients and surface properties can be uncovered using electrochemical methods. The course will present the fundamentals electrochemistry, including electrical potentials, standard reduction potentials, batteries, reference electrodes, ion-selective electrodes, ionic mobilities, calculating junction potentials. Modern electrochemical methods, including cyclic voltammetry, electrogravimetry, ultra-microelectrodes and nanoelectrodes.
3 credits. Prerequisites: Ch 231, Ch 250, Ch 251, Ch 262.

Ch 460 Advanced Physical Chemistry (previously 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).

Mathematics

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, complex numbers.
2 credits. Prerequisites: none

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. Prerequisites: none

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 corequisite: 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. Prerequisites: none

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. Prerequisites: Ma 110 and Ma 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. Prerequisite: Ma 113; corequisite 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
Field, vector space, linear independence, subspace, basis, and dimension. Finite-dimensional vector space theory, including linear transformations, rank, matrix representation, coordinate transformation, systems of linear equations, and matrix algebra. Determinants, eigenvalues, and eigenvectors. Inner product space theory, including orthogonal matrices and quadratic forms. Canonical form.
3 credits. Prerequisite: Ma 223

Ma 336 Mathematical 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. Prerequisites: 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 Mathematical Analysis 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. Metric spaces, connected and compact sets, uniform convergence.
3 credits. Prerequisite: Ma 223

Ma 351 Mathematical Analysis II
Uniform convergence. Differentitation of transformations, inverse and implicit function theorems. Introduction to measure and integration theory. Applications to geometry and analysis.
3 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. Prerequisites: Ma 240 and permission of research adviser

Ma 392 Research Problem 2
(Continuation of Ma 391)
This is intended to allow students to continue ongoing research.
3 credits. Prerequisites: Ma 391 and permission of research adviser

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 and 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 and 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 and Ma 240

Ma 415 Wavelets and Multiresolution Imaging
(same as ECE 415)
3 credits. Prerequisites: ECE 114 and Ma 326 or permission of instructor

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. Prerequisites: 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. Prerequisites: Ma 326 and permission of faculty member

Physics

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. Prerequisites: Ma 110, Ma 111; corequisite: Ma 113

Ph 165 Concepts of Physics I
An introduction to physics with an emphasis on statics and dynamics.
2 credits. 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. 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; corequisite: Ma 223

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 215 Microcontroller Projects in Physics
This course will introduce students to the Arduino prototyping platform, diverse sensors and output devices that may be interfaced to the Arduino, and the programming languages ("Arduino" and "Processing") required for stand-alone operation or interaction with an attached PC. A typical project will involve developing hardware and associated software that requires the study of, and ultimately illustrates, basic physics principles—for example, the construction of a self-focusing telescope. Ideally, student projects will be integrated into the physics lecture courses as demonstration apparatus. The basics of circuit theory that are required for this course will be taught

to those who have not yet completed Ph 213. (Students need not be skilled programmers or have any prior knowledge of circuits for this course.)
3 credits. Prerequisites: CS102, Ph112, and permission of instructor

Ph 235 Physics Simulations
Students will be taught how to numerically solve ordinary differential equations using 4th order techniques such as *Runge-Kutta* and *Adams-Bashforth-Moulton* in the Python programming language. These techniques will be used to solve diverse physics problems not amenable to simple analytical solution, such as n-body gravitational motion, the motion of charged particles in a magnetic bottle, the behavior of a car's suspension on a bumpy road. Emphasis is placed on physically accurate modeling (e.g. satisfying conservation laws to high accuracy) and the effective use of computer graphics/animation for the presentation of results. (Students need not have significant programming experience for this course.)
3 credits. Prerequisites: CS102, Ph112, Ma113, and permission of instructor

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; corequisites: Ph 213

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 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.
2 credits. Prerequisite: PH 214

Ph 346 Quantum Physics of Solids
Why do silicon, calcite and copper have very different properties even though they have similar densities of electrons? The answer is quantum mechanics and its application to band theory. Band theory provides some of the most direct tests of quantum mechanics. The course will develop the theory to explain thermal and electrical properties of everyday materials. We shall see how quantum mechanics and Fermi statistics successfully explained these properties when classical physics could not. The course will provide the concepts and quantum mechanical training needed to understand, for example, the workings of semiconductor devices. It will also provide theoretical understandings of material properties like thermal and electrical conductivity, optical reflection and transmission coefficients that you have seen in mechanics, E&M and modern physics. Topics covered will include: Drude and Sommerfield Models; Bloch's Theorem and periodic potentials; the nearly free electron model; tight binding model; band structures; semiconductors and insulators; band structure engineering. The mathematics required to understand the concepts will be developed as we go through the topics.
3 credits. Prerequisites: Ph 112, Ph 213, and 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.

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

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., gastro-intestinal 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). Prerequisites: 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. Prerequisite: Sophomore standing preferred, but freshman with AP Biology welcome

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 and Python. Students will also master one or more significant engineering design packages such as MATLAB, AUTOCAD, Solid Works, etc. Projects will be assigned.
3 credits. Prerequisites: none

Engineering Sciences

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 aspects of 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. Additionally, a wide range of topics is covered including ethics, environmental awareness, lifelong learning, career development, interpersonal skills, work-place issues, and professional licensure.
0 credits. Attendance required by all first and second year students. Pass/Fail grade based on attendance. Failing grade does not affect GPA or ability to graduate and does not appear on the final transcript. Successful completion will be noted on the final transcript.

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. Prerequisites: none

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 ESC 120 for the first ten (10) weeks.
2 credits. Prerequisite: Ma 113

ESC 130 Engineering Thermodynamics I
Rigorous development of the basic principles of classical thermodynamics. Zeroth, first and second laws of thermo-dynamics and their applications to open and closed systems. Analysis of thermodynamic processes, properties of real substances and thermodynamic diagrams.
3 credits. Prerequisites: none

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. Prerequisites: none

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. Prerequisites: none

Interdisciplinary Engineering

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, teamwork, human values and social concerns are stressed in the engineering design.
3 credits. Prerequisites: none

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)
2 credits. Prerequisites: none

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 116 Musical Instrument Design (same as ME 116)
3 credits. Prerequisite: permission of instructor

EID 120 Foundations of Bioengineering
An introduction to the engineering study of biological systems. Basic physiochemical and organization principles applicable to biological systems. Topics include membrane structure and function, physiology of the circulatory system, and an introduction to biorheology and biological transport phenomena.
3 credits. Prerequisite: Ch 160

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, bio-compatibility, 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 124 Injury Biomechanics and Safety Design
Frequency and severity of common injuries. Mechanisms of musculoskeletal, soft tissue and brain injuries. Injury criteria, reference values and their role in safety design. Experimental and computational methods for safety design and accident reconstruction. Automotive safety. Biomechanical test dummies. Seatbelts, airbags, and energy absorbing structures and materials. Repetitive stress injuries and occupational health. Government regulation and legal liability. Expert witness practice and qualifications.
3 credits. Prerequisites: ESC 100 and 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. Permission of instructor

EID 131 Energetics (same as ME 131)
3 credits. Prerequisite: ESC 130

EID 140 Environmental Systems Engineering (same as CE 141)
3 credits. Prerequisite: permission of instructor

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)
3 Credits. Prerequisite: ME 151 or ECE 121 or ChE 152

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 Sound and Space (same as ME 165)
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. Prerequisites: none

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. Prerequisite: permission of faculty and dean's office

EID 312 Manufacturing Engineering (same as ME 312)
3 credits. Prerequisite: EID 101

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 and 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, masculaskeletal system, robotic surgery and medical business.
3 credits. Prerequisite: permission of instructor

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 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: material covered in core engineering science and mathematics in Freshman and Sophomore years

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. Prerequisite: 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. Prerequisite: EID 101

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. Prerequisite: permission of instructor

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: EID 101

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. Prerequisite: either S 334, S 347, EID 170 or permission of instructor

EID 376 Economics of Alternative Energy
The goal of this course is to explore the economics of alternative energy technologies. As always, engineering considerations determine the feasibility of any technology while economics determine the practicality of the technology in the likely environment of the next five years. The students participating in this course will explore a wide range of alternative energy technologies. It is expected that their analyses will combine both economic and engineering principles in an interesting and creative way. Each student will choose a particular technology to analyze in depth: wind, solar-photovoltaic, passive solar, geothermal, bio-fuels, etc. There will be periodic presentations of their work to the class as a whole. One goal of these class discussions will be to highlight the advantages and disadvantages of the various technologies. At the end of the semester, there will be a formal presentation of the students' conclusions to an audience of Cooper faculty, industry experts and Wall Street analysts.
3 credits. Prerequisite: EID 170, EID 374, or permission of the instructor

GRADUATE

EID 414 Solid Waste Management (same as CE 414)
3 credits. Prerequisite: permission of instructor

EID 422 Finite Element Methods (same as CE 422)
3 credits. Prerequisite: CE 122 or ME 100

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 Structural Dynamics (same as CE 425)
3 credits. Prerequisite: CE 122

EID 430 Thermodynamics of Special Systems (same as ChE 430 and ME 430)
3 credits. Prerequisite: ChE 131 or ME 130

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)
3 credits. Prerequisite: ESC 140

EID 441 Advanced Heat and Mass Transfer (same as ChE 441)
3 credits. Prerequisite: EID 440 or ChE 440

EID 446 Pollution Prevention or Minimization (same as CE 446)
3 credits. Prerequisite: permission of instructor

EID 447 Sustainablitiy and Pollution Prevention (same as ChE 447)
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 458 Industrial Robots (same as ME 458)
3 credits. Prerequisite: ME 151

EID 470 Urban Security (same as CE 470)
3 credits. Prerequisites: CE 122 or ME 101 and permission of instructor

EID 488 Convex Optimization Techniques (same as ChE 488)
3 credits. Prerequisites: ChE 151 or ESC 161, Ma 326 (co-enrollment is fine) and permission of instructor

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As of time of publication, for Fall 2015 and Spring 2016 semesters only

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B.S., M.S., Eng. Sc. Doctorate, Columbia University

Katherine Panchyk
Adjunct Assistant Professor of Graphics
B.S., City College of New York

David Petrillo
Adjunct Instructor of Mechanical Engineering
B.S., Lehigh University

Yashodhan C. Risbud
Adjunct Professor of Electrical Engineering
B.E., M.E., The Cooper Union

Ryan Ronan
Adjunct Instructor of Math
B.E., The Cooper Union

Vincent Salvatoriello
Adjunct Professor of Civil Engineering
B.S., M.S., New Jersey Institute of Technology
Ph.D., Stevens Institute of Technology

Omar A. Sharafeddin
Adjunct Professor of Chemistry
B.S., Baylor University;
Ph.D., University of Houston

Stanley M. Shinners
Adjunct Professor of Electrical Engineering
B.E.E., CUNY City College;
M.S.E.E., Columbia University; P.E.

Susan Slome
Adjunct Professor of Math
Graduate Preparatory Accelerated Program, New York University, Courant Institute
Ph.D., State University of New York, Stony Brook

Robert Smilowitz
Adjunct Professor of Civil Engineering
B.E., The Cooper Union;
Ph.D., University of Illinois; P.E.

Daniel M. Speyer
Adjunct Professor of Mechanical Engineering
B.E., M.E., Ph.D., New York University

Leonid Srubshchik
Adjunct Professor of Mathematics
B.S., M.S., Rostov State University, USSR;
Ph.D., FSU Institute of Mathematics, USSR

Thomas Synnott, III
Adjunct Professor of Industrial Engineering
B.A., Williams College;
M.A., Ph.D., Yale University

Nina Tandon
Adjunct Professor of Electrical Engineering
B.E., The Cooper Union
M.S., MIT
Ph.D. Columbia University

Kevin Tien
Adjunct Professor of Electrical Engineering
B.E., The Cooper Union
M.S., Columbia University

Steven Ungar
Adjunct Professor of Electrical Engineering
B.E., The Cooper Union;
M.S., Ph.D., Stanford University

Joseph Viola
Adjunct Associate Professor of Civil Engineering
B.E., M.E., The Cooper Union;
P.E.

Samuel Wiener
Adjunct Professor of Chemistry
B.S., M.A., Brooklyn College;
M.S., Pace University

Hui (Grace) Yu
Adjunct Professor of Mechanical Engineering
B.S., Wuhan Institute of Chemical Engineering;
M.S., Huazhong University of Science and Technology;
Ph.D., Hong Kong University of Science and Technology;
Ph.D., Boston University

Lori Zaikowksy
Adjunct Professor of Chemistry
B.S., M.S., Ph.D., Stony Brook University

Emeriti Faculty/Administration

See page 132

Technicians

Estuardo Rodas
Mechanical Engineering Technician and Project Coordinator

Patrick Chiu, *Technician Chemistry Laboratories*

Radmila Janjusevic, *Technician Kanbar Center for Biomedical Engineering*

Sinisa Janjusevic, *Technician Student Machine Shop*

Victoria Joyce, *Technician Chemistry Laboratories*

Aladino Melendez, *Senior Technician Electrical Engineering Laboratories*

Jorge Ortega, *Senior Laboratory Technician Mechanical Engineering Laboratories*

Luis Vega, *Technician Civil Engineering Laboratories*

Michael Westbrook, *Technician Chemical Engineering Laboratories*

Brian Yudin, *Technician Student Shop/ME Design Studio*

Engineering Advisory Council

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Flag Telecom

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Con-Edison

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Seth Dubin, Esq.
Law Partner
Saterlee, Stephens, Burke and Burke

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Nobel Laureate
Associate Vice President for Strategic Initiatives
University of Texas–Dallas

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C.E.O., Judlau Contracting Inc.

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Chairman and C.E.O.
Helicos Biosciences

Jay LeBoff
President and C.E.O.
C.E.O. Hotseat Chassis Inc.

Jay Moskowitz (Phy'70)
SPD Control Systems Corp.

Frank Napolitano (ME'88)
President, Lakeside Energy, LLC.

Eduardo F. Palacio (EE'75)
Vice President for Programs,
ITT Electronic Systems

Gerry Posner
C.E.O., Bolder Sensors
Chairman, Aegis Software Systems

Steven Silberstang (CE'70)
President, Foolhardy Investors

Joel Spira
Chairman and Director of Research
Lutron Electronics Co., Inc.

Nina Tandon (EE'01)
Adjunct Professor of Electrical Engineering, The Cooper Union

Donald Toman (EE'55)
Senior Staff Consultant (retired)
Lockheed Martin

Richard Tomasetti,
P.E. Chairman
Thornton-Tomasetti Group, Inc.

Willard Warren (EE'50)
Willard Warren Associates

Philip Weisberg (EE'89)
C.E.O.
FX Alliance

Marie Wieck (BSE'82)
Vice President, WebSphere Platform
IBM

Technology Transfer Advisory Board

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Bristol-Meyers Consultant (retired)

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Ossa Properties, Inc.

Stanley Lapidus (EE'70)
Chairman and C.E.O.
Helicos Biosciences

Barry E. Negrin (ME'89)
Partner
Levisohn, Lerner, Berger and Langsam, LLP

Lawrence Ng (EE'78)
Senior Vice President for Business Development
Moneyline Network

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 required 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 **HUM** and **SS** carry three credits and courses with the prefix HTA carry two credits.

Prerequisites The prerequisites for all courses with the prefixes HUM and SS are HSS1, 2, 3 and 4. HTA 1, 2 and 3 or HTA 101 and 102 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 reexamination, 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.

Change of Program

Adding a Course A student is permitted to add a course only during the first week of a semester, during the drop/add period, and only with the adviser's approval.

Adding a course after the drop/add period is not permitted even if the student has been attending the class.

Dropping a Course A student may drop a course during the first week of the semester, during the drop/add period, with the adviser's approval.

A course dropped during the first week of the semester will be deleted from the transcript.

Withdrawing from a Course A student anticipating inability to continue an assigned program should immediately see his or her adviser. After the drop/add period a student may withdraw from a course through the eighth week of the semester. It is the student's responsibility to obtain the necessary permission from the adviser and to notify the instructor in order to withdraw from a course. A grade of **W** will appear on the transcript. A student who stops attending a course without permission of the adviser will receive a grade of **WU**. However, if the student is failing the course at the time of the unauthorized withdrawal, the instructor is free to record a grade of **F**.

A student is not permitted to drop or withdraw from a course if doing so would impede satisfactory progress towards the degree.

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 the equivalent of one week of unexcused absences will be permitted. In the event of absence a student should contact the instructor in advance. Students who miss more than the equivalent of one week of classes in any one course may receive a reduction of the final grade or, at the discretion of the instructor, may be required 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 the "Code of Conduct" (see page 30).

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 Sohnya Sayres, Academic Adviser 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 I Freshman Seminar
A literature course concentrating on poetry and drama. Selected texts from antiquity and the Renaissance are common to all sections, with works from other genres, periods and cultures chosen by individual instructors. The course develops aesthetic appreciation of literary texts and encourages a range of critical responses. Through close reading and extended discussion students learn to articulate their responses in written and spoken form.
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. Recent topics have included Beckett, humanitarianism, the tourist, and Borges.
3 credits
May be repeated for Free Elective credit in the Schools of Art and Engineering. 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.

HUM 105 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

HUM 107 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

HUM 129 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

HUM 207 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

HUM 208 Aristophanes
Athenian Old Comedy is one of the timelessly funniest and widest-ranging forms of comedy every 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

HUM 230 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

HUM 242 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

HUM 243 The Fairy Tale
This course introduces students to the main features of folk and fairy tales as well as with the developments of such tales through history and across cultures and geographies. As historical constructs, folk and fairy tales reveal significant aspects of the cultures in which they are created and recreated. Thus, while our course focuses on folk and fairy tales in their originary contexts, it will end by considering the work they perform in such diverse modern appropriations as Disney cartoons, gaming, and the men's movement. We will read several folk and fairy tales from each of the major collections of Western Europe, West Africa, the Middle East, South and East Asia. Our investigation will be interdisciplinary, with our critical approach drawing from literary, sociological-historical, psychoanalytic, folklorist, feminist, and film studies.
3 credits

HUM 249 Homer and the Tragic Vision
An in-depth introduction to Homer's Iliad and to the major literary genre it spawned, Greek tragedy. The methodology throughout will be close reading, using comparative translations of select passages checked alongside the original Greek text, with the instructor's guidance. This course is meant to "model" a particular approach to the study of literature in translation. It presents an opportunity for interested but "Greekless" students to experience some of the most important and influential works of classical literature in a manner that approximates as closely as possible the experience of those who do have knowledge of ancient Greek.
3 credits

HUM 250 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

HUM 306 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

HUM 307 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

HUM 311 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

HUM 312 Islamic Aesthetics
This course is an introduction to Islamic aesthetics with emphasis on the nature and development of the arabesque and calligraphy as ornament in art and architecture. Lectures will ask and attempt to answer the question of why a pragmatic and down-to-earth philosophy chose to express itself in a most abstract visual language, how much of the vocabulary of that language was originally Arabic, and how much was inspired and/or acquired from the various lands conquered by Islam. Digital image lectures will be accompanied by some poetry, music, Qur'anic recitations and film viewings.
3 credits

HUM 316 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

HUM 319 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

HUM 321 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. Recent topics: Joyce's *Ulysses*; New York City literature.
3 credits

HUM 323 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

HUM 325 Puppet, Automaton, Robot
Puppets, automata, and robots are toys or machines that look like us (or parts of us). This course will draw upon an interdisciplinary range of materials—from philosophy, the history of science, psychoanalysis, drama, popular culture, and art—to explore ways in which we can think about what we want from our "artificial life," and how the boundaries between living/non-living require constant rethinking.
3 credits

HUM 327 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

HUM 328 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

HUM 329 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

HUM 331 Eros in Antiquity
This course will study the theory and practice of love in the ancient world and its legacy in the modern. Working with primary textual sources, the course will consider Plato's erotic dialogues and writings from the Neo-Platonic tradition extending up to Shelley's poetry as well as Ovid's Amores and the Art of Love. These major texts will be supplemented with examples of erotic poetry from ancient Egypt, Mesopotamia, Archaic and Classical Greece, and Rome, as well as works of visual art.
3 credits

HUM 333 The Age of Augustus
Augustan Rome presents the only serious ancient contender for comparison with the "Golden Age" of Periclean Athens. In all categories of art, architecture, and literature, the age of the first Roman emperor, Augustus (27 BCE-14 CE), rivals that of high Classical Greece. The course thus combines the disciplines of history, the visual arts, and literature, with the heaviest emphasis on literature, to arrive at a comprehensive picture of a relatively short, but disproportionately consequential moment in the history of civilization.
3 credits

HUM 343 Decadence and Modernity
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

HUM 345 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

HUM 346 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

HUM 352 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

HUM 356 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

HUM 357 Philosophy of Science
What, exactly, is science? What is scientific inquiry and explanation, and how might it differ from other forms of inquiry and explanation? In the course, we will investigate the nature and status of scientific knowledge. Along the way, we shall ask such questions as: What are scientific theories? What relations obtain between scientific theories and observed facts? How are scientific theories confirmed or disconfirmed? Do scientific theories represent the true nature of the world, or are they merely convenient tools for making predictions and developing technology? Is scientific inquiry a purely rational process? Is it influenced by social and cultural factors? What makes science successful?
3 credits

HUM 369 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

HUM 373 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.
Recent topic: *Plato's Republic.*
3 credits

HUM 374 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

HUM 375 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

HUM 377 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

HUM 379 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

HUM 381 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

HUM 382 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

HUM 383 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

HUM 386 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

HUM 387 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

HUM 389 Love in Western Art and Literature
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." 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

HUM 392 Ethics
The course considers real-world ethical dilemmas in a philosophical context. Throughout the course, students will examine and critically evaluate a variety of ethical theories with the aim of gaining a fuller appreciation of the complexities of difficult or controversial ethical situations. Particular emphasis will be placed on questions concerning the nature and importance of value, virtue, relationships, commitment, duty, moral disagreement, moral skepticism, and relativism. Student interest will determine the ethical situations that we explicitly discuss in key weeks of the course.
3 credits

HUM 394 World Religions
An introduction to the five major world religions: Hinduism, Buddhism, Judaism, Christianity and Islam. The course considers ancient and contemporary religious practices as it examines faith and belief, ritual, scripture and scriptural interpretation, religious art, orthodoxy and heresy, mysticism, and pilgrimage through a comparative lens. Focus is on origins, textual traditions and central doctrines with further attention to religion "on the ground" as a living and evolving phenomenon.
3 credits

HUM 395 Hip Hop and Culture
In this class, we will trace the roots of rap music to West Africa rhythms, Jamaican sound systems, and oral expressive cultures in the American South; analyze some of the most influential and iconic rap recordings across the decades; study the techniques and technologies that are used to create DJ-based music; consider other pillars of hip hop culture (e.g. graffiti and break dancing); and examine the controversies that swirl around hip hop culture and rap music.
3 credits

HUM 99 Independent Study (Humanities)
3 credits

SOCIAL SCIENCES

SS 220 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

SS 221 History of the Modern Middle East
This course considers topics in Middle Eastern history from the First World War to the present. We examine a century of political unrest that included two world wars, colonialism, the Arab-Israeli conflict, the rise of authoritarian state structures, the Iranian Islamic revolution, and the American war on terror.
3 credits

SS 305 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

SS 308 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

SS 318 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. Recent topics: sustainability; total war; human rights, law, and society; Cooper Union world forum.
3 credits

SS 320 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 policy-making. 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

SS 321 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

SS 323 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

SS 333 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

SS 334 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

SS 335 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

SS 337 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

SS 342 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

SS 345 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. Recent topics: the credit crisis.
3 credits

SS 346 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 onsider 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

SS 347 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

SS 348 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

SS 349 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

SS 351 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

SS 353 American Social History
This course offers an introduction to the major themes in American Social History from the Late Colonial Period to World War Two. Over the last few decades, social historians have introduced a broader cast of characters into the making of American society; workers, immigrants, minorities and native Americans are now seen more as active participants in the story of the United States rather than as passive victims or marginal figures. This course examines the changing role of such significant groups and considers how they may have changed the shape of the dominant political culture.
3 credits

SS 354 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

SS 358 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

SS 360 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

SS 361 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

SS 362 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

SS 367 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

SS 368 History of Modern Asia
This course explores the history of Asia from the later imperial eras of China, Japan, Korea and Southeast Asia into the modern era. A wide range of political, social, economic and cultural issues are explored. While emphasizing the distinctive nature of the region, the course will stress the wide diversity and inter-connectedness of ideas, technologies and religions through the region.
3 credits

SS 369 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

SS 371 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

SS 372 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

SS 373 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

SS 374 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

SS 378 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

SS 381 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

SS 382 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

SS 384 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

SS 385 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

SS 386 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

SS 387 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

SS 388 Comparative Cities: New York/Berlin, 1848-1948
A comparative, team-taught urban history seminar on Berlin and New York from 1848 to 1948. The course examines the differing causes of urban growth and the way it was accommodated in novel forms of urban space, highlighting the differences between a city that became a capital of empire and one given over to commercial and residential development, as well as the very different ways that both cities experienced periods of rebellion and war.
3 credits

SS 390 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

SS 391 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

SS 393 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

SS 394 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 the1950s 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

SS 395 Rome
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.
3 credits

SS 396 North American Environmental History
This course examines recent historical work that makes claims for the "environment" being the major determinant in the development of the North American continent. We will look at land use in pre-colonial times, the spread of slave-based extensive agriculture in the South, wood lot management in the north, mid-western farming, western mining, the parameters of nineteenth century urban growth as well as the consequences of the arrival of the automobile. We will also look at the growth of the environmental movement over the last two centuries.
3 credits

SS 397 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 will course will not only examine 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.
3 credits

SS 398 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 post-feminisms" and changing gender relationships.
3 credits

SS 99 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 101, 102 Modern to Contemporary: An Introduction to Art History
This two-semester art history core course, developed as part of the Foundation year for students in the School of Art but open to all students, is organized around a set of themes running through the history of modernity from the 18th century to the present. Within specific themes, significant works, figures and movements in art/design will be presented chronologically. Students will be able to identify and critically evaluate significant works, figures and movements in art/design in the modern period; be able to describe the main social and political contexts for the changes in art/design over the last two hundred years; and engage, in writing and class discussion, with theoretical perspectives on art/design production. The course will involve museum visits. Grading will be based on class participation, papers, and exams.
2 credits each semester

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 211 The Renaissance in Italy
An investigation of the art produced during the 15th and 16th centuries in Italy, where a revival of classical learning led to an unprecedented artistic flowering. In painting, the course deals with the period from Fra Angelico to Titian; in architecture, from Brunelleschi to Palladio; and in sculpture, from Ghiberti to Michelangelo and Benvenuto Cellini. The course will touch on such themes as the classical ideal, town planning, country villas, fresco painting, patronage, the development of perspective, and the rise of the portrait.
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 historical survey of the visual culture of Buddhism in its chronological, geographical, material and conceptual development from its origin in India, following the death of Siddartha in the fifth century B.C.E., through various parts of the world, such as South East Asia, Central Asia, the Himalayan Mountain regions, and East Asia up to contemporary society in and beyond Asia. The class introduces the basic conventions and traditional visual strategies of Buddhist art in various media through focusing on selected examples of representative images, objects and monuments from historical Buddhist art, while investigating Buddhism as both a philosophy and a religion that has been continuously reinterpreted.
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 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 232 Is Painting Like Poetry?
Inspired by the famous dictum "ut pictura poesis" (literally, 'as painting, poetry,' or more loosely, 'poetry is like painting') from Horace's *Art of Poetry,* the course examines the interconnections between literature and the visual arts, whether as rivals or as allies, from antiquity through the present. A diverse group of topics will be considered, within a specific historical time frame and context, with the goal of seeking a common ground for a discourse with which to evaluate the nature, significance, and aesthetic parameters of each of the two modes of expression in the shared enterprise of the representation of reality and/or the world of ideas.
2 credits

HTA 233 History of Drawing
Our class will examine the changing character and purpose of drawings, from prehistory and antiquity through the Italian Renaissance, Northern Europe, impressionism, Van Gogh, Cezanne, Picasso, and others from the modern and post-modern periods. Topics will include formal accounts, connoisseurship (particularly controversies around Michelangelo and Rembrandt's drawings), technology (camera obscura, camera lucida), figuration and abstraction, and actual practice at a place like Cooper Union today.
2 credits

HTA 240 Issues 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 270 The Art of Greece and Rome
An introduction to the sculpture, painting, and architecture of ancient Greece and Rome with attention to the impact of the classical imagination on the art of succeeding ages.
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.
Recent topic: *Altered images.*
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, multiculturism and site specificity crucial to the current practice of art. Recent topics: German painting.
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: Single-Work Seminar
A seminar devoted entirely to a single monument or work of art that had a particularly profound and wide resonance in the socio-political, economic, and cultural milieu in which it was created and whose range of influence extended well beyond its historical time frame. The focused nature of the course material allows for both a breadth and a depth of analysis to a greater degree than is possible in other elective art history courses. Topics have included Duccio's *Maestà*, Van Eyck's Ghent Altarpiece, and Chartres Cathedral.
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 300 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. Recent topics: Leonardo; Rembrandt; Degas.
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. Recent topics: Picasso.
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 323, 333 Islamic Art and Architecture
An introduction to the evolution of Islamic aesthetics, history and philosophy by examining samples of architectural monuments, painting, ceramics, metalwork's and calligraphy, as well as literary texts, from the 12th century and the Mongol invasion to the Reconquista and the fall of Granada in the15th century. The course traces the development of the truly multi-cultural art of this turbulent period, from Central Asia through Iran and Iraq and the Levant, to Egypt, the Maghrib, and Spain.
2 credits

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 Islamic Art and Architecture
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
From the temples of the land of Sumer to the tower of Babylon, this course provides an overview of the civilizations of ancient Mesopotamia (modern-day Iraq) and Iran, as well as surrounding regions, from the Neolithic period to the 1st millennium B.C.E.—some 10,000 years. We will study the architecture and artifacts excavated at major sites in the fertile crescent including Jericho, Uruk, Ur, Nineveh and many others. In addition, we will discuss major landmarks in the history of civilization such as the development of agriculture, the beginning of urban settlement, the invention of writing, and the discovery of metallurgy, and their impact on the manufacture of art and artifacts and their iconography.
2 credits

HTA 336 Site-Specific Art
This course explores the history of site-specific art, a term that emerged in the 1960s to describe artworks created in response to a place or a set of conditions. The focus will be the role of "site" in minimalism, land-art, post-minimalism, institutional critique, new genre public art, and contemporary participatory and social practices. Each evolution of the term is also a critique of the site's role in the previous moment: the site in minimalism is complicated by feminist performance work; land-art is problematized by the post-minimalists and institutional-critical artists working primarily in the city. In the 1990s site-specificity also became a way to critique the monumentality of public sculpture that claimed to represent everyone: new-genre public art and community-based work comes out of artists' struggle to make work that responds to the social fabric of a site and not simply to its physical location. We will read key historical and theoretical texts closely, and student presentations will be a major part of the course. Material is organized thematically and structured around field trips to art installations throughout New York City.
2 credits

HTA 337 Russian Art and Culture
The class will survey the history of Russian art, reaching back to its pre-modern origins. It will address Russian arts and culture in their specific political and ideological context(s). Special attention will be paid to examining the interdisciplinary character (art, architecture, design, film and theater) of Constructivism and Suprematism of the early 20th century. The course will also address the impact of the historical (or revolutionary) avant-garde on contemporary art practices. Students will be required to prepare short in-class presentation on a specific modern or contemporary artist, architect, or designer, who uses or used the constructivist vocabulary in his or her work, and, as a final project, write a ten page research paper.
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 341 Body Politics in Art Since 1945
This elective will examine the multiple and dynamic ways in which art since the Second World War has constructed understandings of the body. Over the course of the semester, we will meet a strange and motley assortment of bodies: the diseased body, the heroic body, the queer body, the abject body, the body-as-machine. Not primarily concerned with images of the human figure—although they will certainly make appearances from time to time—the course will instead ask, "How does art think the body?
2 credits

HTA 99 Independent Study (History/Theory of Art)
2 credits

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