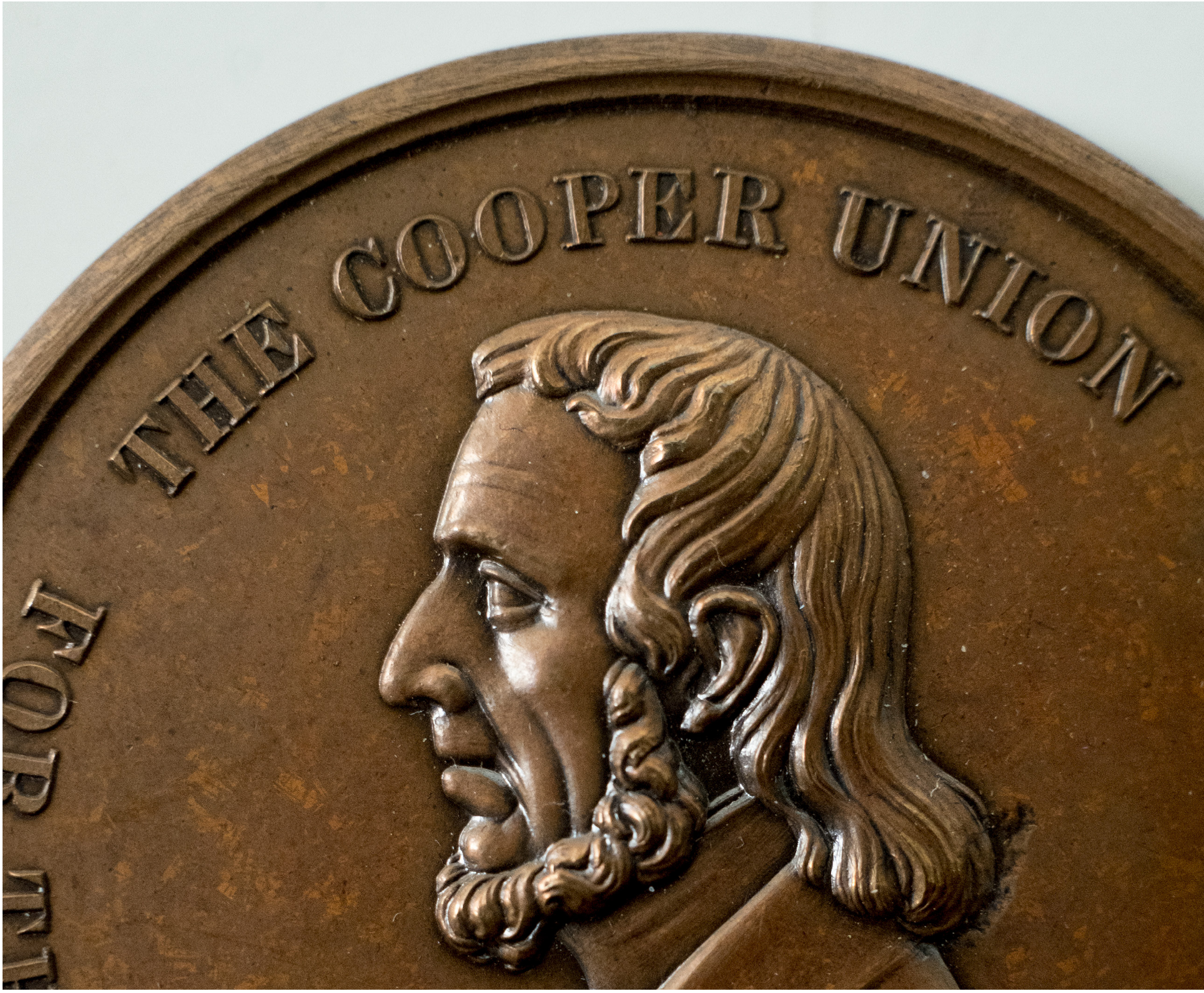
THE COOPER UNION

FOR THE ADVANCEMENT OF SCIENCE AND ART



COURSES 2016|17

COOPER.EDU

GENERAL INFORMATION

MISSION STATEMENT

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

The college admits undergraduates solely on merit and awards full-tuition scholarships to all enrolled students.[1] The institution provides close contact with a distinguished, creative faculty and fosters rigorous, humanistic learning that is enhanced by the process of design and augmented by the urban setting.

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

[1] This mission statement was adopted by The Cooper Union Board of Trustees in 2000. For classes enrolling in fall 2014 and thereafter, The Cooper Union provides half-tuition scholarships, plus additional need-based aid. A committee representative of the campus and alumni communities will undertake the creation of a new mission statement as part of a strategic planning process to begin in fall 2016.

2016-17 ACADEMIC CALENDAR

Aug 28	Sun	Move-in day for Residence Hall
Aug 28–Sep 4	Sun -Sun	New student orientation
Sep 5	Mon	Labor Day Observed
Sep 6	Tue	Fall semester classes begin. Note: Tuesday classes meet
Sep 13	Tue	There will be a $25 fee for Dropping classes after this date
Sep 13	Tue	Fall Festival
Nov 22-23	Tue-Wed	Thursday and Friday Classes Meet
Nov 24-27	Thu-Sun	Thanksgiving (staff holiday)
Dec 1-7	Thu-Wed	Registration for Spring 2017 Classes
Dec 8-9, 12-14	Thu-Fri, Mon-Wed	Last HSS/Engineering Classes
Dec 15-16, 19-21	Thu-Fri, Mon-Wed	Last meeting times for all architecture and art classes/crits. These continue in their Regularly assigned rooms/spaces. Final Exams for HSS and Engineering
Dec 21	Wed	Last day of Fall 2016 semester
Dec 22–Jan 16	Thur-Mon	Winter recess; all schools
Dec 22–Jan 3	Thur-Tue	Staff Holiday
Jan 4	Wed	Administrative Offices reopen. All grades are due in the Office of Admissions and Records before Noon
Jan 16	Mon	Martin Luther King Jr.'s birthday (Staff Holiday)

Jan 17	Tue	Spring semester classes begin. Note: modified schedule; Monday classes meet
Jan 25	Wed	There will be a $25 fee for Dropping classes after this date
Feb 17-20	Fri-Mon	Founder's Day/President's Day (Staff Holiday)
Mar 11-19	Sat-Sun	Spring recess (administrative offices remain open)
Apr 18-21	Tue-Fri	Registration for Fall 2017 classes
Apr 26-27	Wed-Thu	Last HSS/Engineering Wed/Thurs Classes
May 1, 2, 5	Mon, Tue, Fri	Last HSS/Engineering Mon/Tues/Fri Classes
May 3, 4, 8, 9, 10	Wed, Thu, Mon-Wed	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 10	Wed	Note: Friday classes, exams and crits meet
May 10	Wed	Last day of Spring 2017 semester
May 11	Thu	Senior grades due in the Office of Admissions and Records before Noon.
May 15	Mon	All non-senior grades are due in the Office of Admissions and Records before Noon.
May 22	Mon	Commencement rehearsal; annual student exhibition opens
May 23	Tue	Commencement
May 29	Mon	Memorial Day (Staff Holiday)
July 4	Tue	Independence Day Observed (Staff Holiday)

PROGRAMS AND ACCREDITATION

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	Master of Architecture II

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.

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.

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.

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.

Illness

Students who become ill during the course of the school year have an obligation to communicate with their professors about any absences. Students who seek medical assistance should submit that documentation to the Dean of Students office. The Dean of Students will inform the student's faculty and academic school that medical documentation is on file for these absences. NOTE: While medically justified absences will be considered excused, students are still subjected to applicable attendance policies. Most class at the Cooper Union require attendance and even excused absences will not eliminate this requirement. Students with excused absences may be required to take a grade of Incomplete or possibly withdraw from a course and register for it in a later semester. Depending on the length of the absence period, a student may need to take a medical leave of absence. Each situation is unique and the Dean of Students will work with the student and their faculty and academic school to determine the necessary course of action.

LEAVE OF ABSENCE

Medical Leave of Absence A student who must interrupt his/her studies for medical reasons must complete the following process:

1) Student must submit to the Dean of Students documentation from a licensed medical provider indicating a diagnosis of a medical condition and a recommendation by the treating medical provider that the student take a medical leave of absence. The documentation must indicate the length of the leave of absence. The Dean of Students will inform the student's academic dean once this documentation is on file.
2) Student must submit a written request for a Medical Leave of Absence to his/her academic dean.

Return 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 complete the following procedures in order to return:

1) Student must 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 letter must

indicate that the condition for which the student was provided the medical leave has been treated. The letter must also indicate if there are any restrictions or accommodations needed to return to rigorous academic study.

2) The student must formally submit a written request to their academic dean to return from their medical leave.
3) The academic dean will 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 Dean of Students and/or 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 dean of students and the student's academic dean 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 deans 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 deans may recommend that the student be placed on a compulsory medical leave of absence. The student will be sent a letter notifying him or her of the deans' 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 President's Cabinet, ideally another dean, 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 officer(s) 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.

Depending on the level of concern as assessed by the dean of students and the student's academic dean, 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 designated equal opportunity officer (EOO) setting forth the reasons why the appeal is being made. The EOO will convene an Appeal Board within 3 days of receiving the appeal letter. The board will consist of the EOO or his/her designee and one member of the President's Cabinet who was not involved in any way in the prior hearing. The Appeal Board shall limit its review to these issues:

1. Does the record show that the party had a full and fair opportunity to present his or her case?
2. 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.

ADMISSIONS

APPLICATION DEADLINES

Undergraduate
The Cooper Union uses the Common Application as its undergraduate application. The Office of Admissions treats every application in the same manner, whether it is submitted electronically or on paper.

Early Decision for Fall 2018 Applications
School of Architecture: December 1, 2017
School of Art: December 1, 2017*
School of Engineering: December 1, 2017

Regular Decision for Fall 2018 Applications
School of Architecture: January 8, 2018
School of Art: January 8, 2018*
School of Engineering: January 8, 2018

Applicants are welcome to submit additional, OPTIONAL materials such as a résumé, abstract for a research paper, ZeeMee profile, and so forth. You may include this additional information as part of your Common Application or email it to admissions@cooper.edu. We look forward to getting to know you!

*Transfer applicants to the School of Art may apply Early Decision. On the Common Application, you will first need to select 'Regular Decision' for your Decision Plan. After you make this selection and indicate that you are applying to the School of Art, a question will generate asking if you would like to apply Early Decision as a transfer student. To apply Early Decision to the School of Art as a transfer student, you will select 'Yes' and follow the subsequent prompts. Please contact the Office of Admissions at admissions@cooper.edu or 212.353.4120 with any questions or concerns.

**Hometest & Studio Test: Early Decision applicants to the School of Architecture and/or School of Art will be sent a studio test or Hometest, respectively, in December. Regular Decision applicants to the School of Architecture and/or School of Art will be sent a studio test or Hometest, respectively, in January. This must be completed within one month of receipt. The Hometest and studio test will be sent to all applicants via email on the same day after the online application deadline. We highly recommend that you add admissions@cooper.edu to your email address book to prevent important emails from going to spam.

Graduate Deadlines

Please Note: The Fall 2017 Master of Architecture II and Master of Engineering applications are now closed. Graduate applications for Fall 2018 will be available beginning September 2017.

Fall 2017 Masters Applications (Fall 2018 Deadlines Coming Soon)
Master of Architecture II: January 31, 2017
Master of Engineering: March 31, 2017 (for full time study)
Master of Engineering: May 5, 2017 (for part time study)

THE IRWIN S. CHANIN SCHOOL OF ARCHITECTURE

FIRST YEAR REQUIREMENTS BACHELOR OF ARCHITECTURE DEGREE

1. Submit the first part of your application online by January 9, 2017.
2. You will receive a confirmation email.
3. You will have to prepare and submit by January 17, 2017:
   - Your official high school transcript or GED certificate (required for all applicants)
   - Any official college transcripts (sent directly from the college or university)
   - Recommendation letters (1 strongly encouraged)
   - Your SAT I or ACT scores (must be sent directly from the College Board and/or ACT)
   - Send all materials to the Office of Admissions,
     30 Cooper Square, 3rd Floor, New York, NY 10003.
4. You will receive a studio test in late January which you must complete and submit by the deadline provided (approximately 3-4 weeks later).
   The studio test will be sent to all applicants via email on the same day in late January after the application deadline.
   Please follow all instructions carefully. For First Year applicants, no additional portfolio material should be sent.
5. You will receive an admission decision by the first week of April.
   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, and must submit an official transcript documenting successful completion of the course.

*Applicants whose native language is not English and who have not graduated from a secondary school in a country with English as the official medium of instruction are required to take the Test of English as a Foreign Language (TOEFL) and submit official scores to the Office of Admissions. Click here for more information regarding

International Applicants.

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.

TRANSFER REQUIREMENTS BACHELOR OF ARCHITECTURE DEGREE

You may apply for transfer to The Irwin S. Chanin School of Architecture if:

You have completed at least one year of an accredited architecture program elsewhere by June of the year for which you are applying.
OR by June you hold a bachelor's degree or the equivalent in a discipline other than architecture.
OR you can submit a portfolio of your creative work and you have begun studies in a discipline related to architecture.

1. Submit the first part of your application online by January 9, 2017.
2. You will receive a confirmation email.
3. You will have to prepare and submit by January 17, 2017:
   - Your official high school transcript or GED certificate (required for all applicants)
   - Your official college transcripts (sent directly from the college or university)
   - Recommendation letters (1 strongly encouraged)
   - Your SAT I or ACT scores (must be sent directly from the College Board and/or ACT)*
   - Send all materials to the Office of Admissions,
     30 Cooper Square, 3rd Floor, New York, NY 10003.

*Under certain circumstances, we will waive the SAT/ACT requirement. Generally, only transfer students and/or non-traditional students' requests to waive the standardized testing requirement are considered. You must be able to prove you have had at least one year of college-level math and college-level English to apply for the waiver. The Admissions staff will then consider your request and notify you if you can waive the SAT/ACT requirement. Please email admissions@cooper.edu for more information.

4. You will receive a studio test in late January which you must complete and submit by the deadline provided (approximately 3-4 weeks later).
   The studio test will be sent to all applicants via email on the same day in late January after the application deadline.
   The studio test will include portfolio requirements for transfers.
   All portfolio work should be sent with the studio test.
   Please follow all instructions carefully.

5. You will receive an admission decision by the beginning of April.
   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. **

* Applicants whose native language is not English and who have not graduated from a secondary school in a country with English as the official medium of instruction are required to take the Test of English as a Foreign Language (TOEFL) and submit official scores to the Office of Admissions. Click here for more information regarding International Applicants.

** 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.

APPLICATION REQUIREMENTS MASTER OF ARCHITECTURE II DEGREE

The Master of Architecture II program will serve professionals who wish to continue in practice with higher research and design skills in those areas in which the program offers specialization. It will additionally prepare those who wish to develop parallel careers in teaching and/or continue to engage in research toward an appropriate Ph.D degree at another institution.

The Master of Architecture II program is open to applicants who:
hold the degree of Bachelor of Architecture (B.Arch), the Master of Architecture I (M.Arch I) or an equivalent degree from an international institution.
have completed a minimum of one year of work experience after obtaining their first professional degree.

The Master of Architecture II program is open to applicants who:
- hold the degree of Bachelor of Architecture (B.Arch), the Master of Architecture I (M.Arch I) or an equivalent degree from an international institution.
- have completed a minimum of one year of work experience after obtaining their first professional degree.

All applicants must submit the following:

- A completed application form
- A nonrefundable application fee of $75
- Official academic records (transcripts) from all colleges and universities from which you have received credit
- GRE scores are required.
- TOEFL score is required if you have less than three years of study in English.
- Recommendation letters (three are required)
- Resumé/CV
- Written Essay: The essay should succinctly explain your interest in the M.Arch II program as well as the specified area of concentration
- Examples of written work
- Portfolio: Applicants must submit a portfolio that includes their most important and representative design and written work. The portfolio should consist of professional, academic and/or scholarly work. It should be bound into a brochure no larger than 9" x 12" (overall size). Applicant should not submit CDs, slides, loose sheets or original drawings. Simple packaging is preferred.

Potential candidates may be required to be available and make necessary arrangements for a personal interview. While we make every attempt to conduct interviews remotely, any interview expenses will be the responsibility of the candidate.

Applications for the 2016-2017 academic year will be accepted beginning September 2016 through January 31, 2017.

Deferral of an Offer of Admission: 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.

SCHOOL OF ART

FIRST YEAR REQUIREMENTS
BACHELOR OF FINE ARTS DEGREE

EARLY DECISION

If The Cooper Union is your first choice, you may consider applying early decision. If admitted via early decision you must accept our offer and withdraw your other college applications.

1. Submit the first part of your application online by December 1, 2016.
2. You will receive a confirmation email.
3. You will have to prepare and submit by December 1, 2016:
   - Your official high school transcript or GED certificate (required for all applicants)
   - Any official college transcripts (sent directly from the college or university)
   - Recommendation letter (1)
   - Your SAT I or ACT scores (must be sent directly from the College Board and/or ACT)

Send all materials to the Office of Admissions,
30 Cooper Square, 3rd Floor, New York, NY 10003.

4. You will receive a home test in December which you must complete and submit by the deadline provided (approximately 3-4 weeks later).
   The home test will be sent to all applicants via email on the same day in December after the application deadline.
   The home test will include portfolio requirements. All portfolio work should be sent with the home test. Please follow all instructions carefully.
5. You will receive an admission decision by the end of February.

REGULAR DECISION

1. Submit the first part of your application online by January 9, 2017.
2. You will receive a confirmation email.
3. You will have to prepare and submit by January 17, 2017:
   - Your official high school transcript or GED certificate (required for applicants)
   - Any official college transcripts (sent directly from the college or university)
   - Recommendation letter (1)
   - Your SAT I or ACT scores (must be sent directly from the College Board and/or ACT)
   - Send all materials to the Office of Admissions,
     30 Cooper Square, 3rd Floor, New York, NY 10003.

4. You will receive a home test in late January which you must complete and submit by the deadline provided (approximately 3-4 weeks later).
   The home test will be sent to all applicants via email on the same day in late January after the application deadline.
   The home test will include portfolio requirements. All portfolio work should be sent with the home test. Please follow all instructions carefully.
5. You will receive an admission decision by the first week of April.

*Applicants whose native language is not English and who have not graduated from a secondary school in a country with English as the official medium of instruction are required to take the Test of English as a Foreign Language (TOEFL) and submit official scores to the Office of Admissions.

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 (see above), 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.

TRANSFER REQUIREMENTS BACHELOR OF FINE ARTS DEGREE

You may apply for transfer to The School of Art if:
You have completed 18-60 credits of studio art courses.
OR you have previously earned a baccalaureate degree in a discipline other than art.

EARLY DECISION

Transfer applicants to the School of Art may apply Early Decision. On the Common Application, you will first need to select 'Regular Decision' for your Decision Plan. After you make this selection and indicate that you are applying to the School of Art, a question will generate asking if you would like to apply Early Decision as a transfer student. To apply Early Decision to the School of Art as a transfer student, you will select 'Yes' and follow the subsequent prompts. Please contact the Office of Admissions at admissions@cooper.edu or 212-353-4120 with any questions or concerns.

1. Submit the first part of your application online by December 1, 2016.
2. You will receive a confirmation email.
3. You will have to prepare and submit by December 1, 2016:
   - Your official high school transcript or GED certificate (required for all applicants)
   - Your official college transcripts (sent directly from the college or university)
   - Recommendation letters (2)

- Your SAT I or ACT scores (sent directly from the College Board and/or ACT)*
- Send all materials to the Office of Admissions,
  30 Cooper Square, 3rd Floor, New York, NY 10003.

*Under certain circumstances, we will waive the SAT/ACT requirement. Generally, only transfer students and/or non-traditional students' requests to waive the standardized testing requirement are considered. You must be able to prove you have had at least one year of college-level math and college-level English to apply for the waiver. The Admissions staff will then consider your request and notify you if you can waive the SAT/ACT requirement. Please email admissions@cooper.edu for more information.

4. You will receive a home test in December which you must complete and submit by the deadline provided (approximately 3-4 weeks later).
   The home test will be sent to all applicants via email on the same day in mid-December after the application deadline.
   The home test will include portfolio requirements. All portfolio work should be sent with the home test. Please follow all instructions carefully.
5. You will receive an admission decision by the end of February.

REGULAR DECISION

1. Submit the first part of your application online by January 9, 2017.
2. You will receive a confirmation email.
3. You will have to prepare and submit by January 9, 2017:
   Your official high school transcript or GED certificate (required for all applicants)
   Your official college transcripts (sent directly from the college or university)
   Recommendation letters (2)
   Your SAT I or ACT scores (sent directly from the College Board and/or ACT)*
   Send all materials to the Office of Admissions,
   30 Cooper Square, 3rd Floor, New York, NY 10003.

*Under certain circumstances, we will waive the SAT/ACT requirement. Generally, only transfer students and/or non-traditional students' requests to waive the standardized testing requirement are considered. You must be able to prove you have had at least one year of college-level math and college-level English to apply for the waiver. The Admissions staff will then consider your request and notify you if you can waive the SAT/ACT requirement. Please email admissions@cooper.edu for more information.

4. You will receive a home test in late January which you must complete and submit by the deadline provided (approximately 3-4 weeks later).
   The home test will be sent to all applicants via email on the same day in late January after the application deadline.
   The home test will include portfolio requirements. All portfolio work should be sent with the home test. Please follow all instructions carefully.
5. You will receive an admission decision by the first week of April.

* Applicants whose native language is not English and who have not graduated from a secondary school in a country with English as the official medium of instruction are required to take the Test of English as a Foreign Language (TOEFL) and submit official scores to the Office of Admissions. Click here for more information regarding International Applicants.

Transfer applicants typically have fewer than 60 credits at another institution. 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.

ALBERT NERKEN SCHOOL OF ENGINEERING

FIRST YEAR REQUIREMENTS BACHELOR OF ENGINEERING DEGREE

These instructions are for first-year students. There are alternate instructions for transfer students. Admission after three years of high school will be considered for exceptional students. See below for more information.

EARLY DECISION

If The Cooper Union is your first choice, you may consider applying early decision. If admitted via early decision you must accept our offer and withdraw your other college applications. See below for instructions on regular decision.

1. Submit the first part of your application online by December 1, 2016.
   Please note: Competitive applicants have studied chemistry, physics and calculus.
2. You will receive a confirmation email from the Office of Admissions.
   All Engineering applicants must complete the Engineering Part II Questionnaire, a set of short answer essay questions. The Part II Questionnaire must be submitted through the Writing Supplement on your Common Application by December 8, 2016.
   Please Note: The Engineering Writing Supplement may be submitted after you submit your Common Application.
   If you submit your Common Application as an Art or Architecture applicant and wish to submit an additional application to Engineering, you will not be able to access the Part II Writing Supplement via the Common App. Instead, once the Office of Admissions receives your Additional Application(s) Form indicating that you wish to apply to the School of Engineering, we will send you a confirmation email containing a link to the Part II.
3. You will have to prepare and submit by December 1, 2016:
   - Your official high school transcript or GED certificate (required for all applicants)
   - Any official college transcripts (sent directly from the college or university)
   - Recommendation letters (2-3)
   - Your SAT I or ACT scores (must be sent directly from the College Board and/or ACT)
   - Two SAT II scores: one in Math (either 1 or 2) and one in either Physics or Chemistry

Send all materials to the Office of Admissions,
30 Cooper Square, 3rd Floor, New York, NY 10003.

4. You will receive an admission decision by the end of December.
5. Candidate reply date is January 30, 2017.

REGULAR DECISION

1. Submit the first part of your application online by January 9, 2017.
   Note: Competitive applicants have studied chemistry, physics and calculus, though this is not required.
2. You will receive a confirmation email from the Office of Admissions.
   All Engineering applicants must complete the Engineering Part II Questionnaire, a set of short answer essay questions. The Part II Questionnaire must be submitted through the Writing Supplement on your Common Application by January 17, 2017.
   Please Note: The Engineering Writing Supplement may be submitted after you submit your Common Application.
   If you submit your Common Application as an Art or Architecture applicant and wish to submit an additional application to Engineering, you will not be able to access the Part II Writing Supplement via the Common App. Instead, once the Office of Admissions receives your Additional Application(s) Form indicating that you wish to apply to the School of Engineering, we will send you a confirmation email containing a link to the Part II.
3. You will have to prepare and submit by January 9, 2017:
   - Your official high school transcript or GED certificate (required for all applicants)
   - Any official college transcripts (sent directly from the college or university)
   - Recommendation letters (recommended: 2-3)
   - Your SAT I or ACT scores (sent directly from the College Board and/or ACT)
   - Two SAT II scores: one in Math (either 1 or 2) and one in either Physics or Chemistry

We strongly encourage you to take any SAT or ACT tests by December 2016 in order for us to receive these scores and review your application in a timely manner.

Send all materials to the Office of Admissions,
30 Cooper Square, 3rd Floor, New York, NY 10003.

4. You will receive an admission decision by the first week of April.

* Applicants whose native language is not English and who have not graduated from a secondary school in a country with English as the official medium of instruction are required to take the Test of English as a Foreign Language (TOEFL) and submit official scores to the Office of Admissions. Click here for more information regarding International Applicants.

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

Preference for transfer is given to those applicants that have completed all of Cooper Union's first year program at another accredited college. If space is available, students are admitted on the basis of prior college records. It may be necessary to wait until late June for a decision.

1. Submit the first part of your application online by January 9, 2017.
2. You will receive a confirmation email from the Office of Admissions.
   All Engineering applicants must complete the Engineering Part II Questionnaire, a set of short answer essay questions. The Part II Questionnaire must be submitted through the Writing Supplement on your Common Application by January 17, 2017. Please Note: The Engineering Writing Supplement may be submitted after you submit your Common Application.

   If you submit your Common Application as an Art or Architecture applicant and wish to submit an additional application to Engineering, you will not be able to access the Part II Writing Supplement via the Common App. Instead, once the Office of Admissions receives your Additional Application(s) Form indicating that you wish to apply to the School of Engineering, we will send you a confirmation email containing a link to the Part II.
3. You will have to prepare and submit by January 17, 2017:
   - Your official high school transcript or GED certificate (required for all applicants)
   - Your official college transcripts (sent directly from the college or university)
   - Recommendation letters (2-3)
   - Your SAT I or ACT scores (sent directly from the College Board and/or ACT)*
   - Two SAT II scores: one in Math (either 1 or 2) and one in either Physics or Chemistry

Send all materials to the Office of Admissions,
30 Cooper Square, 3rd Floor, New York, NY 10003.

* Under certain circumstances, we will waive the SAT/ACT requirement. Generally, only transfer students and/or non-traditional students' requests to waive the standardized testing requirement are considered. You must be able to prove you have had at least one year of college-level math and college-level English to apply for the waiver. The Admissions staff will then consider your request and notify you if you can waive the SAT/ACT requirement. Please email admissions@cooper.edu for more information.

4. You will receive an admission decision in late May or early June.

**Applicants whose native language is not English and who have not graduated from a secondary school in a country with English as the official medium of instruction are required to take the Test of English as a Foreign Language (TOEFL) and submit official scores to the Office of Admissions. Click here for more information regarding International Applicants.

APPLICATION REQUIREMENTS MASTER OF ENGINEERING DEGREE

Cooper Union offers a Master of Engineering program that prepares graduates for entry into the engineering profession at an advanced level or for further graduate study. See the general curriculum and course listings.

Applications to the Master of Engineering program for full-time study for the 2016-2017 academic year will be accepted beginning September 2016 through March 31, 2017. Applicants interested in part-time graduate study in engineering may apply through May 5, 2017.

Please submit the following supplemental information no later than March 31, 2017 to the Office of Admissions, The Cooper Union, 30 Cooper Square, New York, NY 10003. Please note, applicants for part time graduate study may submit supplemental materials through May 5, 2017.
Materials may also be sent to admissions@cooper.edu. Please reference in the subject line of your email "Graduate Engineering Supplemental Information".
Application Requirements:

- B.E. or B.S. in an engineering discipline;
- Official copies of school transcripts. This includes secondary (high school), college and university work;
- GRE Scores (optional);
- TOEFL Scores (if Bachelor's Degree was taught in a language other than English);
- Two letters of recommendation.
- Résumé (see below for detailed information)

- Letters of recommendation are optional for Cooper students. If Cooper alums applying to the graduate program want to submit the letters, the letters can be emailed to admissions@cooper.edu. If they decide not to include them, nothing needs to be communicated/sent.
- Non-Cooper students are required to submit 2 letters of recommendation and they can be sent to the Office of Admission (either via email to admissions@cooper.edu or mailed to our office).
- In a separate document, please submit a résumé, listing any professional licensure or certification along with a statement indicating what areas within engineering you seek to study.
- Be sure to outline any relevant academic honors or awards, teaching or work experiences, internships, publications, research, projects, websites, patents, or other evidence of creative scholarship.
- Also, please list in the same document, any relevant graduate-level coursework taken and method of instruction (traditional, on-line, hybrid (mix of on-line and traditional)).

INTERNATIONAL APPLICANTS

At Cooper Union, we value the importance of a diverse student body. As such, we attract and enroll students from around the world. Please read below for important information pertaining to international students:

Definition: International students are those who do not hold U.S. citizenship or permanent residency.

Financial Aid: International students are not eligible for Federal or State Financial Aid. However, they are eligible for the half-tuition scholarship and additional merit aid.

Required Tests

International applicants who have studied for less than three years in English 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. The IELTS score is not accepted by Cooper Union and may not be substituted for the TOEFL.

- All applicants to The Cooper Union are required to submit scores from the SAT exam or ACT exam.
- Make sure the name on your passport matches your name on the application, TOEFL and SAT/ACT scores.

All high school and college transcripts must be translated into English, notarized and sent to The Cooper Union.

Students needing an I-20 (those who are non-citizens or who are not permanent residents) who are accepted to The Cooper Union will be required to submit a Certificate of Finances with the Office of Admissions and Records and International Student Advisement prior to being issued an I-20. The Certificate of Finances must certify that students meet the minimum financial support requirements for resident students. Please contact the Office of Admissions at admissions@cooper.edu to receive this form.

International students are assessed a fee of $2,010 per year.

Please e-mail: admissions@cooper.edu with other questions.

TUITION & FEES

TUITION

Undergraduate Tuition

The cost of tuition at The Cooper Union for the 2016-2017 academic year is $42,000. Starting in the Fall of 2014, all students enrolling for the first time at Cooper Union receive a half-tuition scholarship currently worth $21,000 per year ($10,500 per semester). Additional financial aid is provided to the least fortunate students to help cover tuition, housing, food, books, supplies etc. The amount of additional aid is based upon a student's demonstrated financial need. Students must file a FAFSA to be considered for additional financial aid. Please note that Cooper Union offers merit scholarships to exceptional students. Also, Cooper Union uses a need-blind admissions process, meaning that a student's ability to pay does not impact the admissions decisions.

Undergraduate students first enrolling at Cooper Union prior to the Fall of 2014, receive a full tuition scholarship valued at $42,000 ($21,000 per semester) for the 2016-2017 school year.

Graduate Tuition

School of Architecture 2016-2017: The Master of Architecture II program is a three-semester program. All admitted students will be assessed tuition at the rate of $21,000 per semester. Graduate fellowships are available for admitted students of exceptional merit and/or need.

School of Engineering 2016-2017: Students in the Master of Engineering program are charged $1,235 per credit; 30 credits total. Any admitted Cooper Union alumnus entering the graduate program in Fall 2016 is eligible for a half-tuition scholarship for two years of study. Merit-based scholarships and research assistantships will be available to a select group of exceptional applicants in every degree-granting department. The deadline to apply for Fall 2016 full time graduate study is April 1, 2016.

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 up to the 7th day of class, 50 percent refundable up to the 14st day of class and 25 percent refundable up to the 28th day of class. 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.

Withdrawal Fees

Should a student choose to withdraw, tuition can be refunded. It is 100 percent refundable up to the 7th day of class, 50 percent refundable up to the 14th day of class and 25 percent refundable up to the 28th day of class. Thereafter, it is not refundable.

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. This fee covers normal usage, "wear and tear," and basic supplies for laboratory and studio projects. For new students, this fee is payable on acceptance of admission and is non-refundable.

Student Residence Fees

Students electing to live in Student Residence will be responsible for paying the regular housing fees. The fees for the 2016-2017 academic year are $11,910 for a double (two students per bedroom) and $12,980 for a single (one student per bedroom). The fees cover residence for the fall and spring semesters and may be paid in two parts.

Refund Policy for Student Residence

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

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

Health Service 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 September 9th will be billed $1,520 for the Health Service and Insurance Fee for that academic year.

International Student Fee

Students on visas (those who are non-citizens or who are not permanent residents) are responsible for an additional fee of $1,005 per semester payable by August 15 in the Fall semester and February 15th in the Spring semester.

Graduation Fee

A graduation fee of $250 is required of all students entering their first semester of their undergraduate/graduate senior 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 Maintenance of Matriculation Fee

The requirements for the Master of Engineering program must be completed within two years of admission to graduate status, except with the expressed consent of the Dean of Engineering. Requests for extension must be presented in writing to the Dean in the final semester of the second year. In addition, approval must be granted from the student's thesis adviser. 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.

Cooper Union Health Insurance

It is a requirement that all matriculated students have health insurance coverage. The Cooper Union provides health insurance for all students through The Cooper Union Accident and Sickness plan. The cost of insurance will appear on every student's billing statement, which should be sent out to every student approximately by July 15, 2016. Students who are covered under their own or their parent's insurance policy may choose to waive The Cooper Union Accident and Sickness plan. Please be advised that if you wish to waive the insurance, the insurance you provide must be currently active and will be subject to verification.

To enroll or waiver in the health insurance plan, you must access The Cooper Union Accident and Sickness plan online at http://www.christiestudenthealth.com/cooperunion using their Cooper Union ID number. International and Exchange students will NOT be permitted to waive their insurance and are required to enroll in the Cooper Union health insurance plan.

If you do not provide proof of insurance by August 18, 2016, you will not be allowed to waive your insurance and you must pay for the Fall semester portion. There will be no exceptions to this rule.

International Students Fee	August 15, 2016
Proof of Insurance to Waive Cooper Union Insurance	August 18, 2016
Student Accident and Sickness/Enrollment Waiver form	September 9, 2016

FINANCIAL AID

The Cooper Union was founded on the principle of providing access to higher education regardless of race, creed, gender or financial means. Tuition assistance has been integral to the make-up of the institution since it began over 150 years ago. Our admissions process is need-blind which means your financial circumstances have no bearing on your admissions decision.

As an all honors college, every admitted student receives a half-tuition scholarship valued at $21,000 per academic year (2016-2017). Students will automatically be considered for additional merit based scholarship through the admissions process. In order to be considered for need-based aid, students must file the FAFSA form.

The Cooper Union's Office of Financial Aid helps students and their families understand the financial requirements of a Cooper Union education and explore options and funding to meet educational expenses. We provide assistance with all aspects of the financial aid application process and help individuals and families financially plan their academic careers at the institution.

The Financial Aid Office reserves the right to change or modify your financial aid package at any time without prior notifications.

You may contact the Office of Financial Aid with the information below:

Office of Financial Aid
30 Cooper Square, 3rd Floor
New York, NY 10003-7120

Email: financialaid@cooper.edu
Telephone: (212) 353-4113
Fax: (212) 353-4193

STUDENT COST OF ATTENDANCE BUDGET

This budget guide has been prepared to 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.

Art & Architecture Students

	Living w/ Parents	Living in the Residence Hall	Living Off-Campus
Tuition	$42,000	$42,000	$42,000
Student Fee	$1,600	$1,600	$1,600
Lab & Studio Materials Fee	$250	$250	$250
Books & Supplies	$1,800	$1,800	$1,800
Room & Board	$1,600	$15,910	$15,910
Personal	$1,575	$1,575	$1,575
Transportation	$750	$700	$750
Sub-total:	$49,575	$63,835	$63,885
(1) Less Half-tuition Scholarship	($21,000)	($21,000)	($21,000)
Total:	**$28,575**	**$42,835**	**$42,885**

International Students are charged an semester fee of $1,050 ($2,010 for one year)

Engineering Students

	Living w/ Parents	Living in the Residence Hall	Living Off-Campus
Tuition	$42,000	$42,000	$42,000
Student Fee	$1,600	$1,600	$1,600
Lab & Studio Materials Fee	$250	$250	$250
Books & Supplies	$1,000	$1,000	$1,000
Room & Board	$1,600	$15,910	$15,910
Personal	$1,575	$1,575	$1,575
Transportation	$750	$700	$750
Sub-total:	$48,775	$63,035	$63,085
(1) Less Half-tuition Scholarship	($21,000)	($21,000)	($21,000)
Total:	**$27,775**	**$42,035**	**$42,085**

International Students are charged an annual fee of $2,010

(1) All students receive a half-tuition scholarship

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. First time students must complete the FAFSA to be considered for additional financial aid. Please note that for exceptional students, Cooper Union may also offer merit scholarships.

NOTE: Students without health insurance must add a Health Service and Insurance Fee of $1,200.

THE IRWIN S. CHANIN SCHOOL OF ARCHITECTURE

MISSION

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 creative 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 strengths and individual talents, interests and modes of working, to their highest potential.

The traditional and essential skills of drawing, model-making and design development are complemented by a full investigation of the analytical and critical uses of digital technologies. The study of world architecture and urbanism is deepened by the understanding of individual cultures, environmental, and technological issues at every scale. The theory of the discipline, past and present, is investigated through the close analysis of critical texts and related to the theory and practice of other arts, such as public art, film and video. The position of the School of Architecture, together with the Schools of Art and Engineering and the Faculty of Humanities and Social Sciences, offers a unique opportunity for interaction and interdisciplinary research and experience. In recent years the school has developed the studio curriculum in ways that have reinforced its strong traditions of design and craft while investigating problems that reflect the changing conditions of contemporary practice, the urgent issues resulting from rapid urbanization and the need for environmental and cultural conservation. In these studio experiments students and faculty together explore the potential contributions of architecture to our changing world, redoubling their efforts to imagine a positive future for an architecture that is, after all, a discipline of design. This task does not involve a wholesale rejection of the past—our traditions and historical experience—for what has changed are not the principles, but rather the determinants and the materials of design. We are in the process of re-learning the poetics of a space of life: of air and water, of geology and geography, of culture and society, of poetics that lie deeply within these elemental forces. On this re-framing—programmatically, technologically, and above all formally—rests not simply the future of architecture, but of our life in the world. Gradually, out of this process, architecture, once more, may become a force through which life is transcribed into art in order to enhance life.

BACHELOR OF ARCHITECTURE

PROGRAM DESCRIPTION

The Bachelor of Architecture curriculum of the School of Architecture is designed to provide the student with a comprehensive educational experience, gaining knowledge and skills in preparation for the successful and ethical practice of architecture. Design studios and courses build cumulatively over the five years in order to establish a broad and deep foundation of knowledge in architecture and urban design in relation to developments in the sciences, arts, and technology. The curriculum stresses the importance of architecture as a humanistic discipline concerned with the design and construction of habitats in diverse social and ecological conditions, and their corresponding requirements for sustainability and ethical responsibility.

The five year professional program is framed within the context of a rigorous liberal arts education that includes a wide range of required and elective courses in the Humanities and Social Sciences, together with elective opportunities in the Schools of Art and Engineering, emphasizing the nature of architecture as a cultural, social, and technological practice intimately tied to the increasingly urgent questions raised by the man-made and natural environment.

First Year

The First Year is conceived as a broad introduction to society, culture, environment, and the nature, place and role of architecture in this context. The student is introduced to the principles and experience of drawing and representation in a broad range of media and formats: freehand drawing is taught side by side with projective geometry (hand constructed and computer generated), and other means of architectural representation. The Architectonics Studios encourage the investigation of space, structure, and form, as inflected by the occupation and movement of the human body, and situated in the context of environments from natural to urban. The first two semesters of the History of Architecture sequence take the student through the global developments in architecture from Antiquity to the end of the Medieval Period, with special attention to non-western and traditional architectures. The First year of the Humanities and Social Sciences Core emphasize the student's reading, writing, and analytical skills through the study of literary, historical, and sociological texts.

Second Year

The Second Year advances the student's knowledge of architecture historically, culturally, and professionally. The Second Year Design Studios are dedicated to the examination, through analysis and design exercises, of the "elements" of architecture and their assemblage, including sites and its ecological conditions, program, spatial accommodation and organization structure and environment. The first segment of the structures sequence introduced students to the principles of architectural structure. The second two semesters of the History of Architecture sequence examine the history of global architecture from the Renaissance to the present, with special emphasis on the complex environmental relations between increasingly industrialized and developing societies. The second year of the Humanities and Social Sciences core advances the students' knowledge of writing and analytic skills with in-depth courses in literature, history, and philosophy.

Third Year

The Third Year is envisaged as a comprehensive experience of the discipline in design and professional knowledge, supplemented by a range of required and elective courses in environmental, technological, and humanistic subjects, forming an integrated introduction to the environmental, social, and programmatic understanding of design. The Third Year Design Studios build from analysis to synthesis, from analyses of total building assemblages and smaller-scale design exercises, to the development of a comprehensive design for a complex programmatic institution. To this end, the faculty responsible for the teaching of environmental technology, building technology, and structures join the design faculty as teachers in the design studio, with students bringing appropriate aspects of their design proposals for elaboration within the specialized courses.

Fourth Year

The Fourth Year broadens the study of architecture, placing it within its diverse urban and rural contexts, with students gaining advanced knowledge of technological, structural, and professional concerns, the planning, zoning, social and cultural implications of architectural interventions. The Fourth Year Design Studios study the relation of institutional architecture to urban networks and infrastructures, public space, and typologies, from the investigation of rebuilding strategies following disasters, the role and nature of tall buildings, the nature of public and private institutions. The study of landscape is emphasized, both as large-scale natural environments and smaller scale site developments. A broad spectrum of specialized elective courses, including Modern Architectural Concepts, Analysis of Architectural Texts, Landscape, Advanced Topics in Environmental Studies, History, Theory and Criticism, Advanced Concepts in the related arts and professional ethics, deepens the understanding of the profession, and its relationship to different cultures and environmental context.

Fifth Year

The Fifth Year is constructed around the student's development of their individual thesis project, and the in-depth study of professional practice in all its aspects. The year-long Thesis is divided into two stages over two semesters, with intensive research followed by a comprehensive design. The subjects of the thesis vary in scale and context, with the proviso that the student investigates a problem of fundamental importance to contemporary life and architecture, identified as a site for the intervention of design as an ameliorative construct. Overall the design thesis emphasizes the profound relationship of architecture to the broader problems of the environment and ecological sustainability, whether at the scale of desertification and rising sea-waters brought on by global warming, the provision of unpolluted water to developing communities, to the smaller scales of urban signification, mobility, and programmatic re-use. The course in professional practice surveys the questions of licensing, internship and IDP participation, and introduces students through site visits to a range of practices and public hearings.

Minor

Architecture students in good academic standing with advance permission 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. Students must apply in advance of completing their coursework to be considered for the minor. Approval of the dean of the school of architecture is required for the minor. Additional information is available from the office of the dean of humanities and social sciences.

DEGREE REQUIREMENTS: BACHELOR OF ARCHITECTURE

The Irwin S. Chanin School of Architecture offers a five-year program leading to the Bachelor of Architecture degree. The requirements are as follows:

Courses		Credits	
First Year		**Sem 1**	**Sem 2**
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
FA 100R A-B	Introduction to Techniques	1	1
ARCH 103-4	Calculus and Analytic Geometry	3	3
HSS 1	The Freshman Seminar	3	-
HSS 2	Texts and Contexts: Old Worlds and New	-	3
Total Credits First Year		**19**	**19**
Second Year		**Sem 1**	**Sem 2**
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
HSS 3	The Making of Modern Society	3	-
HSS 4	The Modern Context: Figures and Topics	-	3
Total Credits Second Year		**15**	**15**
Third Year		**Sem 1**	**Sem 2**
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		**Sem 1**	**Sem 2**
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		**16**	**16**
Fifth Year		**Sem 1**	**Sem 2**
ARCH 151 A-B	Thesis	6	6
ARCH 152	Structures IV	2	-

* The Bachelor of Architecture curriculum requires 32 credits of required coursework outside in general studies (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 credits must be completed outside of the discipline of architecture for a total of thirteen elective credits in general studies.

Approval for these elective courses must be granted by the appropriate academic faculty. A minimum of six elective credits must be taken in the humanities and social sciences. The School of Architecture curriculum includes 32 credits of required coursework in general studies (non-professional coursework outside the discipline of architecture). In addition, students are required to complete 13 more credits of elective coursework outside the discipline of architecture.

The complete Cooper Union catalog with course descriptions, academic standards, etc., is available online and maintained by the Registrar's office.

MASTER OF ARCHITECTURE II

In addition to the existing curriculum of Advanced Design Studio work that culminates in a design-research Thesis project, the Criticism, History and Theory concentration offers a intensive one-year immersion in the criticism, history and theory of architecture. Emphasis is placed on approaches to architectural analysis and history, the role and contemporary relevance of theory, and the relations between theory and design. Seminars will offer students preparation for careers in journalism, teaching, and eventual doctoral studies, with a broad understanding of the cultural conditions of architectural production and a concentration on excellence in writing. Analysis studios provide a deep insight into the formal and programmatic diversity of historical and contemporary architecture, the process of design, and potential avenues for new approaches towards theory and practice. A required emphasis in Urbanism or Technologies of Representation allows for deeper investigation into specific areas of historical or contemporary architectural theory.

Faculty directly engaged with the Master of Architecture II program in studios and seminars for the current year include Diana Agrest, who directs the Graduate Research Design Studios and Thesis, Pablo Lorenzo-Eiroa, Daniel Meridor, Will Shapiro, Anthony Vidler, Michael Young, Tamar Zinguer and Guido Zuliani.

Instructors and guest lecturers have included Barry Bergdoll (MoMA and Columbia University), Craig Buckley (Yale University), Daniella Fabricius (Princeton University), Dietrich Neumann (Brown University), Spyros Papapetros (Princcteton University), Emmanuel Petit (Yale University), Lucia Allais (Princeton University), D. Graham Burnett (Princeton University), Kurt Forster (Yale University), Ruben Gallo (Princeton University), Adam Maloof (Princeton University), Joan Ockman (UPenn School of Design), Gyan Prakash (Princeton University), Lydia Xynogala (The Cooper Union), among others.

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 NewYork 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.

DEGREE REQUIREMENTS MASTER OF ARCHITECTURE II

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

Courses		Credits
Semester 1 (Fall)		
ARCH 411	Graduate Research Design Studio I	6
ARCH 401	Proseminar	2
FA 100R	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
FA 100R	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 M.Arch II Degree		**30**

Thesis

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

Seminars Out of Concentration
It is recommended that students register for courses originating in the graduate program (Arch 482, Arch 483 and Arch 485) to satisfy their out-of-concentration seminar requirements.

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.

PROFESSIONAL ACCREDITATION

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 program: Bachelor of Architecture (160 undergraduate credits)
The next accreditation visit for this program will be in 2024.

The NAAB expects programs to be transparent and accountable in the information provided to students, faculty, and the public. As a result, the following seven conditions require all NAAB-accredited programs to make certain information publicly available online.

II.4.1 Statement on NAAB-Accredited Degrees

All institutions offering a NAAB-accredited degree program or any candidacy program must include the exact language found in the NAAB 2014 Conditions for Accreditation, Appendix 1, in catalogs and promotional media.

II.4.2 Access to NAAB Conditions and Procedures

The program must make the following documents electronically available to all students, faculty, and the public:
The 2014 Conditions for Accreditation
The 2009 Conditions for Accreditation (in effect at the time of the last visit)
The Procedures for Accreditation (edition currently in effect)

II.4.3 Access to Career Development Information

The program must demonstrate that students and graduates have access to career development and placement services that help them develop, evaluate, and implement career, education, and employment plans. See The Center for Career Development

II.4.4 Public Access to APRs and VTRs

To promote transparency in the process of accreditation in architecture education, the program is required to make the following documents electronically available to the public:

- All Interim Progress Reports (and Annual Reports [narrative only] submitted 2009–2010, 2010-2011, 2011-2012)
- All NAAB responses to Interim Progress Reports (and NAAB Responses to Annual Reports [narrative] submitted 2010–2011, 2011-2012)
- The most recent decision letter from the NAAB
- The most recent APR
- The final edition of the most recent Visiting Team Report, including attachments and addenda

II.4.5 ARE Pass Rates

NCARB publishes pass rates for each section of the Architect Registration Examination by institution. This information is considered useful to prospective students as part of their planning for higher/postsecondary education in architecture. Therefore, programs are required to make this information available to current and prospective students and the public by linking their web sites to the results.

II.4.6. Admissions and Advising

The program must publicly document all policies and procedures that govern how applicants to the accredited program are evaluated for admission. These procedures must include first-time, first-year students as well as transfers within and from outside the institution. This documentation must include the following:

- Application forms and instructions. See Admissions
- Admissions requirements, admissions decisions procedures, including policies and processes for evaluation of transcripts and portfolios (where required), and decisions regarding remediation and advanced standing.
- Forms and a description of the process for the evaluation of preprofessional degree content.
- Requirements and forms for applying for financial aid and scholarships. See Financial Aid

II.4.7 Student Financial Information

The program must demonstrate that students have access to information and advice for making decisions regarding financial aid. The program must demonstrate that students have access to an initial estimate for all tuition, fees, books, general supplies, and specialized materials that may be required during the full course of study for completing the NAAB-accredited degree program.

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 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 order intended. Students admitted as freshmen will complete the program in five years; transfer students will complete the program in accordance with their placement in the design sequence.

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

Each year of the five-year B.Arch curriculum consists of a carefully calibrated required coursework including classes which may be part of a larger sequence. Students must complete required courses in the appropriate semester/year of the curriculum plan. Failure to do so not only disrupts the student=s academic advancement but also potentially places the student at a disadvantage in the following semester/year. Scheduling conflicts may also arise. All of these factors make it essential for students to complete their required coursework according to the curriculum plan. Students who do not complete their required coursework according to the curriculum plan may be placed on a required leave of absence in order to complete missing requirements outside of The Cooper Union, at their own expense, before being permitted to resume their studies.

Students 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 16–19 credits per semester. Students are required to be registered for a minimum of 12 credits per semester. Failure to maintain satisfactory progress toward the degree may be grounds for dismissal. Students are eligible to register for more than 18 credits per semester, but not more than 20, if they have received at least a 3.0 rating for the previous semester.

Transfer Credit

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

When admitted, transfer students are offered admission into a specific year of the five-year design sequence. This decision is final, and acceptance of the offer of admission represents agreement on the part of the admitted student with this decision.

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 seek transfer credit for all other eligible coursework. 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.

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

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.

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.

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.

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. 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 immediately, automatically and permanently dismissed from The Cooper Union with a forfeit of the right of appeal. Automatic dismissal on final probation unconditionally and irrevocably terminates a student's academic career in the School of Architecture.

A student on probation may not carry more than 18 credits per 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, 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 Irwin S. Chanin School of Architecture.

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

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

Additional credits for repeated Design studio (or 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 if doing so would impede satisfactory progress towards the degree.

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

Leave of Absence

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

Required Leave of Absence A student who fails Architectonics, Design or Thesis will have his/her academic record reviewed by the Academic Standards Committee. If the student is permitted to continue, the student will be required to repeat that semester of studio (Architectonics, Design or Thesis) as well as meet any other conditions set by the Academic Standards Committee. If it is not possible for the student to make significant progress towards the degree requirements in the semester prior to repeating the studio course (as determined by the Academic Standards

Committee and/or the dean), the student will be placed on a mandatory leave of absence for one semester and will resume his 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.

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. A written request for the Leave must be submitted 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 the degree.

A request for a Discretionary Leave beginning in Fall semester must be made before April 15. A request for a Discretionary Leave beginning in Spring semester must be made before November 15. Approval for a Discretionary Leave is neither automatic nor guaranteed.

Returning from a Discretionary Leave of Absence Students on a Discretionary Leave must notify 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 that he/she is ready and able to return to school. The 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 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 and 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.

Interim Year/Independent Study

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

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

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 in competition with transfer applicants.

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

Students who have been dismissed for academic deficiencies and are eligible for readmission must apply within two years to the 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 due to academic deficiencies and who have been out of The Cooper Union for more than two years (four semesters) at the time of anticipated return must apply through the regular admission procedure. If offered admission, previous Cooper Union credits earned may be evaluated for transfer credit.

Residence

A candidate for a degree must be enrolled 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 the minimum number of credits listed for his or her curriculum and must spend a minimum of four semesters in full-time resident study at The Cooper Union. Students are responsible for their total accomplishment and for being continuously aware of the standards for graduation. Graduation requirements as outlined in this catalog are guidelines that are subject to change.

ACADEMIC INTEGRITY

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

Authorship

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

The Studios

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

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

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

Annual Exhibition of Student Work

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

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

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

COURSE LISTINGS

UNDERGRADUATE REQUIRED

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

Arch111A-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.

Arch114A-B | Freehand Drawing
Basic drawing skills, composition and color perception.
Studio and homework assignments.
3 credits per semester.

Arch115A-B | History of Architecture I
Semester 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.
Semester 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 per semester.

Arch118A-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.

Arch121A-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.

Arch122A-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 ofthe materials of construction used in structures.
2 credits per semester.

Arch125A-B | History of Architecture II
Semester 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.
Semester 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 per semester.

Arch 131A–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.

Arch132A-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 lowrise steel structures.
2 credits per semester. Prerequisites: Arch 103/104, Ph 165/166, Arch 122 A-B Structures I.

Arch 133 | Introduction to Urban History & 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.

Arch134A-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.

Arch135A-B | Building Technology
Materials and methods of architectural construction, lectures, examination and discussion of classic as well as current building techniques. Students assemble full-size "mock-ups" of details for class study germane to their design classes. In general, this course does not separate "construction" from "design" but attempts to supplement, by a means of a more detailed study of design assignments. Field trips may be made to buildings under construction.
2 credits per semester.

Arch141A-B V | Design I
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.

Arch142A-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.

Arch143A-B | Construction Management
Introduction to construction management principles, techniques and methods including scheduling, cost-estimating, planning and controlling construction process.
1 credit per semester.

Arch151A-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.

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.

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.

Arch154A-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.

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.
2 credits. After fulfilling the Arch 205 Advanced Concepts degree requirement, a student may enroll in other additional Arch 205 Advanced Concepts classese for elective credit.

Arch 225 | Advanced Topics in History, Theory, Criticism
Advanced study in history, theory, criticism of architecture, urbanism and technology.
2 credits. Prerequisites: Arch 115 A-B, Arch 125 A-B and Arch 175 or permission of the instructor. After fulfilling the Arch 225 Advanced Topics degree requirement, a student may enroll in other additional Arch 225 Advanced Topics classes for elective credit.

UNDERGRADUATE ELECTIVES

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 and Arch 125 A-B 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

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.

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 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.

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 or permission of the instructor 2 credits.

Arch 300 | Computer-Aided Design and Descriptive Geometry
Architecture-specific exploration into perception, methods and conventions of the geometric representation of space through the new perspective of computer applications. Introduction to concepts of projections, hinge and projector lines as well as absolute and relative coordinate systems through local deduction by considering parallel, axial, radiant and stereoscopic projections as variations of the same system. Introduction of CAD specificmethods such as Solid, NURBS and Parametric Modeling, hierarchical-and command-based programs. Critical comparison of computer capabilities and architectural tangible scale modeling methods to understand possibilities and limitations of computer-aided design in architecture. Critical exploration of methods and media for representation and design of specific works of architecture.
2 credits.

GRADUATE REQUIRED

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. Open to undergraduate fourth and fifth year students with permission of the instructor and dean.

Arch 483 | Graduate Seminar in Urban Studies
Selected topics in the advanced study of urban form including readings and case studies in urban analysis, global development, historic preservation and typological transformation. Open to undergraduate fourth-and fifth-year architecture students as an elective with permission of the instructor and the dean.
2 credits.

Arch 485 | Graduate Seminar in Theory, History and Criticism of Architecture
Selected topics in the advanced study of the theory and criticism of modernism and contemporary architecture, the philosophy and aesthetics of architecture, the mediatization of architecture and broader cultural and historical issues, through the critical readings of texts as well as case studies. Open to undergraduate fourth-and fifth-year architecture students as an elective with permission of the instructor and the dean.
2 credits.

FACULTY LIST

ADMINISTRATION

Nader Tehrani, Dean
Elizabeth O'Donnell, Associate Dean
Monica Shapiro, Academic Administrator
Robyn Fitzsimmons, Administrative Assistant
Mauricio Higuera, Administrative Assistant for Public Programs and New Projects
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, .F.A., B.Arch., Rhode Island School of Design; Architectural Association; M.A.U.D., Harvard University

Anthony Vidler, .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, .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

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

Instructors

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, Thomas Phifer, 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.

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

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

SCHOOL OF ART

MISSION

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.

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.

BFA 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.)

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 Requirements for the 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

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*
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 firstyear 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 who have taught at the School of Art for at least seven semesters). 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.

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 Incomplete (see below)
W Withdrawn (see below)
WU Withdrawn Unauthorized (see below)
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. 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 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 here 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.

FACILITIES

The School of Art is primarily housed in the 1859 landmark Foundation Building. Additional classroomsand student studio spaces, the Computer Studio, the Herb Lubalin Study Center, and the 41 Cooper Gallery are housed across the street at 41 Cooper Square. The studios, classrooms, shops, and labs of the School of Art offer complete facilities for a visual arts education. A professional staff of technical assistants is available in many of these facilities seven days a week to provide help and guidance to students in the School of Art, and to provide a healthy and safe working environment.

CLASSROOMS AND STUDIOS

In the Foundation Building, skylight ceilings flood abundant natural daylight throughout a number of classrooms, workrooms and student studio spaces. Additional studios and classrooms are located in newly constructed building at 41 Cooper Square.

Most studio classrooms are equipped with easels, model stands, palette tables, and sawhorse tables. Common workrooms are furnished with slop sinks, worktables and storage racks to accommodate the preparation and storage of artwork. Seminar classrooms provide seating for between fifteen and seventy five people. Four classrooms in the Foundation Building are fitted with digital projectors and sound & video connections. Two multimedia classrooms at 41 Cooper Square are equipped with high-definition projection teaching stations, and with Apple MacPros, which are connected to the Internet via T1 lines.

All students in their second, third, and fourth year in the School of Art, as well as Exchange and Mobility students, are provided with individual studio spaces. These studios are located on the second, fourth, and sixth floors of the Foundation Building, and on the fifth, sixth, and ninth floors of 41 Cooper Square. Each studio has pinup wall space and is set up with a desk and a lockable storage cabinet.

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 high-end Apple MacPro classrooms and a central scanning and 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 MacPro 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 includes complete suites of applications for graphic design, multimedia, 3D Design, audio-video and animation. The fully-networked studio also provides Internet access, , 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.

FILM, VIDEO AND ANIMATION

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.

The Checkout Office provides HD camcorders for students in introductory classes. Advanced classes use professional largesensor 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 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 rotoscope 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.

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.

PHOTOGRAPHY LAB

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 30x48 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 SHOP & TYPE SHOP

A well-equipped and ventilated printmaking shop on the fifth floor of the Foundation Building 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 metal type shop, also located on the fifth floor of the Foundation Building, with Vandercook presses is also available with technical staff assistance. The students' personal studio areas provide individual drawing tables and flat file storage for advanced students.

SCULPTURE SHOP

A large, all-college sculpture shop supports opportunities for production of a wide range of three-dimensional work. This facility, located on the fourth floor of the Foundation Building, 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 is also available.

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.

HERB LUBALIN STUDY CENTER OF DESIGN AND TYPOGRAPHY

The Herb Lubalin Study Center of Design and Typography in the School of Art was founded in 1985 by The Cooper Union and friends of the late Herb Lubalin. Its mission is to focus on the preservation of design history through its core collection of the work of Herb Lubalin and extensive library and archive of design ephemera. The Study Center and its archive are important central resources for the students and faculty as well as the professional and general public. All materials are fully available by appointment and are regularly highlighted through center's public exhibitions and lecture programming.

COURSE LISTINGS

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)

FOUNDATION

Foundation courses are required of all first year students.

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.

Required for first year students. 1/2 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.

Required for first year students. 2 credits. Fall only. Ellis/Hewitt/Osinski

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.

Required for first year students. 3 credits per semester. One-year course. Morton/Rub/Tochilovsky/Lessard

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.
Required for first year students. 3 credits per semester. One-year course.
Brown/Masnyj/Morgan/Villalongo

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.
Required for first year students. 3 credits. Spring only. Burckhardt/Lehyt/Raad/Raven

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.
Required for first year students. 3 credits per semester. One-year course.
Adams/ Duerksen/Farmiga/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.
Required for first year students. 1 credit. Raad/Bordo

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 letterspacing 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.
One-semester course. Cannot be repeated. Free elective credit.

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. McWreath

TE 305 | Techniques in HTML and Programming
This course explores programming techniques using HTML, CSS, Javascript and other data formats. Students will complete projects that demonstrate their skill and understanding of building web sites and basic programming. The purpose of this course is for the student to develop the skills necessary to utilize the many and varied web technologies for their artistic and professional practices.
2 credits. One-semester course. Cannot be repeated. Free elective credit. Kendall

CONTEMPORARY ART ISSUES

SE 401A, SE 401B
Topic for Fall 2016: What is contemporary art? What are its conditions? How do we engage, analyze and/or construct it? This course will explore topics in contemporary art through the exploration of critical texts and artist practices. Lectures, presentations, critiques, visits to key exhibitions and guest speakers will allow for an extended and in-depth look at concepts such as materiality, intersectionality and multiplicity in the present-day context.
2 art history credits. One-semester course.
May be repeated once for art history credit. Hewitt

DRAWING

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. Cornejo/Gleeson/Leary/Morgan

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

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 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

FA 348A, FA 348B | 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. True

FA 344A, FA 344B | Advanced Drawing/Visiting Artists
Offered to students working independently in any medium. Must be self-motivated. There will be group and individual critiques.
3 credits. One-semester course. Visiting Artist Caitlin Keogh

For Spring 2017 and later semesters, please see course schedule and registration materials for course descriptions specific to Visiting Artists teaching that semester.

FA 499 | Independent Study in Drawing
1–3 credits. Requires approval of instructor and the Dean of the School of Art

FILM/VIDEO

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. Note: Video I is required for all students who wish to pursue additional work in the medium.
3 credits. One-semester course. May not be repeated. Prerequisite to Video II. Ghani/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. Olujimi

FA 270 | Film

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. Note: Film I is required of all students who wish to pursue additional work in the medium.
3 credits. One-semester course. May not be repeated. Prerequisite to all advanced film courses. Pre-or corequisite to Animation I. McLaren/Simpson

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 learn16mm 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 376A | Animation I

Students will learn an arsenal of physically-based film animation techniques from line animation, directon-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. Prerequisites: Film I or Video I; 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. Visiting Artist Claudia Joskowicz/ Raven

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.
Visiting Artist Claudia Joskowicz/Raven

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 Raad

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

INTRADISCIPLINARY SEMINAR

SE 403A, SE 403B

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. Cameron

GRAPHIC DESIGN

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 imagemaking processes as well as be instructed in digital production techniques.
3 credits. Fall only. Essl/Gasparska

FA 212 | Graphic Design II
The complex relationship between word and image is explored. The study of semiotics, emphasizing the philosophy of communication, provides a rich historical and intellectual base for experimental projects combining verbal and pictorial information. 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. Essl/Gasparska

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

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 co-requisite: 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
FA315A Web Design 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 II. Pre-or corequisite: Typography. Bergdoll
FA 315B Game Design Play is a voluntary activity enjoyed by animals and humans alike. Games have been around for centuries offering structured play and have been used for entertainment, skill building, learning and more. The course explores how the game experience and the reward systems are designed with human pleasure/fun as the motivating factor. The course starts by familiarizing with the different genres of games from board games, card games to video games and console games and their history.
It explores the concepts that govern game design and building blocks of games in each genre. Weekly projects dive into creating prototypes of different games followed by tests run in class to validate and iterate on the design.
3 credits. Prerequisite: Graphic Design II. Pre-or corequisite: Typography I. Udayasankar

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.

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. Derose

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. Kendall

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

INTRADISCIPLINARY SEMINAR

SE 403A, SE 403B
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. Cameron

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

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 Griffin/True/Villalongo

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

FA 336A, FA 336B | 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 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

ADVANCED PAINTING VISITING ARTISTS

Course description varies according to instructor. For Fall 2016:

FA 332A
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. Visiting Artist Caitlin Keogh

FA 335A
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

For Spring 2017 and later semesters, please see class schedule and registration materials for course descriptions specific to Visiting Artists teaching that semester.

FA 439A, FA 339B | 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. Visiting Artist: TBA

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 Yve Laris Cohen (Fall 2016)

PHOTOGRAPHY

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.*

*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.

3 credits. One-semester only. May not be repeated. Mickey/Osinski

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 Fall 2016: Introduction to Wet Plate Collodion
This course explores photography's 19th century beginnings with wet plate collodion. Students will learn how to make these beautiful, instantaneous, hand-poured objects, along with the basics of the chemistry involved. They will learn how to adapt standard film holders in order to make their glass negatives, tintypes or ambrotpes with a traditional view camera as well as how to make enlarged collodion plates from either film or digital negatives. This class will also cover some of the short history of the medium, various 19th century photographers along with contemporary practitioners. Discussion will include the context and relevance of historic processes in today's changing photographic climate, 19th century brass lenses and spirit photography. Student will visit tour the Center for Alternative Photography in order to see a north light studio and work with 19th century reproduction cameras and original brass lenses. Students are required to have a final body of work for review at the end of the semester.
3 credits. Prerequisite: Photo I. Visiting Artist: Joni Sternbach (Fall 2016)

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/Williams

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 2016:
FA 364A
Emphasis in this course will be on the development of each student's work through class discussion, individual and group critiques. Student work will be viewed within a larger context of contemporary and historical issues within the visual arts. Student must be proepared to speak clearly about their ideas, present work multiple times throughout the semester and participate in class discussions and critiques.
3 credits. Prerequisite: Photo I. Henry Wolf Chair Jack Pierson (Fall 2016)

FA 469A, FA 469B | Independent Study in Photography
1–3 credits. Requires approval of instructor and the Dean of the School of Art

PRINTMAKING

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. Nobles.

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. Gleeson/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. Nobles/Powell

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 (Leave of absence Fall 2016)/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. Powell

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.
Gleeson/Nobles/Powell

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. Powell

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 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-inprogress 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

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

SCIENCE

RS 201 | Science (topics vary)
3 general studies credits. Required science course. To be taken during the sophomore, junior or senior year. Armstrong/Nadin

RS 201a | 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 & 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

FA 392A, FA 392 B | 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. 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/Magid

FA 396A, FA 396B | Sculpture: Seminar in Public Art

This course focuses on the production of artworks that question and/or reinvent the boundaries between public and private spheres. Student projects will be generated and analyzed in relation to current transformations in culture and technology as they affect the meaning of "publicness." Complementing studio production will be lectures, readings and discussions that engage social, political and urban issues relevant to the topic. Traditional approaches to public art, such as enhancement and commemoration will be challenged by more temporal and critical strategies Historical examples will be examined, including the Flaneur, Russian Constructivism, the Situationists, Fluxus and Conceptualism, as well as the most recent example of public interventions.
3 credits. Adams

FA 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

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. Raven

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

ADMINISTRATION

Mike Essl, Acting Dean
Stamatina Gregory, Associate Dean
Judith Cantor Bernstein, Coordinator of Academic Operations
Emmy Mickelson, Coordinator of Student Exhibitions
Tia Jeung, Budgets Coordinator
Tessa Sutton, 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, 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
Walid Raad, Rochester Institute of Technology; M.A., Ph.D., University of Rochester

Associate Professors

Robert Bordo, 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

Proportional-Time Faculty/Associate Professors

Douglas Ashford, B.F.A., The Cooper Union
Leslie Hewitt, B.F.A., The Cooper Union; M.F.A., Yale University
Lucy Raven, B.F.A., University of Arizona; M.F.A., Bard College
Alexander Tochilovsky, B.F.A., The Cooper Union; M.F.A., Cranbrook Academy of Art
David True, B.F.A., M.F.A., Ohio University
William Villalongo, B.F.A., The Cooper Union; M.F.A .,Tyler School of Art

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
Warren Corbitt, B.A., Vassar College; M.F.A., Cranbrook Academy of Art
Lorenzo Clayton (Leave of Absence Fall 2016), B.F.A., The Cooper Union
Cara DiEdwardo, B.F.A., The Cooper Union
Stephen Ellis, B.F.A., Cornell University; New York Studio School
Adriana Farmiga, B.F.A., The Cooper Union; M.F.A., Bard College
Glenn Goldberg, New York Studio School; M.F.A., Queens College, CUNY
Beverly Joel (Leave of Absence Fall 2016), B.F.A., The Cooper Union
Mindy Lang, B.F.A., The Cooper Union
Pamela Lins, M.F.A., Hunter College, CUNY
Jill Magid, B.F.A, Cornell University; M.A, Massachusetts Institute of Technology
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
Yasuyuki Shibata, B.F.A., Kyoto Seika University, Japan
Erin Sparling, School of the Art Institute of Chicago
Michael Vahrenwald (Leave of Absence 2016-17), 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

Seth Cameron, B.F.A, The Cooper Union
Oscar Cornejo, B.F.A., The Cooper Union; M.F.A., Yale University
Steve Cossman, B.F.A., Albright College
Rondi Davies, B.S., University of Sydney (Australia); PhD., Macquarie University (Australia)
Frank Derose, B.A, Skidmore College; M.S. Pratt Institute
Trenton Duerksen, B.F.A., The Cooper Union
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

Mariam Ghani, B.F.A., New York Univerity; M.F.A., School of Visual Arts
Nora Griffin, B.A., Oberlin College; M.F.A., Columbia University
Iman Issa, B.F.A., American University in Cairo (Egypt); M.F.A., Columbia University
Ellen Jorgensen, B.A., New York University; M.A.; M. Phil, Columbia University; PhD., New York University
Joe Kendall, B.F.A., The Cooper Union
James Leary, B.F.A., The Cooper Union
Cristobal Lehyt, Universidad Catolica de Chile; Hunter College; Whitney Independent Study Program
Darin Mickey, B.F.A., The School of Visual Arts
Nyeema Morgan, B.F.A., The Cooper Union; M.F.A., California College of the Arts
Kambui Olujimi, B.F.A, Parsons School of Design; M.F.A., Columbia 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
Roy Rub, B.F.A., The Cooper Union
Subalekha Udayasankar, B.E., University of Madras (India); M.F.A., Parsons School of Design
John Vondracek, B.F.A., The Cooper Union

VISITING ARTISTS (FALL 2016)

Yve Laris Cohen, B.S., Universiy of California, Berkeley; M.F.A., Columbia University
Claudia Joskowicz, B.Arch., University of Houston, M.F.A., New York University
Geoff Kaplan, Stanton Chair in Graphic Design;B.F.A., Carnegie Mellon University; M.F.A., Cranbrook Academy of Art
Caitlin Keogh, B.F.A., The Cooper Union; M.F.A., Bard College
Alex Kwartler, B.F.A., The Cooper Union
Jack Pierson, Henry Wolf Chair in Photography, B.F.A., Massachusetts College of Art
Joni Sternbach, B.F.A., School of Visual Arts; M.A., New York University

STAFF

Zeljka Gita Blaksic, Technical Assistant, Film/Video
Amy Buckley, Technical Assistant, Photography
Joseph Buckley, Technical Assistant, Film/Video
Ian Burnley, Acting Senior Coordinator, Painting/Drawing
Lea Cetera, Technical Assistant, Art and Architecture Shop
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
Amanda Friedman, Technical Assistant, Painting/Drawing
Pedro Gonzalez, Technical Assistant, Film/Video
Vanesa Gully, Acting Painting Office Coordinator, Painting/Drawing
Anna Hostvedt (Leave of Absence 2016-17), Senior Coordinator, Painting/Drawing
Haisi Hu, Technical Assistant, Film/Video
Anna Hutchings, Technical Assistant, Art and Architecture Shop
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
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
Simone Meltesen, Outreach Program Manager
Aisha Tandiwe Bell, Saturday Program General Coordinator
Mary Valverde, Saturday Program Office Manager

ALBERT NERKEN SCHOOL OF ENGINEERING

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 advisor(s) approval only. If the course is to substitute for a Cooper Union course, prior approval must be given by the chair of the appropriate department in the engineering school or by the appropriate school or faculty for courses outside engineering. 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 or an appropriate high academic standard. 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 curriculumand is consistentwith the program and institutional objectives.

In order to graduate, all students must meet the following conditions:

- A minimumof 135 credits are required
- Satisfaction of all programcurricula
- 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

Program Requirements

The specific programs for entering students are shown in detail for each department. 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. Changes in engineering programs reflect advances in science and technology as well as advances in pedagogical techniques and developing industrial, graduate school and societal needs and expectations.

Faculty Advisors

All first-year students have the same faculty advisor. For subsequent years, students will be assigned one, two or more advisors each, appropriate to their field of study. Each student's program is established in consultation with his or her advisor(s); changes can only be made with approval of the advisor(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.

Free Electives/Non-Technical Electives

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.

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 advisor(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

0.5 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'S DEGREE 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.

See the application guidelines for the admissions procedure. See the course list for graduate level courses.

See the 2016 Master of Engineering Student Handbook.

General Application Requirements

Applicants who are not Cooper Union graduates 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 advisor 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 advisor.

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). In addition, an essay is required of all applicants who were not Cooper Union graduates. 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

The Albert Nerken School of Engineering offers both thesis and non-thesis Master of Engineering degrees. A minimum of 30 graduate level credits beyond the baccalaureate degree must be completed at The Cooper Union (in addition to resolving 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 advisor(s). A complete program of study is designed by the student with the assistance and approval of the academic advisor(s) and filed in the Office of the Dean of Engineering.

Each student is required to submit a thesis or project in their area of study, equivalent to a maximum of six credits (graduate level), for partial fulfillment of the master of engineering requirements. This project must be discussed with and approved by an advisor prior to being started. The thesis or project must be successfully presented orally by the student and submitted in written form.

Each of the engineering departments may have additional specific guidelines for the requirements for the M.E. degree. See links for Masters Program found under each department.

Thesis Requirements

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

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

Non-Thesis Requirements

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

- Major: Complete a minimum of 18 credits of graduate level courses in a 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) Submit a report to the Dean's office of other course work that satisfies 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 Special Projects requirement report.
When the special projects requirement is completed this form should be filled out and submitted, along with any report, to the Dean's office.

Other General Requirements

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 graduate 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 advisor 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 advisor'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.

Graduate Tuition & Fees

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 have satisfactorily completed all required chemistry courses in the ChE curriculum and plan to do graduate work in chemistry, chemical engineering, chemistry-based environmental engineering, or chemistry-based bioengineering. Recipients are selected by the joint faculties of chemistry and chemical engineering.

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 is not 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.

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.

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 approval in advance. 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. (A grade of B-or worse cannot be transferred). 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.

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 l 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 l designation will be given only with the approval of the dean or associate dean of engineering. At the time of submission of an l 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 l designation will be deter-mined 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 l is not removed within the set time limit, either by completing the work in the subject or by passing a re-examination, the l 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 advisor and additional academic counseling. A student on academic probation must fulfill conditions as prescribed by the Academic Standards Committee.

- The records of all students may be reviewed by the office of the 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."

Students seeking readmission to the School of Engineering with a separation from Cooper Union of less than two years must apply through the Academic Standards Committee. The student must first contact the Dean of Admissions and Chair of

Academic Standards to discuss the measures required to meet before the Academic Standards Committee. Students seeking readmission for the fall term must contact the Dean of Admissions and Chair of Academic Standards no later than April 1 to schedule an appointment for the June Academic Standards meeting.

Students seeking readmission to the School of Engineering with a separation from Cooper Union of more than two years must apply through the Office of Admissions and adhere to the transfer application requirements stated on page 15 of the catalog.

- 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 advisor'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 advisor'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 advisor. A student's program may be adjusted at the discretion of and after conferring with the advisor 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 advisor, 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 A course may be repeated if a student has failed the course or, with appropriate approval been allowed to withdraw from the course. When a course is repeated, the grade earned when 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.

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 advisor(s) and the Office of the Dean. Normally, such courses will require prerequisites and are usually taken by juniors and seniors.

• A minimum of 12 credits of engineering electives must be at an advanced level.

CHEMICAL ENGINEERING

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 and 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 under-goes 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.

If you have any questions or need additional information about the department, please contact our faculty directly using the links to the left or contact our department administrator Liz Leon:

Liz Leon
Chemistry & Chemical Engineering Departments
The Cooper Union Albert Nerken School of Engineering
41 Cooper Square
New York, NY 10003
212.353.4370
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CURRICULUM

UNDERGRADUATE

FRESHMAN YEAR CREDITS

Fall Semester:	Credits
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:	Credits
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:	Credits
ESC000.3 Professional Development Seminar	0
ChE 221 Energy and Material Balances	3
Ma 223 Vector Calculus	2
Ph 213 Physics II: Electromagnetic Phenomena	4
ESC 211 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	**Credits**
ESC000.4 Professional Development Seminar	0
Ma 240 Ordinary and Partial Differential Equations	3
Ph 214 Physics III: Optics and Modern Physics	3
Ch 232.1 Organic Chemistry II	2
Ch 233 Organic Chemistry Laboratory	2
ChE 232 Chemical Engineering Thermodynamics	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 221 Basic Principles of Electrical Engineering	2
Ch 351 Instrumental Analysis Laboratory	2
Ch 361 Physical Chemistry I	3
ChE 331 Chemical Engineering Thermodynamics II	3
ChE 341 Fluid Mechanics and Flow Systems	3
Engineering Elective	3
Total Credits Fall Semester	**18**

Spring Semester	
Ch 362 Physical Chemistry II	2
ChE 332 Chemical Reaction Engineering	3
ChE 342 Heat and Mass Transfer	4
ChE 352 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 371 Chemical Engineering Laboratory I	1.5
ChE 381 Process Evaluation and Chemical Systems Design I	3
ChE 351 Separation Process Principles	3
ChE 361 Chemical Process Dynamics and Control	3
Engineering or Science Elective	3
Humanities/Social Sciences Elective	3
Total Credits Fall Semester	**16.5**

Spring Semester	**Credits**
ChE 372 Chemical Engineering Laboratory II	1.5
ChE 382 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**

The Chemical Engineering Department does not permit the substitution of any courses as outlined in the Course Substitutions and Credits section of the 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 344/Environmental Systems Engineering (also EID 344)
CE 343/Water Resources Engineering (also EID 343)
CE 414/Solid Waste Management (also EID 414)
CE 440/Industrial Waste Treatment Design (also EID 438)
CE 441/Water and Wastewater Technology (also EID439)
CE 446/Pollution Prevention or Minimization (also EID 446)
CE 447/Stream and Estuary Pollution
CE 449/Hazardous Waste Management (also EID 449)
ChE 447/Sustainability and Pollution Prevention (also EID 447)

Biomedical Engineering
Bio 201/Biology for Engineers I Bio 202/Biology for Engineers II
Ch 340/Biochemistry
Ch 440/Biochemistry II
ChE 475/Pharmaceutical Engineering ECE 444/Bio-instrumentation
EID 221/Biotransport Phenomena EID 222/Biomaterials
EID 223/Injury Biomechanics
and Safety Design
EID 224/Biomechanics
EID 320/ Special Topics in Bioengineering I
EID 321/ Special Topics in Bioengineering II
EID 322/ Special Topics in Bioengineering III
EID 323/ Special Topics in Bioengineering IV
EID 325/Science and Application of Bioengineering Technology
EID 327/Tissue Engineering
EID 424/Bioengineering Applications in Sports Medicine

Energy Engineering
ChE 421/Advanced Chemical Reaction Engineering
ChE 430/Thermodynamics of Special Systems (also EID 430 and ME 430)
ChE 434/Special Topics in Combustion (also ME 434)
ME 331/Advanced Thermodynamics
ME 326/Energetics (also EID 225)
ME 431/Internal Combustion Engines
ME 432/Introduction to Nuclear Power Plant Technology

MASTERS 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 (also EID 441)

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.

Thesis option: 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 to supervising the thesis, 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. There may be a co-adviser for the thesis, approved by the principal thesis adviser and the electrical engineering department chair; any co-advisor who is not a member of the full-time faculty of the school of engineering must also be approved by the dean of engineering.

Non-thesis option: The candidate must choose a full-time Cooper Union faculty member from the electrical engineering department as his or her adviser. 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.

A fundamental goal of the Master's program is for the student to attain a higher degree of specialization within electrical engineering, beyond that achieved with an undergraduate degree. Therefore, it is departmental policy that at most 6 credits of non-ECE courses can be used to fulfill the requirements of the Master of Engineering degree, although the department may approve waivers to this rule when deemed appropriate.

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, natural language processing, reconfigurable and distributed computing; electronic materials and integrated circuit engineering; control; sustainable engineering.

CIVIL ENGINEERING

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 and sustainable 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:

- An ability to apply knowledge of mathematics, science and engineering
- An ability to design and conduct experiments, as well asto analyze and interpret data
- 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
- An ability to function on multidisciplinary teams
- An ability to identify, formulate, and solve engineering problems
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

- A recognition of the need for, and an ability to engagein life-long learning
- A knowledge of contemporary issues
- An ability to use the techniques, skills and modern engineering tools necessary for engineering practice
- 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 specialties: 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 specialties, 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 Engineering

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 431, CE 432, CE 433, CE 434, CE 435, CE 436, CE 438, CE 450, CE 470, CE 481, CE 482, CE 483

Water Resources and Environmental Engineering: CE 437, CE 414, CE 440, CE 441, CE 442, CE 444, CE 446, CE 447, CE 448, CE 449, CE 485, CE 486, CE 487

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.

CURRICULUM

UNDERGRADUATE

CIVIL ENGINEERING PROGRAM FOR FRESHMAN CLASSES THAT ENTERED COOPER UNION IN FALL 2016 AND SUBSEQUENT YEARS

FRESHMAN YEAR CREDITS

Fall Semester	Credits
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	Credits
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 200 Engineering Mechanics	3
ESC 210 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
CE 251 Urban Transportation Planning	3
Ma 240 Ordinary and Partial Differential Equations	3
Ph 214 Physics III: Optics and Modern Physics	3
ESC 201 Solid Mechanics	3
CE 220 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 321 Structural Engineering	4.5
CE 344 Environmental Systems Engineering	4.5
ESC 330 Engineering Thermodynamics	3
ESC 140 Fluid Mechanics and Flow Systems	3
Humanities/Social Sciences Elective	3
Total credits fall semester	**18**

Spring Semester	
CE 322 Structural Engineering II	3
CE 331 Introduction to Geotechnical Engineering	4.5
CE 343 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	**Credits**
CE 342 Design of Reinforced Concrete Structures	3
CE 363 Civil Engineering Design I	3
Engineering or Science Electives	9
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**

CIVIL ENGINEERING PROGRAM FOR FRESHMAN CLASSES THAT ENTERED COOPER UNION IN FALL 2015 AND PRIOR YEARS

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	**Credits**
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 200 Engineering Mechanics	3
ESC 210 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 220 Principles of Electrical Engineering	3
Ma 240 Ordinary and Partial Differential Equations	3
Ph 214 Physics III: Optics and Modern Physics	3
ESC 201 Solid Mechanics	3
CE 220 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 321 Structural Engineering	4.5
CE 344 Environmental Systems Engineering	4.5
ESC 330 Engineering Thermodynamics	3
ESC 140 Fluid Mechanics and Flow Systems	3
Humanities/Social Sciences Elective	3
Total credits fall semester	**18**

Spring Semester	
CE 322 Structural Engineering II	3
CE 331 Introduction to Geotechnical Engineering	4.5
CE 343 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	**Credits**
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**

MASTERS PROGRAM

Completion of the Master of Engineering degree program in civil engineering is important for entry into the profession. The civil engineering department offers the master's degree in two specialized areas: structural and geotechnical; water resources and environmental engineering.

The student must complete a coherent concentration of graduate-level courses approved by the department.

Both the thesis and non-thesis options are available to the student.
• Thesis Project (6 credits)
• Total Credits: 30

Graduate students in the department of civil engineering become equipped with the theoretical and practical knowledge needed to solve many problems facing both our built and natural environments. Coursework grounded in the principles of mathematics, structural mechanics, fluid mechanics, soil mechanics, environmental sciences, and computer applications prepares students for careers in structural engineering, construction management, infrastructure rehabilitation, geotechnical engineering, water resources and environmental engineering.

Employers of our graduates include: Thornton Tomasetti, Arup, Mueser Rutledge, Metropolitan Transportation Authority, Skanska, Gilbane, Port Authority of New York & New Jersey, NYC Department of Design and Construction.

ELECTRICAL ENGINEERING

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 two areas:

- Signals and Electronics
- Computer Engineering

There is overlap among the courses in the these 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 that include material at the graduate level. The only required courses in the senior year are the capstone senior design project courses (ECE395/396). 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 but not limited to humanities and social sciences. The electrical engineering department, as part of its advisory process, designates the set of courses that qualify as non-technical electives. The latest set of eligible courses is posted on the department's website at: http://www.ee.cooper.edu/academics-and-courses/technical-and-nontechnical-electives

Team and individual projects begin in the freshman year and culminate with year-long senior projects. All laboratory courses are project based, and many lecture courses require project work as well. 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 advisor. Through extensive experience working on team projects and proper selection of courses, students obtain a well-rounded, diverse and challenging educational experience.

MASTERS PROGRAM

The Master of Engineering program in Electrical Engineering challenges students to pursue one or more areas of specialization in depth, combining rigorous theory and enhancement of analytical skills together with a significant research project experience. An essential aspect of the program is the close working relationship between the student and faculty advisor.

The candidate must choose a full-time Cooper Union faculty member from the electrical engineering department as his or her advisor. With the approval of this advisor and the department chair, a second person who is not among the full-time electrical engineering faculty may be a co-advisor.

The advisor, 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.

Most EE graduate level courses have a significant project component, and many are research oriented, for example requiring readings in the technical literature. The Master Thesis is based on a research project undertaken by the student in collaboration with the thesis advisor. For students pursuing the non-thesis option, one of the graded projects from a graduate level ECE course must be identified, with the approval of the advisor, and submitted to the engineering dean's office as evidence of significant project work; the grade for this project must have been at least a B, and the grade for the course for which this project was performed must have been at least a B.

As noted above, the advisor approves the set of courses used to fulfill the requirements for the master degree, subject to the following constraints. For each course, the course grade must be at least a C, and the overall GPA for the credits used to fulfill the master of engineering degree must be at least 3.0. A limited set of non-ECE courses may be permitted, but the overall course plan should indicate a strong concentration in some area within the broad discipline of electrical engineering.

The Integrated Master Program allows undergraduate students at The Cooper Union who take additional courses beyond those required for the Bachelor of Engineering degree, who then enter the Master of Engineering program, to apply those additional credits towards the requirements for the Master degree, with the approval of the advisor.

Students entering the Master of Engineering program in electrical engineering are expected to have a bachelor's degree in electrical engineering or a related field from an accredited institution. The exception is that Cooper Union undergraduates or alumni with an engineering degree in a major other than electrical engineering, including the Bachelor of Science of Engineering degree, would be considered for admission into the Master of Engineering program in electrical engineering if they have taken a substantial number of ECE courses and are prepared for advanced studies in the field.

Students who apply to the program must specify thesis or non-thesis options in advance, and changing to the other option would be permitted by the department only in exceptional circumstances.

CURRICULUM

UNDERGRADUATE SIGNALS AND ELECTRONICS TRACK

FRESHMAN YEAR CREDITS

Fall Semester	**Credits**
Ch 110 General Chemistry	3
EID 101 Engineering Design	3
EID 102 Engineering Graphics	1
Ma 110 Intro Linear Algebra	2
Ma 111 Calculus I	4
HSS 1 HSS: Freshman Seminar	3
Total Credits Fall Semester	**16**

Spring Semester	**Credits**
Ch 111 Chemistry Laboratory	1.5
ECE 150 Digital Logic Design	3
ECE 160 Programming for Electrical Eng	3
Ma 113 Calculus II	4
Ph 112 Physics I (Mechanics)	4
HSS 2 HSS: Texts and Contexts	3
Total Credits Spring Semester	**18.5**

SOPHOMORE YEAR CREDITS

Fall Semester	
ECE 240 Circuit Analysis	3
ECE 291 EE Sophomore Projects	1
Ma 223 Vector Calculus	2
Ma 240 Ord & Part Differential Eqns	3
Ph 213 Physics II (Electromagnetics)	4
Ph 291 Intro Physics Lab	1.5
HSS 3 The Making of Modern Society	3
Total Credits Fall Semester	**17.5**

Spring Semester:	
ECE 210 MATLAB Seminar: Signals and Systems	0
ECE 211 Signal Processing & Systems Analysis	3
ECE 241 Electronics I	3
ECE 251 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	**Credits**
ECE 300 Communication Theory	3
ECE 310 Digital Signal Processing	3
ECE311 Hardware Design	3
ECE 342 Electronics II	3
ECE 393 Electrical & Computer Engineering Projects I	1.5
Ma 326 Linear Algebra	3
Total Credits Fall Semester	**18**

Spring Semester	
ECE302 Prob Models & Stoch Proc	3
ECE303 Communication Networks	3
ECE335 Engineering Electromag	4
ECE345 Integrated Circuit Eng	3
ECE394 EE Junior Projects II	3
Hum/SS Hum/Soc Sci elective	3
Total Credits Spring Semester	**19**

SENIOR YEAR CREDITS

Fall Semester	
ECE 395 Electrical & Computer Engineering Projects III	3
Eng/Sci/Math electives	6
Hum/SS Hum/Soc Sci elective	3
Non-technical elective	3
Additional electives for Integrated Masters*	3
Total Credits Fall Semester	**15 / 18***
Spring Semester	
ECE 396 Electrical & Computer Engineering Projects IV	3
Eng/Sci/Math electives	8
Non-technical elective	3
Additional electives for Integrated Masters*	6
Total Credits Spring Semester	**14 / 20***
Total credits required for Bachelor's degree	**135**

COMPUTER ENGINEERING TRACK

FRESHMAN YEAR CREDITS

Fall Semester Credits	
Ch 110 General Chemistry	3
EID 101 Engineering Design	3
EID 102 Engineering Graphics	1
Ma 110 Intro Linear Algebra	2
Ma 111 Calculus I	4
HSS 1 HSS: Freshman Seminar	3
Total Credits Fall Semester	**16**

Spring Semester	
Ch 111 Chemistry Laboratory	1.5
ECE 150 Digital Logic Design	3
ECE 160 Programming for Electrical Eng	3
Ma 113 Calculus II	4
Ph 112 Physics I (Mechanics)	4
HSS 2 HSS: Texts and Contexts	3
Total Credits Spring Semester	**18.5**

SOPHOMORE YEAR CREDITS

Fall Semester	
ECE 240 Circuit Analysis	3
ECE 291 EE Sophomore Projects	1
Ma 223 Vector Calculus	2
Ma 240 Ord & Part Differential Eqns	3
Ph 213 Physics II (Electromagnetics)	4
Ph 291 Intro Physics Lab	1.5
HSS 3 The Making of Modern Society	3
Total Credits Fall Semester	**17.5**

Spring Semester	**Credits**
ECE 210 MATLAB Seminar: Signals and Systems	0
ECE 211 Signal Processing & Systems Analysis	3
ECE 241 Electronics I	3
ECE 251 Computer Architecture	3
ECE 264 Data Structures & 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 300 Communication Theory	3
ECE 310 Digital Signal Processing	3
ECE 342 Electronics II	4
ECE 357 Operating Systems	3
ECE 365 Data Structures & Algorithms II	2
ECE 393 EE Junior Projects I	2
Total Credits Fall Semester	**17**

Spring Semester	
ECE302 Prob Models & Stoch Proc	3
ECE303 Communication Networks	3
ECE 366 Software Engineering	4
ECE 394 EE Junior Projects II	3
Ma 352 Discrete Math	3
Hum/SS Hum/Soc Sci elective	3
Total Credits Spring Semester	**18**

SENIOR YEAR CREDITS

Fall Semester	
ECE 395 Electrical & Computer Engineering Projects III	3
Eng/Sci/Math electives	6
Hum/SS Hum/Soc Sci elective	3
Non-technical elective	3
Additional electives for Integrated Masters*	3
Total Credits Fall Semester	**15 / 18***

Spring Semester	**Credits**
ECE 396 Electrical & Computer Engineering Projects IV	3
Eng/Sci/Math electives	8
Non-technical elective	3
Additional electives for Integrated Masters*	6
Total Credits Spring Semester	**14 / 20***

Total credits required for Bachelor's degree **135**

GRADUATE

SIGNALS AND ELECTRONICS TRACK

Fall Semester:	**Credits**
ECE 499 Thesis	3
Electives	9
Total Credits Fall Semester	**12**
Spring Semester	
ECE 499 Thesis	3
Electives	6
Total Credits Spring Semester	**9**

Total credits required for Masters degree 165

COMPUTER ENGINEERING TRACK

Fall Semester	
ECE 499 Thesis	3
Electives	9
Total Credits Fall Semester	**12**
Spring Semester	
ECE 499 Thesis	3
Electives	6
Total Credits Spring Semester	**9**
Total credits required for Masters degree	**165**

MECHANICAL ENGINEERING

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, fluid mechanics, vibrations and acoustics, heat transfer and thermodynamics, combustion, control systems, materials and manufacturing, CAD/CAE/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 and problem-solving practice.

The sequences of courses shown in the undergraduate curriculum table emphasize the fundamental engineering sciences as well as their applications in the analysis and solution of contemporary engineering problems. 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/engineering/manufacturing, robotics, biomedical engineering, automotive systems, modern control systems, mechatronics, thermoelectric power generation, vibrations and acoustics, combustion and other interdisciplinary areas of engineering.

CURRICULUM

UNDERGRADUATE

FRESHMAN YEAR CREDITS

Fall Semester	Credits
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
Ph 112 Physics I: Mechanics	4
EID 103 Principles of Design	3
Ch 111 General Chemistry Laboratory	1.5
ME 102 Statics	3
HSS 2 Texts and Contexts: Old Worlds and New	3
Total Credits Spring Semester	**18.5**

SOPHOMORE YEAR CREDITS

Fall Semester	**Credits**
ESC 000.3 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
ME 200 Dynamics	3
ME 210 Materials Science	3
HSS 3 The Making of Modern Society	3
Total Credits Fall Semester	**19.5**

Spring Semester	
ESC 000.4 Professional Development Seminar	0
Ph 214 Physics III: Optics and Modern Physics	3
ESC 221 Basic Principles of Electrical Engineering	2
ME 201 Mechanics of Materials	3
ME 330 Engineering Thermodynamics	3
ME 211 Design and Prototyping	2
ME 251 Systems Engineering	3
HSS 4 The Modern Context: Figures and Topics	3
Total Credits Spring Semester	**19**

JUNIOR YEAR CREDITS

Fall Semester	
Ma 224 Probability	2
ME 340 Fluid Mechanics & Flow Systems	3
ME 300 Stress and Applied Elasticity	3
ME 351 Feedback Control Systems	3
ME 352 Process Control Laboratory	1
Engineering or Science Elective	3
Humanities/Social Sciences Elective	3
Total Credits Fall Semester	**18**

Spring Semester	**Credits**
ME 301 Mechanical Vibrations	3
ME 342 Heat Transfer	3
ME 360 Engineering Experimentation	3
Engineering or Science Elective	3
Humanities/Social Sciences Elective	3
Total Credits Spring Semester	**15**

SENIOR YEAR CREDITS

Fall Semester	
ME 312 Manufacturing Engineering	3
ME 331 Advanced Thermodynamics	3
ME 393 Mechanical Engineering Projects	3
ME 300- or 400-level Lecture Course	3
Free Elective	3
Total Credits Fall Semester	**15**

Spring Semester	
ME 394 Capstone Senior Mechanical Engineering Design	3
ME 300- or 400-level Lecture Course	3
Free Electives	6
Total Credits Spring Semester	**12**

Total credits required for degree **135**

GRADUATE

Areas of research include computer-aided design/engineering/manufacturing, robotics, biomedical engineering, automotive systems, modern control systems, mechatronics, thermoelectric power generation, vibrations and acoustics, combustion and other interdisciplinary areas of engineering.

GENERAL ENGINEERING

The School of Engineering offers a program in General Engineering leading to the degree of Bachelor of Science (B.S.). This program is designed for students with a clear idea of their educational objectives which require a more flexible, interdisciplinary course of study.

This program is suitable for students who desire a strong, broad-based, rigorous engineering background as preparation for fields such as: chemistry, mathematics, medicine, biomedical engineering, law, business, or entrepreneurship. Each B.S. student's program is administered by an advisor assigned by the dean's office who closely develops a coherent educational plan with the student.

Students are required to enroll in 55 core curriculum credits in mathematics, the sciences, and the humanities (similar to the B.E. degree) as they prepare to select courses open to all Engineering students. Art, Architecture, and Humanities courses may also be selected as seats in those courses become available and the respective schools/faculty grant permission The B.S. program is not suitable for students who wish professional licensure.

CURRICULUM

BACHELOR OF SCIENCE

The Bachelor of Science (B.S.) degree is intended for students who have a clear idea of their educational objectives in which a more flexible and interdisciplinary course of study would be more appropriate.

In the first two years a student must complete a minimum of 55 credits in core engineering, engineering sciences (ESC) and interdisciplinary engineering (EID) courses, thereby building a strong analytical background, in addition to fulfilling all the requirements for the bachelor's degree as summarized here:

	Credits
Core Courses (freshman and sophomore)	55
Humanities and Social Sciences (over and above the core courses)	6 minimum
Engineering and Engineering Sciences (over and above the core courses)	44 minimum
Free Electives	30
Total credits	**135**

For the junior and senior years students are advised to identify one or more areas in which they would like to focus their plan of study and to find a academic advisor(s) in those fields for specific guidance. Students may choose from all courses available at The Cooper Union and may work in such interdisciplinary areas as environmental and energy resources engineering, systems and computer engineering, bioengineering and ocean and aerospace engineering.

Students who are considering applications to other professional schools after completing the engineering degree are advised to take one year of organic chemistry and one year of biology for medicine and dentistry, additional courses in the social sciences for law, and one year of economics for business or finance. Such students should consult their faculty advisors in order to design a program to meet professional goals and degree requirements.

CURRICULUM

UNDERGRADUATE

FRESHMAN YEAR CREDITS

Fall Semester	**Credits**
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 Laboratory	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**

CHEMISTRY

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) and General Chemistry Laboratory (chemical preparation and analysis, data recording, report writing and safety). Students majoring in chemical or civil engineering also take Physical Principles of Chemistry (a quantitative treatment of chemical thermodynamics, electrochemistry and kinetic theory) during their first year.

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

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.

CURRICULUM

The department of mathematics offers a minor in mathematics. Students seeking a minor in mathematics must complete at least 15 credits of mathematics coursework in addition to the 17 credits required by every engineering department. These additional credits must include Advanced Calculus I and II (Ma 350 and Ma 351), Linear Algebra (Ma 326), Modern Algebra (Ma347) and an elective course 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

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. All first-year engineering students enroll in Physics I: Mechanics. All second-year engineering students enroll in Physics II: Electromagnetic Phenomena, Introductory Physics Lab, and Physics III: Optics and Modern Physics. The Physics Department occasionally offers elective courses such as General Relativity, Physics Simulations, and Deterministic Chaos, that have been designed to provide an enhanced understanding of specially selected fields of interest in engineering science.

COURSE LISTINGS

CHEMICAL ENGINEERING UNDERGRADUATE

ChE 221 | 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.

ChE 232 | 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 auxiliary thermodynamic functions and conditions of equilibrium in imperfect gasses.
3 credits. Prerequisite: Ch 160 or ChE 221

ChE 331 | 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 232

ChE 332 | 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 221 and ChE 341

ChE 341 | 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 342r | 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 340.

ChE 351 | 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 331 and ChE 342

ChE 352 | 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 341

ChE 361 | 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-loopsystems; phase plane analysis of reaction systems; application of analog computer in solution of problems.
3 credits. Prerequisite: ChE 352

ChE 371 | Chemical Engineering Laboratory I
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. Prerequisites: ChE 332, ChE 342; corequisite: ChE 351

ChE 372 | Chemical Engineering Laboratory 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. Prerequisites: ChE 332, ChE 342; corequisite: ChE 351

ChE 381 | 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 PROvision/PRO-II and an examination of optimization techniques.
3 credits. Prerequisites: ChE 342 and ChE 332

ChE 382 | Process Evaluation and Design II
This is a continuation of ChE 381, and is the "capstone design course" in chemical engineering. All aspects of chemical engineering are integrated inthe design of a chemical process plant. The design process consists of flowsheet 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 381

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 III
Continuation of ChE 392.
3 credits. Prerequisite: ChE 392

ChE 394 | Research Problem IV
Continuation of ChE 393.
3 credits. Prerequisite: ChE 393

CHEMICAL ENGINEERING 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
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. Same as EID 430 and ME 430
3 credits. Prerequisite: ChE 331 or ME 331

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 331

ChE 433 | Rocket Science
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. Same as ME 433
3 credits. Prerequisite: ESC 330 and ESC 340

ChE 434 | Special Topics in Combustion
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. Same as ME 434
3 credits. Prerequisite: ESC 330/ChE 232

ChE 440 | Advanced Fluid Mechanics
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. Same as EID 440 and ME 440
3 credits. Prerequisite: ESC 340

ChE 441 | Advanced Heat and Mass Transfer
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. Same as EID 441
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 bulksolids. Mixing and segregation. Particle size reduction and enlargement. Aerosol dynamics. Industrial petrochemical and pharmaceutical processes: fluid catalytic cracking, gascyclones, hoppers, granulation, coating.
3 credits. Prerequisite: ESC 340

ChE 447 | Sustainability and Pollution Prevention
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.

ChE 460.1 | Heat Transfer Equipment Design (Heat Exchangers)
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.
Same as EID 460.1

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 332, ChE 351, and Ch 262, or permission of instructor

ChE 488 | Convex Optimization Techniques
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 the 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. Same as EID 488
3 credits. Prerequisites: ChE 151 or ME 251, Ma 326 (co-enrollment is fine)

ChE 490 | Process Synthesis
This course provides a new basis forthe 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 overallprocess power optimization, design for flexibility, total sites layout, batch processes and process plant retrofit.
3 credits. Prerequisites: ChE 381 and ChE 382 or permission of instructor

ChE 491 | Graduate Research Problem I

ChE 492 | Graduate Research Problem II
Continuation of ChE 491

ChE 493 | Graduate Research Problem III
Continuation of ChE 492

ChE 494 | Graduate Research Problem IV
Continuation of ChE 493

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 escribing the results of the work.
6 credits for full year

CIVIL ENGINEERING
UNDERGRADUATE

CE 220 | Civil Engineering Fundamentals
Planning, execution and interpretation of drawings and specifications for civil engineering projects. Sample drawingsand 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 321 | 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 201

CE 322 | Structural Engineering II
Modern methods of structural analysisof 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 321

CE 331 | 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 340

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 321; corequisite: CE 322

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 322

CE 343 | Water Resources Engineering
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. Emphasisis placed on basic experimental techniques, design of experiments, selection and use of appropriate instrumentation and interpretation of results.
This course is the same as EID 343
4.5 credits (3 hours of lecture, 3 hours of laboratory). Prerequisite: ESC 340;
Same as EID 343

CE 344 | Environmental Systems Engineering
Qualitative and quantitative treatment of water and wastewater systems as related to domestic and industrial needs and their effect on the environment. Introduction to air pollution sources and control and solid/hazardous waste engineering. Design of water and wastewater treatment plants. Field and laboratory techniques for measurement of water quality parameters. Laboratory analysis of representative waters and wastewaters for commonly determined parameters as related to applications in water environment.This course is the same as EID 344.
4.5 credits (3 hours of lecture, 3 hours of laboratory). Prerequisite: ESC 340;
Same as EID 344

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 343

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 inmaterials, 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 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. Same as EID 390
3 credits. Prerequisite: ESC 340, CE 322 or ME 300 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-hour weekly laboratory sessions for 15 weeks.
3 Credits. Prerequisites: 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.

CIVIL ENGINEERING GRADUATE

CE 414 | Solid Waste Management
Engineering aspects of solid waste collection, transport and disposal, including sanitary landfill design, incineration, composting, recovery and re-utilization of resources. Optimization techniques of facility-siting and collection route selection and economic evaluation of factors affecting selection of disposal methods.
3 credits. Prerequisite: permission of instructor

CE 422 | Finite Element Methods
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. Same as EID 422
3 credits. Prerequisite: CE 322 or ME 300

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 322

CE 425 | Structural Dynamics
Dynamic behavior and design of structures subjected to time-dependent loads. Included in the load systems are earthquakes, blasts, wind and vehicles. Shock spectra and pressure impulse curves. Special applications in blast mitigation design. Same as EID 425
3 credits. Prerequisite: CE 322

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 retrofit 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 | Foundation Engineering I
Layout of subsurface investigation program, SPT (Standard Penetration Test), Dutch-cone penetrometer. Analysis and design of spread footings on cohesive and cohesion less soil by stability and settlement procedures, combined footings, strap footings, floating foundations and pile foundations. Settlement analysis due to deep-seated consolidation.

CE 432 | Foundation Engineering II
Analysis and design of foundations subjected to vibratory loading, beamson 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 331 and permission of instructor

CE 433 | Lateral Earth Pressures and Retaining Structures I
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 331

CE 434 | Lateral Earth Pressures and Retaining Structures II
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 331 and permission of instructor

CE 435 | Special 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 436 | Special 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 preloading, sand drains and prefabricated vertical drains.
3 credits. Prerequisite: permission of instructor

CE 437 | 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 340, CE 331, CE 344, and permission of instructor

CE 438 | 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 the presentations of case studies.
3 credits. Prerequisite CE 331 or permission of instructor

CE 440 | Industrial Waste Treatment Design
Integrated lecture and design periods that cover the sources of industrial wastewaters, their quantities and characteristics, and their treatability by physical, chemical and biological processes. Status of regulations involving categorical standards, local and state industrial pretreatment programs, NPDES permits, etc. Problems and solutions involved in combining municipal and industrial waste treatment. Case studies.
3 credits. Prerequisite: permission of instructor

CE 441 | Water and Wastewater Technology
Wastewater sources and estimates of domestic, commercial and industrial flows. Integrated lecture and design periods that cover unit processes for water and wastewater treatment. Design projects include hydraulic and process design of oxidation ponds, screening, grit removal, sedimentation tanks, secondary biological treatment,other physicochemical processes and outfall design.
3 credits. Prerequisite: permission of instructor

CE 442 | Open Channel Hydraulics
Derivation of the general one dimensional equations of continuity, momentum and energy used in open channel flow analysis. Steady uniform flow and boundary resistance. Steady nonuniform flows, channel transitions and controls, hydraulic jumps, surges, surface curves for gradually varied flow including the effects of lateral inflow. Unsteady flow in open channels. Dynamic waves, method of characteristics, surge formation. Kinematic waves, flood routing and overland flow. Design of channels and other hydraulic structures.
3 credits. Prerequisite: CE 343

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 343

CE 446 | Pollution Prevention or Minimization
Introduction to the new concept and regulations in the U.S. and Canada of Pollution Prevention or Waste Minimization for managing hazardous pollution and protecting the environment and public health. Methodology of conducting environmental audits and lessons learned from successful pollution prevention programs. Case studies of various programs in industry, etc.
3 credits. Prerequisite: permission of instructor

CE 447 | Stream and Estuary Pollution
Application of basic concepts of fluid kinetics and dynamics to the analysis of dispersal and decay of contaminants introduced into lakes, streams, estuaries and oceans. Analysis and modeling of leachate and other contaminants into groundwater.
3 credits. Prerequisite: CE 343

CE 448 | Environmental and Sanitary Engineering (same as EID 448)
Engineering (same as EID 448) Topics include types of environmental pollution and their effects; water quality standards and introduction to laboratory analyses of water quality parameters; sources and estimates of water and wastewater flows; physicochemical unit treatment processes. Integrated lecture and design periods cover water supply network, wastewater collection system and water treatment design projects.
3 credits. Prerequisite: permission of instructor

CE 449 | Hazardous Waste Management
Definition and characteristics of hazardous wastes. Generation, transport, treatment, storage and disposal of hazardous wastes. Leachate characteristics and management. Treatment technologies. Monitoring and safety considerations. Obligations under Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Field trips.
3 credits. Prerequisite: permission of instructor

CE 450 | Civil Engineering Construction
Preparation of plans and specifications.The bidding and award process. Contractual relations between the owner and the contractor. Preparation of cost estimate for a competitively bid project. Preparation of a progress chart and critical path. Sequencing various job elements. Engineering the actual construction. Management of labor. Interlacing with the community. Environmental requirements. Job safety. Changes and unanticipated conditions. Contract disputes and their resolutions.
3 credits. Prerequisite: CE 341

CE 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, geographica linformation 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 321 or ME 301

CE 469 | Independent Research Project

CE 470 | Urban Security
Design of urban systems to protect against terrorism. Analysis of blast loads. Blast mitigation design considerations. Technology transfer:military/defense to civilian sector. Response spectra. Pressure-Impulse Curves. Stand off distances. Blast mitigation measures for buildings, bridges and tunnels. Prevention of progressive collapse in tall buildings. Design of glazing. Retrofit upgrade of existing urban infrastructure.Proposed changes in New York City Building Code to protect against terrorism. Insurance issues forcommercial buildings. Same as EID 470
3 credits. Prerequisites: CE 322 or ME 301 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 superstructures-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 322 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 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 the full year

ELECTRICAL AND COMPUTER ENGINEERING UNDERGRADUATE

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 o fBoolean 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.

ECE 160 | Programming for Electrical Engineers
Programming in C in a Linux environment, with an emphasis on software development methodology. Data types, expressions, control flow, pointers, subroutines, numerical and text processing, data structures and algorithms. Introduction to computer architecture and operating systems. Introduction to object oriented programming in C++, and classification of programming languages.
3 credits. Prerequisites: None

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 210 | 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 111or 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 211 | Signal Processing & Systems Analysis
This course presents a unified treatment of signals and systems. Signal-space concepts for representation and approximation: inner product, orthogonal expansions, projection, Lp-norms. Phasors, complex baseband representation, line spectra. Sampling, aliasing and imaging. Analog and digital LTI systems in the time, frequency and transform domains: convolution, impulse response, frequency response, transfer functions. Continuous and discrete time Fourier transforms, Laplace and z-transforms. Poles and zeros, transient response modes. Block diagrams, stability, feedback. FIR and IIR digital filters and filter structures. Initial conditions, resonance, damping factor, Bode plots. Analog and digital state-space realizations, transition matrix, transfer function matrix. Random signals and vectors: correlation matrices, Gaussian vectors and signals, white noise, stationarity, ergodicity, power spectral density, ARMA models. Extensive use of MATLAB.
3 credits. Prerequisite: Ma 113; corequisite: ECE 210

ECE 240 | 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 241 | 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 240

ECE 251 | 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 264 | Data Structures & Algorithms I
An introduction to fundamental data structures and algorithms, with an emphasis on practical implementation issues and good programming methodology. Topics include lists, stacks, queues, trees, hash tables and sorting algorithms. Also an introduction to analysis of algorithms with big-O notation. Assignments include programming projects and problem sets.
2 credits. Prerequisite: ECE 161

ECE 291 | Electrical Engineering Sophomore Projects
This course focuses on one particular complex system (e.g., music synthesizer, wireless transceiver, radar) to introduce a wide range of electrical engineering principles such as frequency response, noise, feedback, loading and interfacing. In a laboratory setting, students investigate the design of subsystems that may include amplifiers, oscillators, RF or opto-electronic circuits, A/D and D/A converters, and power circuits. By measuring the impact of the operating conditions on circuit performance, students learn the principles of systems engineering, development of a testbench, and proper documentation. By the end of the semester, the class will have developed a complete functioning system through reverse engineering.
1 credit. Prerequisite or corequisite: ECE150. Corequisite: ECE240.

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, ISIand equalization. Coherent and noncoherent detection, carrier recovery and synchronization. Performance: computation of SNR, BER, power and bandwidth requirements. TDMA, FDMA, CDMA.
3 credits. Prerequisites: Ma 224 and ECE 211

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. Coursework will include penetration testing, code auditing and independent programming projects using professional auditing frameworks.
3 credits. Prerequisite: ECE160 or ECE161

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 filterbanks, 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 211

ECE 311 | Modern DSP Hardware
Development methodologies for signal processing hardware systems: RTL, HDL, synthesis and verification. Special processors including FPGA, multicore, ARM and GPU. ADC and DAC, interchip and intrachip communication, mixed-signal systems, clock and power distribution, loading, sensors and actuators, embedded systems. PCB and surface mount devices. Systems engineering. Course work including projects involving hardware realizations, simulation and emulation, and software tools for system design.
3 credits. Prerequisites: ECE211, ECE241, ECE251.

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 241 and ECE 151, or ME 151 and ME 153

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-loopand 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 211

ECE 321 | Control Systems Design
Control system design using Bodeplots, 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 Bodeplots 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 andD/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, andstudents are required to design and construct an embedded system.
3 credits. Prerequisites: ECE 320 and ECE 251

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. Introductionto power electronics. Applications including high-speed transportation, energy storage and interconnection of distant generating stations.
3 credits. Prerequisites: ESC 220 or ECE 240 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. Planewaves in lossless and lossy materials, polarization, incidence. Transmission lines: transient analysis, TDR, phasoranalysis, 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 240 and ECE 211

ECE 342 | 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 241 and ECE 21

ECE 345 | 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 342

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 251 and ECE 161 or ECE 264

ECE 365 | Data Structures & Algorithms II

A continuation of ECE 264, 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 264

ECE 366 | 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 365

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
Research Problem II (continuation of ECE 391)
3 credits. Prerequisite: instructor approval

ECE 393 | Junior Electrical 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 211, ECE 241, ECE 150. Co-requisite: ECE 342

ECE 394 | Junior Electrical Engineering Projects II
Principles learned in ECE 393 are applied to the design, construction and characterization of electrical and computer engineering projects of significant complexity. Assignments typically involve both analog and digital design, and students are free to pursue any solution that satisfies the engineering requirements and meets with the instructor's approval. Formal and informal lectures are given on safety, circuit operation and design, and construction techniques; participation in design reviews and technical reports.
4 credits. Prerequisite: ECE 393

ECE 395 | Senior Electrical Engineering Projects I
ECE 395 and ECE 396 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 396 | Senior Electrical & Computer Engineering Projects II
This course concludes the senior project begun in ECE 395. 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 395.

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

ELECTRICAL AND COMPUTER ENGINEERING 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 404 | Satellite Communication
This course covers the design of satellite systems for applications such as communication, weather, sensing, research, GPS. Basic planetary physics, orbit selection, spacecraft lifetime. Reliability and component requirements, environmental effects and impact on electrical performance. Common modulation schemes and selection strategy. "Bent pipe" spacecraft configuration, atmospheric effects and loss (e.g., rain fade effects). Earth station configuration, uplink and downlink configurations, spectral maps and spectral power requirements and stresses. System level link budgets. Time delay and synchronization, frequency planning and re-use. Antenna beams and configurations.
3 credits. Prerequisites: ECE300

ECE 405 | Advanced Digital Communications
Advanced digital modulation including formats with memory, continuous phaseand 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 realtime experimentation of these systems via SDR will enable greater flexibility in the assessment of design trade-offs as well as the illustration of 'realworld' 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 trendsand 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, hand off 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); beam forming 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: Ma 224 and ECE 211. Prerequisite or corequisite: ECE 302

ECE 413 | 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 211 and ECE 150

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: leastsquares, regularization methods, logistic regression. Clustering using kmeans and EM algorithms. Model selection: bias-variance tradeoff, crossvalidation, over-fitting. Feature selection and dimensionality reduction methods including PCA, ICA, MDS. Kernel methods. Other topics may be covered as time permits.
3 credits. Prerequisites: Ma 223, Ma 224; either ECE 211, ChE 352 or ME 251

ECE 415 | Wavelets and Multiresolution Imaging (same as MA 415)
Wavelets and multiresolution signal processing with an emphasis on 2Dand 3D cases. STFT, wavelet analysis, wavelet packets, DWT. Multirate filterbanks, 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. Coursework 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 Kalmanfilters, 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 211

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 DSPalgorithms 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 251

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, blockmatching; 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

ECE 419 | 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: ECE 310 and Ma 224

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 351

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 ztransfer 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 phaseshifters.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 datalinks. Solitons.
3 credits. Prerequisite: ECE 342; Prerequisite or 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 241 or ESC 220, 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, floor planning, 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 345

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 300ECE 342. 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 non epitaxial 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 342

ECE 444 | Bio-instrumentation

The basic human vital signs and some related elementary physiology viewed from an engineering standpoint with special emphasis placed upon current electronic measurement methods. Electrocardiographic and electromyographic signals. Safety problems related to electrical isolation. Guarded, fully isolated, modulated carrier operational amplifiers and microvolt-level amplification. Solid-state 'grain of wheat' pressure sensors, microelectrodes, thermal probes, ultrasonic transducers and other biosignal sensors. Course work includes instrumentation and sensing projects.
3 credits. Prerequisites: ECE 114 and ECE 142

ECE 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 phaselocked loops. Introduction to issues such as static and dynamic limitations, noise and stability. Use of industry standard CAD software.
3 credits. Prerequisite: ECE 342

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 342, ECE 345 or permission of instructor

ECE 447 | Digital VLSI System Design
This course focuses on the top-down, automated digital system design flow using CMOS logic: RTL design/simulation, timing/power driven circuit synthesis, automated place-and-route, and post-layout simulation with emphasis on test/manufacturability in deep sub-micron technologies. The course culminates with the tape-out of a large design project covering functional specification to sign-off layout.
3 credits. Prerequisites: ECE 251, ECE 342

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 251

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 onthe topics to be covered.
3 credits. Prerequisite: permission of instructor

ECE 462 | Computer 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 264

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 264

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: ECE 251, ECE 264

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. Prerequisites: ECE 151 and ECE 165

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 speechr ecognition. Course work includes programming projects and tests.

3 credits. Prerequisite: ECE 264

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 211 and ECE 161, or ECE 264

ECE 469 | Artificial Intelligence
This course covers many subtopicsof 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 165

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 102 | Statics
This foundation course develops a sound problem solving methodology, basic laboratory experience and technical communication skills based on engineering applications that involve forces acting on non-accelerating structures. Topics include equivalent system of forces; equilibrium; moments and couples; centroids and distributed forces; forces in structures (trusses, frames, machines); friction forces. Laboratory modules focus on the measurement of force from both mechanical and electrical signals.
3 credits

ME 105 | Drawing and Sketching for Engineers
This course introduces engineering students to the fundamentals of freehand 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. Same as EID 105
2 credits. Prerequisites: none

ME 200 **Dynamics**
This course introduces the effects of motion caused by unbalanced forces on structures. Topics include particle and rigid body mechanics; kinematics; kinetics; Newton's laws of motion; work and energy; impulse and momentum; introduction to vibrations. Laboratory modules focus on measurement of velocity and acceleration.
3 credits. Prerequisite: ME 102

ME 211 | Design and Prototyping
A mechanical engineering hands-on workshop geared towards the understanding and practice of basic engineering design and fabricationtools. Topics include hand tools, simplemachining, 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 231 | Energetics

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; magnetohydrodynamics, fuel cells, thermionic and thermoelectric. Design of the thermodynamic operation of a steam power plant. Same as EID 231
3 credits. Prerequisite: ESC 330 or Ch160 or permission of instructor

ME 251 | 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 spaceequations, 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. Same as ESC 251
3 credits. Prerequisites: Ma 240

ME 300 | 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 201

ME 301 | 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 201 and Ma 240

ME 310 | 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 300

ME 311 | 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 310

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 are as 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 342 and ME 211

ME 313 | 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: ME 211 or permission of instructor

ME 314 | Cloud-Based Design and Manufacture

Introduction to today's cloud-based design and manufacture (CBDM) technology. Topics include: fundamentals of geometric modeling; cloud-based computer-aided design (CAD); overview of commercially available, cloud-based CAD platforms; impact of deploying cloud-based design methodology on engineering practices; collaborative team design project management; extension of cloud-based CAD to manufacture and performance simulation applications. Students will gain hands-on experiences in managing collaborative team design projects. Same as EID 314
3 credits. Prerequisites: CS 102 and Ma 113

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 340

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: ME 200

ME 331 | 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 330

ME 342 | 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 340

ME 351 | Feedback Control Systems
Modeling and representation of dynamic physical systems: transfer functions, block diagrams, state equations, and transient response. Principles of feedback control and linear analysis including root locus and frequency response methods. Practical applications and computer simulations using MATLAB. Discussions of ethics will be integrated into the curriculum.
3 credits. Prerequisite: ME 251

ME 352 | Process Control Laboratory
An introduction to process control using DC motor, liquid-level tank, and heat exchanger experimental rigs. Students will characterize systems, implement on-off control and PID-control, and apply various tuning methods. Practical applications and assignments cover actual heating, ventilation, air conditioning, and building automation systems.
1 credit. Co-requisite: ME351

ME 353 | Mechatronics
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. Same as EID 353
3 credits. Prerequisite: ME 351 or ECE 320 or ChE 361

ME 360 | Engineering Experimentation
Election, 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: junior standing 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

ME 393 | 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 394 | 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: ME 393

MECHANICAL ENGINEERING GRADUATE

ME 401 | Advanced Mechanical Vibrations
Combined analytical and experimenta lapproach 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 301

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 331 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 340

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 201

ME 412 | Autonomous Mobile Robots
The objective of the course is to build a mobile robot capable of competing in a competitive robot tank battle game. 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, inertia sensing, encoders, electric 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 in a singles-match game, or to perform a team-oriented task. During the semester, students are expected to demonstrate progress on the development of their robot and complete project assignments that will lead to the final competition-ready robot and accompanying quality research paper.
3 credits. Prerequisite: ME 353 or ECE 251

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 clean room protocol will be included.
3 credits. Prerequisite: ESC 210 or ESC 211

ME 415 | Introduction to Nanotechnology
Understanding and control of matter at dimensions in the range from one to100 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 210 or ESC 211

ME 430 | Thermodynamics of Special Systems
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. Same as EID 430 and ChE 430
3 credits. Prerequisite: ChE 331 or ME 331

ME 431 | Internal Combustion Engines
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 331 or permission of instructor

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 330 and ESC 340

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: ESC 330 and ESC 340

ME 434 | Special Topics In Combustion
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. Same as ChE 434
3 credits. Prerequisite: ESC 330

ME 440 | Advanced Fluid Mechanics
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. Same as EID 440 and ChE 440
3 credits. Prerequisites: ESC 340 and permission of instructor

ME 451 | Modern Control

An introduction to the concepts and techniques utilized in the analysis and design of robust control systems. Topics include a review of state-space control systems concepts; standard regulator problem; reduced order observers and state feedback controllers; optimal and robust control design methods; utilization of computer-aided optimal control systems design software such as MATLAB. Techniques developed will be applied, in the form of student design projects, to a variety of challenging control systems design problems.
3 credits. Prerequisite: ME 351

ME 452 | Heating, Ventilation, Air-Conditioning and Energy Efficient Building Systems

Introduction to heating, ventilation and air-conditioning (HVAC) with emphasis on thermodynamics, fluid dynamics, mass and heat transfer, psychometrics, cycles, load calculations, component and systems performance, absorption, refrigeration, heat pumps, air-handling units, heating and cooling systems, cogeneration, and building automation systems. Technical projects provide exposure to open-ended problems related to actual building HVAC and automation systems.
3 credits, Prerequisites: ESC330, ESC340, and ME352

ME 458 | Industrial Robots

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. Same as EID 458
3 credits. Prerequisite: ME 351 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

ENGINEERING SCIENCES UNDERGRADUATE

ESC 000.1-000.4 | Engineering Professional Development Seminars
The Engineering Professional Seminars and Workshops offer students an introduction to the profession of engineering as well as deal with their development as students. The Cooper Union's CONNECT program is an integral part of these courses and provides intensive training in effective communications skills. A wide range of topics is covered in addition to communications skills including ethics, environmental awareness, life-long learning, career development, conflict resolution, entrepreneurship, marketing, work-place issues, team dynamics, professional licensure and organizational psychology.

Each successfully completed semester of ESC 000 will be noted on the student's external transcript. Failure to participate in ESC 000, or failure to successfully complete one or more semesters of the program will not be noted on any external transcript (such as is provided to employers or graduate schools)

ESC 200 | 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 201 | 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 200 or ME 200

ESC 210 | 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 211 | 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. Prerequisites: ESC 100

ESC 220 | 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 221 | Basic Principles of Electrical Engineering
Selection of topics from ESC 220. This class meets with ESC 220 for the first ten (10) weeks.
2 credits. Prerequisite: Ma 113

ESC 251 | 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. Same as ME 251
3 credits. Prerequisites: none

ESC 330 | Engineering Thermodynamics
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 340 | 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.

INTERDISCIPLINARY ENGINEERING UNDERGRADUATE

EID 101 | Engineering Design and Problem Solving
Students work on cutting-edge, exploratory design projects in interdisciplinary 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 102 | Engineering Graphics
An introduction to graphical representation of 3-dimensional objects. After learning the principles of technical drawing using precision hand tools, students utilize CAD software to create professional caliber engineering drawings. An introduction to solid modeling is given. Topics include orthographic projections, linetypes, geometric dimensioning and tolerancing, layers, layouts, solid modeling, part assemblies and finite element analysis.
EID 102
1 credit. Prerequisites: none.

EID 103 | Principles of Design
This course is designed to introduce students from all disciplines to theconcepts 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
This course introduces engineering students to the fundamentals of freehand 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. Same as ME 105
2 credits. Prerequisites: none

EID 210 | Engineering Design Graphics
In this class, Building Information Modeling (BIM) is used to create both Architectural and Structural models. Along the way, students learn about the Revit Program's user interface & modeling tools essential for working with 3D models. Other topics include creating Sheets, Custom Building Elements, Topography, Landscaping, Perspectives, Rendering & Animation. As students gain expertise in using Revit, they are assigned various Structural & Architectural projects to develop and present to the class. At the end of the semester, a Final Independent Design Project is presented by each student using the Revit Modeling Program.
3 credits. Prerequisite: permission of instructor

EID 220 | Foundations of Bioengineering
An introduction to the engineering study of biological systems. Basic physiochemical and organization principles applicable to biologica lsystems. 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 221 | 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 222 | Biomaterials

A study of both natural and synthetic materials, especially those for orthopaedic applications. Mechanical properties, design considerations, biocompatibility, potential for allergic response and carcinogenic ramifications, mechanical compatibility and effects of long-term implantation. Metallics, ceramics and polymers. Relative advantages and disadvantagesof various materials. Materials for cardiovascular applications. Corrosion and chemical degradation.
3 credits. Prerequisite: permission of instructor

EID 222 | 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 acciden treconstruction. 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 200 or ME 200 and ESC 210

EID 224 | Biomechanics

An in-depth treatment of orthopaedic biomechanics, including freebody analysis applied to the musculoskeletal system, applied statics, dynamics and kinematics. Clinical problems relating to biomechanics. Lubrication theory applied to hard and soft tissues. Mechanical testing of tissue, including both static tests and dynamics tests.Tensor treatment of kinematic motions. Extensive reference to current literature. Muscle function, evaluation and testing. Exploration of the concepts of development of muscular power, work and fatigue.
3 credits. Prerequisites: ESC 100 and permission of instructor

EID 231 | Energetics

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; magnetohydrodynamics, fuel cells, thermionic and thermoelectric. Design of the thermodynamic operation of a steam power plant. Same as ME 231
3 credits. Prerequisite: ESC 330 or Ch 160 or permission of instructor

EID 260 | 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 270 | 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 276 | 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: ME 342 and ME 211

EID 314 | Cloud-Based Design and Manufacture
Introduction to today's cloud-based design and manufacture (CBDM) technology. Topics include: fundamentals of geometric modeling; cloud-based computer-aided design (CAD); overview of commercially available, cloud-based CAD platforms; impact of deploying cloud-based design methodology on engineering practices; collaborative team design project management; extension of cloud-based CAD to manufacture and performance simulation applications. Students will gain hands-on experiences in managing collaborative team design projects. Same as ME 314
3 credits. Prerequisites: CS 102 and Ma 113

EID 320-323 | Special Topics in Bioengineering I-IV
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 genera loverview of the scope of bioengineering. The major areas in the course are design in biomedical engineering, tissue engineering, medical imaging, cardiovascular, vision, rehabilitation, masculaskeletalsystem, 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 343 | Water Resources Engineering
Same as CE 343
4.5 credits (3 hours of lecture, 3 hours of laboratory). Prerequisite: ESC 340

EID 344 | Environmental Systems Engineering
Same as CE 344
3 credits. Prerequisite: permission of instructor

EID 353 | Mechatronics
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. Same as ME 153
3 Credits. Prerequisite: ME 351 or ECE 320 or ChE 361

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 theplanet. 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 advisor and appropriate Department Chair.

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 366 | Lean Launchpad
Lean Launchpad guides students on their own search for a scalable, repeatable business model for a high-tech company. Students use a customer centric approach to brainstorm and evaluate potential ideas. Working in small groups, students will continuously refine their business models through a process that includes exhaustive interviewing of potential customers, fast iteration cycles, and a flipped classroom model that dictates more than half of class hours be used for student presentations and critiques. A panel of local industry experts including engineers, executives and venture capitalists will serve as mentors to the teams and will evaluate their progress and presentations throughout the semester in person. Teams are encouraged to design and prototype the technological solutions developed during their search if appropriate.
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 371 | Operations Management
An in-depth exploration of specific problems and techniques applicable to the management of production and large operating systems (e.g., engineering projects). The specific problems of demand analysis, capacity planning, production and inventory planning as well as scheduling and progress control will be presented. In addition, the concepts of total quality management, material requirements planning and statistical quality control will be presented. The presentation will include lectures and case problems.
3 credits. Prerequisite: EID 370

EID 372 | Global Perspectives in Technology Management
Current global political, social and economic developments and future trends as they relate to technology management are discussed. Students learn to address issues of international technology transfer, multinational sourcing, quality control, diverse staff management, environmental considerations, etc. Working in teams on case studies and projects, students learn to conduct international negotiations and develop solutions to complex business problems. Special emphasis is placed on team cooperation and personal leadership.Oral presentations and written reports are required.
3 credits. Prerequisite: 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 270 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, solarphotovoltaic, 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 270, EID 374, or permission of the instructor

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.
Same as CE 390
3 credits. Prerequisite: ESC 340, CE 322 or ME 300 and permission of instructor

INTERDISCIPLINARY ENGINEERING GRADUATE

EID 414 | Solid Waste Management (same as CE 414)

3 credits. Prerequisite: permission of instructor

EID 422 | Finite Element Methods

Shape functions and generalized displacements. Assemblage of elements, Convergence criteria. Triangular, rectangular and quadrilateral elements in plane stress and strain. Isoparamentric formulations. General Solids. Hexahedral and tetrahedral elements. Flexure in plates. General solids. Natural Coordinates. Special applications in blast mitigation design. Computer codes. Same as CE 422
3 credits. Prerequisite: CE 322 or ME 300

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
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. Same as CE 425

EID 430 | Thermodynamics of Special Systems
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. Same as EID 430 and ChE 430
3 credits. Prerequisite: ChE 331 or ME 331

EID 437 | Geo-Environmental Engineering
Same as CE 437

EID 438 | Industrial Waste Treatment Design (same as CE 440)
3 credits. Prerequisite: permission of instructor
Water and Wastewater Technology (same as CE 441)
3 credits. Prerequisite: permission of instructor

EID 440 | Advanced Fluid Mechanics
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. Same as ChE 440 and ME 440
3 credits. Prerequisite: ESC 140

EID 441 | Advanced Heat and Mass Transfer
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. Same as ChE 441
3 credits. Prerequisite: EID 440 or ChE 440

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

EID 447 | Sustainability and Pollution Prevention
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. 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 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. Same as Ch 451
3 credits. Prerequisites:Ch 110, Ch 111, and Ph 213, or permission of instructor

EID 458 | Industrial Robots

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. Same as ME 458
3 credits. Prerequisite: ME 351 or ECE 320

EID 460.1 | Heat Transfer Equipment Design (Heat Exchangers)

Same as ChE 460.1

EID 469 | Independent Study Project

Same as CE 469

EID 470 | Urban Security

Design of urban systems to protect against terrorism. Analysis of blast loads. Blast mitigation design considerations. Technology transfer; military/defense to civilian sector. Response spectra. Pressure/impulse diagrams. Stand off distances. Blast mitigation measures for buildings, bridges and tunnels. Prevention of progressive collapse in tall buildings. Design of glazing. Retrofit upgrade of existing urban infrastructure. Building code and insurance issues. Same as CE 470
3 credits. Prerequisites: CE 122 or ME 101 and permission of instructor

EID 486 | Urban Megaprojects and Environmental Impact Assessment

Same as CE 486

EID 488 | Convex Optimization Techniques

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 the 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. Same as ChE 488

3 credits. Prerequisites: ChE 361 or ESC 251 or ME 251, Ma 326 (co-enrollment is fine) and permission of instructor

BIOLOGY

Bio 201 | Biology for Engineers I

This course will examine in depth the genetics, molecular and cellular biology, pathology, toxins, microbiology and environment as they relate to humans and disease using organ-based or systems biology approaches (e.g., gastrointestinal pulmonary, cardiovascular, urinary endocrine, etc.) Major assignments will be individualized to student's interests and majors when possible. As such, this course will provide the biological fundamentals for further study in biotransport, biochemistry, graduate school in biomedical engineering, etc. Combined with Biology 202 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 202 | 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

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: CH110.

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; corequisite: Ch 111

Ch 231 | Organic Chemistry I
Bond types and strengths, structural theory, bond angles and hybrid bonds; covalent bonds, polarity of bonds and molecules; dipole moments; 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, polyfunctional compounds, carbohydrates and heterocyclic compounds.
3 credits (2 lecture hours). Prerequisite: Ch 231; co-requisite: 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) Prerequisite: 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 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 201 and Ch 231

Ch 351 | 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 361 | 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 362 | Physical Chemistry II
Continuation of Ch 261 with emphasison electrochemistry, chemical kinetics and solid state chemistry. Selected topics.
2 credits. Prerequisite: Ch 361

Ch 364 | Solid-State Chemistry
Solid-state reactions; nucleation and diffusion theory; thin films of elements and compounds; current topics.
3 credits. Prerequisite: Ch 362

Ch 365 | Chemical Kinetics
Fundamental study of chemical reaction systems in gaseous and condensed phases; absolute rate theory; collision theory; energetics from molecular and macroscopic viewpoints. Experimental rate techniques, interpretation of experimental data. Reaction mechanisms and models for complex and elementary reactions. Homogeneous and surface catalysis; enzyme-controlled reaction rates.
3 credits. Prerequisite: Ch 362

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; lig and-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 361

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 392-398 | 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)

CHEMISTRY GRADUATE

Ch 433 | 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. (2 hours of lecture; 4 hours of Laboratory). Prerequisite: Ch 232

Ch 440 | Biochemistry II
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
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. Same course as EID 451
3 credits. Prerequisites: Ch 110, Ch 111, and Ph 213, or permission of instructor

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 351, Ch 362

Ch 460 | 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 361, Ch 362 or permission of instructor

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

MATHEMATICS

UNDERGRADUATE

Ma 110 | Introduction to Linear Algebra
Vectors in two-and three-dimensions, vector algebra, inner product, crossproduct and applications. Analytic geometry in three dimensions: lines, planes, spheres. Matrix algebra; solution of system of linear equations, determinants, inverses.
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-Euclideangeometries, 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 general studies credits. Spring only.

Ma 223 | Vector Calculus

Double and triple integrals and their applications. Vector fields. Gradient, divergence and curl. Line and surface integrals. Theorems of Green, Gaussand 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. ANOA. 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
Finite-dimensional vector spaces. Linear independence. Dimension. Basis. Subspaces. Inner product. Matrices. Rank. Determinant. Systems of linear equations. Matrix algebra. Coordinate transformation. Orthogonal matrices. Linear transformation. Eigen values and eigen vectors. 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, Markovchains, 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.
3 credits. Prerequisite: Ma 223

Ma 351 | Mathematical Analysis II
Uniform convergence. Differentitation of transformations, inverse and implicit function theorems. Applications to geometry and analysis.
3 credits. Prerequisite: Ma 350

Ma 352 | Discrete Mathematics
Relations. Mathematical structures. Number theory. Algorithms. Complexity of algorithms. Cryptology. Recurrencerelations. Graph theory. A shortest-pathalgorithm. Planar graphs. Trees. Amaximal 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 371 | Selected Topics in Mathematics
This course is intended to allow undergraduate students to continue Ma 370 with related topics.
3 credits. Prerequisites: Ma 370 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)
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 to be determined by faculty on individual basis. Prerequisite: Ma 381

Ma 391 | Research Problem 1
An elective course available to qualified advanced undergraduate 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
This course, a continuation of Ma 391, is intended to allow undergraduate students to continue ongoing research.
3 credits. Prerequisites: Ma 391 and permission of research adviser

MATHEMATICS 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: ECE 114 and Ma 326 or permission of instructor

Ma 415 | Wavelets and Multiresolution Imaging
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

Ma 471 | Selected Topics in Mathematics
This course is intended to allow graduate students to continue Ma 470 with related topics.
3 credits. Prerequisites: Ma 470 and permission of the mathematics faculty

Ma 491 | Research Problem 1
An elective course available to qualified graduate 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: Permission of research adviser

Ma 492 | Research Problem 2
This is intended to allow graduate students to continue ongoing research.
3 credits. Prerequisites: Ma 491 and permission of research adviser

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. Prerequisites: Ma 160, CS 102; corequisite: Ma 163. Cannot be used to satisfy any degree requirement in the School of Engineering

Ph 166 | Concepts of Physics II
This is a continuation of Ph 165. Additional topics include optics, waves and an introduction to structural analysis.
2 credits. Cannot be used to satisfy any degree requirement in the School of Engineering. Prerequisite: Ph 165; corequisite: Ma 164.

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. Emphasisis 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, Ma 240

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 tensures; 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 ofthe 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 348 | Flow Visualization

Study of a broad range of fluid flow phenomena emphasizing the features and patterns characteristic of each. Introduction to visualization techniques used to reveal and capture details of these flows, leading to the application of these techniques to actual flows in the lab or in the field. Essential photographic methodology for still images and movies, including lighting, exposure, depth of field and digital image post-processing. Use of tracers, including dyes, vapor, bubbles and particles as well as optical tools, such as schlieren and/or shadowgraph. Natural and engineering flows will be examined, beginning with mathematical and physi-cal analysis of visualizable properties, including buoyancy, interfaces, vorticity, streamlines and pathlines, and concluding with an actual image or movie. Motivated by the immense scientic and engineering importance of flow visualization in vehicle design, dispersal of en-vironmental pollutants, biomedical flows and many others, flow images are an important form of technical communication and will be critiqued and improved, culminating in a nal project exhibition.
3 credits. Prerequisites: ESC 340 and permission of instructor

Ph 360 | Special Projects in Physics

Special projects in experimental or theoretical physics.
Credits and prerequisites determined in each case by the physics faculty

PHYSICS 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

FACULTY

ADMINISTRATION

Richard J. Stock, Acting Dean, Albert Nerken School of Engineering
Anita Raja, Associate Dean of Research and Graduate Programs
Daria Sapienza, Administrative Associate to the Dean
Beth Slack, Adminstrative Associate
Brandee Sharma, Administrative Assistant
George J. Delagrammatikas, Program Director, STEM/Outreach
Christopher Lent, Director of Academic Computing;
Assistant to the Dean for Student Advisement
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Elizabeth Leon, Secretary, Chemical Engineering and Chemistry Faculties
Maria Jimenez, Secretary, Civil and Mechanical Engineering Faculties

Department of Information Technology

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Associate Professor of Mathematics
Gearoid Dolan, Director, Computer Studio; Senior Academic Associate (Art)
Jeff Hakner, Director of Telecommunications
Ian Hochstead, Information Technology Support Specialist
John A. Kibbe, Director of Administrative Systems
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Paul Tummolo, Director, Multimedia
Wayne Adams, Academic Support Specialist
Craig Branum, Academic Support Specialist
Dennis Delgado, Academic Support Specialistt
Bernie Brandell, Audio-Visual Technician
John Enxuto, Academic Support Specialist
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Joyce Lee, Academic Support Specialist
Marget Long, Academic Support Specialist
Lawrence Mesich, Academic Support Specialist
Keith Ng, Senior Systems/Software Engineer

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Robert Dell, Research Fellow

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John Osburn, Associate Director CONNECT Program, Coordinator for ESC000 Professional Development

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EMERITI

Eleanor Baum, Dean Emeritus, B.E.E., CUNY City College; M.E.E., Ph.D., Polytechnic Institute of New York
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Gerry Weiss, Professor of Electrical Engineering Emeritus, B.E., The Cooper Union; S.M., Harvard University; D.E.E., Polytechnic University; P.E.

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

FACULTY OF HUMANITIES & SOCIAL SCIENCES

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.

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.

CORE CURRICULUM

Peter Cooper believed that a practical education should offer students a means of livelihood and a sense of intellectual curiosity as well as encouraging involvement in the cultural and political life of the city and the nation. So important did he hold the education of the citizenry to be that courses in the social sciences were to be considered preeminent. The core curriculum offered by the Faculty of Humanities and Social Sciences continues Peter Cooper's commitment to liberal learning and social awareness. Through critical examination and discussion of primary materials students develop a broad understanding of the origins of modern society and the conflicts within it. The courses encourage conversation and collaboration to engender a community of inquiry and expertise, preparing students for professional careers and for active participation in society.

The core curriculum of Cooper Union is a required four-semester sequence from HSS1: Literary Forms and Expressions through HSS4: The Modern Context. The core curriculum requirement is satisfied by completing these four semesters in order. HSS1 and HSS3 are offered in fall semesters; HSS2 and HSS4 are offered in spring semesters.

HSS 1 | The Freshman Seminar

A literature course concentrating on poetry and drama. Selected texts from antiquity and the Renaissance are common to all sections.

HSS 2 | Texts and Contexts: Old Worlds and New

A study of texts and topics from 1500 to 1800. Sections read common texts and some selections by individual instructors, with emphasis on literary expression and cultural context. Requirements include written analysis and class discussion.

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. Monday 11-12 lecture in LL117 (Rose Auditorium). All students enrolled in HSS3 must attend the Monday 11-12 lecture in addition to one of the below sections.

HSS 4 | The Modern Context: Figures and Topics

A study of important figures or topics from the modern period whose influence extends into Contemporary culture. Requirements include individual research and writing projects. In choosing a section, students should consider its figure or topic for study.

HTA 101, 102 | ART HISTORY

While contributing to the required curriculum of students enrolled in the School of Art, both the Art History Core and art history electives are also available to students in the other Schools.

HTA 101, 102 | MODERN TO CONTEMPORARY: AN INTRODUCTION TO ART HISTORY

This two-semester art history core course, developed as part of the 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 critical 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.

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.

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.

COURSES

CORE CURRICULUM

HSS 1 | 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. Thiscourse is organized chronologically, beginning with the Industrial and French Revolutions. Students develop an understanding of the political grammar and material bases of the present day by exploring the social origins of conservatism, liberalism, feminism, imperialism and totalitarianism. In discussions and in lectures students learn to study and to respond critically in written and spoken form to a variety of historical documents and secondary texts.
3 credits

HSS 4 | The Modern Context: Figures and Topics

A study of an important figure or topic from the modern period whose influence extends into contemporary culture. The figures and subjects are chosen from a broad range of disciplines (including literature, history, politics, technology and art history, among others). Through concentration on a single figure or focused topic students are encouraged to develop a deep awareness of works of great significance and to understand them in the context of modernity. Guided independent writing projects

and oral presentations give students an appreciation for what constitutes research in the humanities and social sciences.
3 credits. 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.

HUMANITIES ELECTIVES

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 231 | Milton

An in-depth study of Milton's Paradise Lost, the greatest epic in English, a poem about devils and angels, small humans and immense immortals, appetite, food, lust, confusion, despair and courage. Our focus will be on close reading, often explaining the poem line by line, in order to get at the riches within Milton's creation. In addition to Paradise Lost in its entirety, we will study some of Milton's short poems, selections from Virgil, and, if time permits, Milton's dramatic poem Samson Agonistes.
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 development of fairy and folk tales through history, and across cultures and geographies. While we focus on these tales in their originary contexts, we will consider the work they perform in such diverse modern appropriations as Disney cartoons, gaming, and the men's movement. Excerpts from the major collections of Western Europe, West Africa, the Middle East, South and East Asia will furnish our primary readings. We pay particular attention to the collected tales of the brothers Grimm, the Panchatantra, The Thousand and One Arabian Nights, The Tales of Anansi and Brer Rabbit, and Miscellaneous Morsels from Youyang. Our investigation will be interdisciplinary, with our critical approach drawing from theorists such as Freud, Jung, and Frazer, and modern scholars such as Maria Tatar and Jack Zipes.
3 credits

HUM 250 | Shakespeare

Our course will be devoted to really reading Shakespeare—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. We will also consider 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. This semester we will study and explore six plays: Titus Andronicus, A Midsummer Night's Dream, Henry V, As You Like It, Hamlet, and The Winter's Tale.
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 credit

HUM 309 | Art and the Crisis of Modernity

This course will develop a parallel reflection on the world in which the art of our time expresses itself, and which art, in turn, tries to shape. In the first part, we analyze different interpretations of the crisis of modernity, which aim to offer, through different historical and philosophical approaches, other meanings of the age of 'postmodernity'. In the second part, we initially focus on some of the artistic revolutions that took place almost simultaneously in the early twentieth century, a time of enormous tension that led to radical changes of worldviews. Thereafter, the discourse develops around some of the avant-garde movements that staged an aesthetic explosion from mid-century onward, such as abstract expressionism, minimalism or post-minimalism; a choice, however, that does not imply the possibility of defining a unique direction in the artistic experience of our time. Yet, precisely the re-definition of time that emerges in the work of some of these artists can be seen as a metaphor of the art of our time. As T.W. Adorno observes in Aesthetic Theory, it is precisely through a fragmentary and 'not closed' form, through a 'synthesis of the dispersed' which renounces the idea of consonance, that art can express the reality of our time.
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 315 | Science and Contemporary Thought

The aim of this course is to reflect on the role of science in our society, with particular emphasis on the philosophical, political and social aspects of contemporary thought. Although the importance of science in our daily life is indisputably assumed—giving rise to a sort of myth of technology—it is important to analyze its influence on other aspects of contemporary thought, as well as on the very concept of knowledge. The essence of science, in fact, lies in the desire for searching, leading to a necessarily provisional knowledge which survives as a paradigm until it is eventually contradicted by new investigations. Moreover, it is important to acquire consciousness of the political, economic, and cultural constraints acting on both the methodology and the goals of contemporary science. Nowadays these constraints cannot be ignored, but few are really prepared to reflect free from political or philosophical bias.
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: Joyce's "Ulysses"

The title of James Joyce's Ulysses raises a number of issues about the meaning and method of the text: by naming his novel about an Irish Everyman after the Latin version of the Greek hero Odysseus, Joyce sets up a complex web of cultural and political references that ramify throughout the work. Students in this course will learn to read Ulysses by paying close attention to the text itself and by making strategic associations to the political and cultural contexts that inform the novel. Along the way, we will ask ourselves such questions as these: What adjustments does the reader have to make to the practice of "normal" reading in order to understand and appreciate the novel? What makes Ulysses different from novels written before it?

What makes it a modernist work? Or a proto-postmodernist work? What is the relationship of tradition and experimentation in the novel? And so on. Students should purchase the edition of Ulysses edited by Hans Walter Gabler and read the first chapter for the first class meeting.
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
They are us, and not us: puppets, automata, and robots are toys or machines that look like us (or parts of us). From antiquity to the present, we have imagined, and then invented, inorganic versions of ourselves, sometimes for entertainment, sometimes to perform essential tasks. This course will draw upon an interdisciplinary range of materials –from philosophy, the history of science, and psychoanalysis to drama, popular culture, and art. Instead of separating the "scientific" from the "poetic," this course will introduce and explore ways in which we can thinkabout 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 330 | 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 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 332 | Ut Pictura Poesis
A study of ekphrasis and other interconnections between the visual and the verbal arts from antiquity to the present. Primary readings are drawn from Homer, Hesiod, Plato, Aristotle, lyric poetry, tragedy, Virgil, Horace, Lessing, Keats and Ashbery, among others.
3 credits

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 explores the relation of decadence to modernity in fin de siècle European and American culture, with some attention given to subsequent theoretical formulations and popular responses. Located historically in the transitional period between romanticism and modernism, decadent culture involves a paradoxical mixture of refinement and corruption. The transitional, in-between status of decadence includes many paradoxes, not the least of which is the dual allegiance of decadent artists and writers to both avant-garde culture and reactionary politics. Decadent culture also concerns a mixed response to the modern city, and decadents often express a wish to return—not to nature—but to some pre-modern model of urban society. In this course we will examine the hybrid culture of decadence within the context of the modern European city, notably Paris, London, Vienna, and Berlin. We will also consider the phenomenon of transatlantic decadence, and explore the culture as it was represented and understood in such key American cities as New York, Boston, Chicago and San Francisco. The course draws on the work of poets and novelists (Charles Baudelaire, Joris-Karl Huysmans, Walter Pater, Oscar Wilde, Andre Gide, Djuna Barnes); philosophers (Arthur Schopenhauer, Friedrich Nietzsche); psychoanalysts (Josef Breuer and Sigmund Freud); artists (Gustave Moreau, Aubrey Beardsley, Gustav Klimt); and filmmakers (Alla Nazimova, Walter Ruttmann, Anthony Asquith, Ken Russell).
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 349 | 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 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 353 | Public Speaking: Contemporary Issues
Develops skills in persuasive and expository speech-making—extemporaneous, written and memorized—on contemporary issues and topics. Students learn how to research a speech, marshal arguments and use language effectively by speaking clearly and eloquently.
3 credits

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 358 | Studies in Cinema
A seminar based on a special topic in the study of cinema. The seminar may be repeated for credit with the permission of the dean of the Faculty of Humanities and Social Sciences.
3 credits

HUM 359 | Intention, Action and Self-Knowledge
Studies the problem of defining the philosophical nature of action by investigating the nature of intention and coherent self-knowledge. The course seeks to distinguish various forms of action—involuntary, intentional, teleological (goal directed)—by examining relationships among levels of agency, conditions of freedom and states of awareness.
3 credits

HUM 360 | Mind and Morals
Examines the philosophical dichotomy of moral realism and moral naturalism, with emphasis on three types of new moral naturalism: normative moral naturalism, meta-ethical moral naturalism and cognitive moral naturalism. Authors include Bratman, Churchland, Descartes, Flanagan, Goldman, Hume, Johnson, Kant, Longino, Mill, Millikan, Moore and Streba.
3 credits

HUM 361 | Modern Philosophy: Knowledge and the Mind
The course considers questions at the intersection of epistemology and the philosophy of mind. Throughout the course, we will think about what knowledge is, how practical knowledge differs from theoretical knowledge, the epistemic scope and limits of scientific investigation, how we know about our own actions and mental states, why we should believe that there are other minds, and whether we can know that we are not in something like The Matrix. A principal consideration is the extent to which advances in cognitive science can inform our philosophical theories of knowledge.
3 credits

HUM 362 | Black Literature in a World Perspective
An examination of black literature from South America to Papua New Guinea, chiefly in the 20th century. Stress is placed on the connections between various literatures and how they form a world culture. The course considers oral literature, the Harlem Renaissance, Negritude poetry, the African novel and Indian Ocean poets.
3 credits

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 (variable topics)
This course introduces South Korean cinema from the late-1980s to the present, addressing the concept of New Korean Cinema, the rise of the domestic film industry and auteurs, the emergence of blockbusters, and their growing regional and international recognition, popularity and dependence. Among the selected commercial and independent features, consideration will be given to how they reclaim and redefine South Korea and its history across film genres, including the divided nation, the Korean War, the military regimes, and the process of democratization and globalization. Other topics include the role of censorship, quota systems, and international film festivals in the development of the local film industry.
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

Did human beings invent ideas of right and wrong? Are there such things as moral facts, that is, facts that dictate how we ought to live and what sorts of actions are worth pursuing? This course surveys three central traditions in ethical theory in the West as typified by the works of Aristotle, Immanuel Kant, and J. S. Mill, together with a radical critique by Friedrich Nietzsche and ending with selections from 20th-century philosophy.
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 ELECTIVES

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 315 | Human Rights, Law, and Society (variable topics)
In the aftermath of the second world and the genocide directed against European Jewry, a new language of human rights and international law developed to address the consequences of total war and the Holocaust: trials and tribunals sought to mete out justice for crimes against humanity and international agencies worked to provide relief and rehabilitation for survivors and displaced refugees. The postwar discourse of international law, human rights, and commemoration has not prevented further outbreaks of extreme racial and ethnic violence and the trans-generational legacies of collective trauma, but it has provided us with a framework for analyzing historical origins, the gendered experiences of both victims and perpetrators, and the possibilities and limits of resistance, as well as redress and reconciliation efforts and multiple forms of memorialization. With the Holocaust as the limit case,and using a wide variety of sources including historical accounts, eyewitness reports, contemporary reportage, archival records, memoirs, oral and written testimonies, and visual representations in photography, film, and art, we will examine cases of genocide and mass violence incomparative global context, ranging from German East Africa at the beginning of the century to Armenia during World War I, and Bangladesh, Cambodia, former Yugoslavia, and Rwanda in the post-World War II era.
3 credits

SS 318D | Seminar in Political Theory: Global Justice
This course digs deeply into the philosophical and political issues surrounding global justice. We pursue this project by engaging several profound thinkers of global justice, beginning with Immanuel Kant, whose essay on perpetual peace continues to shape modern conceptions of cosmopolitanism. Then, we consider John Rawls's vision of an overlapping consensus of decent peoples, Martha Nussbaum's defense of cultural universals, Samuel Huntington's diagnosis of a clash of civilizations, Diego von Vacano's vision of a post-racial world, Tariq Ramadan's reform of Islamic ethics, and Pema Chödrön's call for practicing peace in times of war. The course thus aims to construct a Socratic dialogue about global justice between profound representatives of diverse schools of thought: Enlightenment, liberalism, political liberalism, cosmopolitanism, realism, Hispanic political thought, Islam, and Buddhism. Throughout, we test each author's ideas by how well they help us grasp contemporary issues of global justice, including human rights, American foreign policy, international trade agreements, war, non-governmental organizations, media, and theOlympics. Students are encouraged to form a mental map of the world and the flows across by it by reading the New York Times, Financial Times, Foreign Affairs, and other international journals and newspapers. The hope is that by weighing contending theories in the light of world events,we may clarify our own thinking and practice of global justice.
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 policymaking. Several distinct systems will be studied; these will be chosen not only for their geographical, but also for their political diversity, representing first-world nations such as the United States, Britain and France, as well as post-communist and post-colonial states such as Russia, China and Nigeria.
3 credits

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
This course presents an overview of the principles of theeconomics of scarcity and choice; supply and demand; output and price. It utilizes marginal analysis as well as theories of the firm. It considers the market system in terms of both its virtues and vices. It focuses especially on the distribution of income and the labor market of the United States but also includes a section on the stock and bond markets. In addition, it covers the role of government in the economy.
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 Ray Brown Seminar (variable topics)
In the 1930s, philosopher (of phenomenology) Edmund Husserl coined the term "life-world" to express his concerns that modern science structurally could not find its way back to lived experience. Hence, the "life-world" would be misunderstood. We are at a wonderful juncture where biology, neuroscience, ethics, branches of politics and humanities have new ways of speaking together. This course explores these new perspectives. No science Background is required. Readings include such figures as Husserl (philosopher),Gaston Bachelard (mathematician, thinker), Diane Ackerman (poet, essayist),Frans de Waal (primatologist, ethicist) and Antonio Damasio (physician and brain theorist of emotions).
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 352 | Environmental Sustainability
This course will be a dialogue on sustainability, the concept of a society that flourishes by living within the limits of, and in harmony with, the natural environment. Taking an integrative approach to all aspects of sustainable development, the course will stress the ecological character of human life and human history, how both have been shaped by the natural environment and have shaped it in return, and how issues of environmental sustainability shape our lives and careers
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
New York City will serve as our model for exploring how the history of urban land use is illuminated through archaeology, and what archaeological excavation in an urban context entails. In class lectures and field trips, we will look at the geography and physical history of the city as preserved both in documents and in the archaeological remains of sites and artifacts characteristic of its successive culture periods from the prehistoric era to the early 20th century.
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, modernization 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 seeks to explore the history of Asia from the later imperial eras of China, Japan, Korea and Southeast Asia into the modern era. The course examines a wide variety of political, social, economic and cultural issues that predominated during this period. While emphasizing the distinctive nature of the region, the course will stress the wide diversity and interconnectedness of ideas, technologies, and religions of modern East Asia.
3 credits

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

This course offers an introduction to the fields of inquiry that have come to be known as women's, gender, and/or queer studies, and to the feminist theory that informs those studies. Students will engage in an interdisciplinary examination of the ways in which gender (that is, feminity and masculinity) has been constructed by visual media, literature, political theory, and social, political, and economic institutions; the historical bases for these constructions; and the activism that challenges some of these gender constructs. We will pay particular attention to the interlocking of gender with other forms of hierarchy, including race, ethnicity, class, and sexuality. We will read current scholarship in works of literature, film, history, social science, and theory, but above all, we will work our way through some of the "canonical" texts which inform that current scholarship, theory, and indeed popular culture (and our own ideas about women and men, gender and sexuality)
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
This course will explore the social, intellectual and economic relationships of science and technology in the modern world (approximately 1845 to the present day). We will use a modified case-study approach to create "snapshots" of topics that incorporate such factors as who participates in scientific and technological endeavors, where work is conducted, and the supports (social, financial, emotional) necessary to individual and collective pursuits. Class members will have some input into the topics we study, which may include: Technology and science in everyday things, Darwin and his aftermath, Communication technologies, Science and technology in war, Transportation, Health and Medicine. Sub-themes that will be incorporated into all topics include: Objects and physical spaces of science and technology, Attitudes about the immediate and larger environment, Changing ideas of improvement and progress.
3 credits. Sarah Lowengard

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 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 will use the work and life of Charles Darwin (12 February-1809-19 April 1882) to examine the nature of scientific practices during the nineteenth century and their changing, often revolutionary, role in life —then and now. Our study will look at Darwin's life, and conduct close readings of Darwin's writing on geology and evolutionary biology. We will consider and discuss both interpretations and implications of "Darwinism," and opposition to Darwin's ideas.
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 the 1950s and the Neo-Conservatives of the 1970s. Through figures such as Randolph Bourne, John Dewey, Meyer Schapiro, Lewis Mumford, C. Wright Mills and Dorothy Day, we will trace the rise and fall of the American avant-garde, the quest for an indigenous theory of culture, the social sources of counterculture, and the shifting meanings of the concepts "mass culture," "consumer culture," "kitsch," and highbrow/middlebrow/lowbrow. Among the questions we will address are: Can one be a political radical and a cultural conservative? A political conservative and a cultural radical?
3 credits

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

CORE

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.

HTA 220 | Japanese Art
An introduction to the art of Edo period Japan (1603-1867), covering painting, printmaking, and the allied arts.
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 Siddhārtha 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 224 | Printmaking in New York
Beginning in the 19th-century, New York; became; a destination for immigrating European printmakers. They quickly established the city as one of the leading printmaking centers in the United States, a status which continues until today. This course will survey the history of printmaking in New York from its early beginnings until the present day. ;Through a combination of lectures and visits to prominent collections and printshops, we will consider how the vibrant commercial and collaborative art scene of New York has created a thriving printmaking community.
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 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.
2 credits

HTA 274 | History of Photography (1835-1965)
There is no one history of photography. It is constantly evolving and changing.The course is designed to touch on photographic innovations that pushed the medium forward; photographers whose vision broke new ground; and looking at images that connect us powerfully to past worlds. The course is focused on the development of photographic vision in the 19th and early 20thcenturies with reference to major photographers up to the 1960s. Two or three class trips to view vintage photographs will be arranged.
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 280 | International Futurism
Futurism (1909-1944) was the first avant-garde movement to emerge from the zperipheries of modernity. Founded by Italian and Egyptian artists, Futurism embraced a problematic ideology. Yet the movement has functioned ever since as a strategic model for several groups of artists fighting against dynamics of exclusion. The first part of the course focuses on Futurism and its international network. The second part discusses more recent artistic movements from Russia, Argentina, Japan, Italy, and the US, which have adopted Futurism's guerrilla-like methods to strike an attack on the hegemonic center.
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.

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. Past topics have included Duccio's "Maesta."
2 credits

HTA 296 | Synartesis

This seminar centers on the idea of "synartesis"—the act of fastening or knitting together to produce union even among disparate kinds of knowledge and materials. Drawing on what has often been pejoratively referred to as anachronistic or philosophical art history, this course will explore new potentials for understanding works of art outside the bounds of traditional linear narrative by experimenting with how inter-chronological and thematic comparisons of artworks might allow us to develop a more personal relationship to the past as it intersects with the constantly unfolding future.
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 | The Anatomy of Painting

This class introduces students topainting as a medium, concept,and phenomenon through around 150 of the greatest examples we possess, based on fourteen fundamental issues: Line;Color; Light; Texture; Material; Shape; Scale; Composition; Realism; Abstraction; Symbolism; Style; Viewing; Meaning. By way of diverse examples from across the history of art, primarily but not exclusively from the Western tradition before 1700—we will of course consider other examples and visit private and public collections in New York; the principles continue to apply today—students will be brought into the flesh, blood, and central nervous system of paintings. The idea for the course is to introduce students of art to some of the great works in the history of painting as painting, that is, the history of art, rather than the history of art. We will also reconsider what painting is, what painting can do, how painting has changed and remained the same, why painting is important, what there is new to say about painting, and why saying or writing anything about painting matters (the relation betweenwriting, thinking, seeing, and understanding).
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
A chronological study of Islamic art and architecture, including an introduction to Islamic aesthetics, history and philosophy. The course will examine samples from religious and literary texts, architectural monuments, painting, ceramics, metal works and calligraphy from Spain, North Africa, the Levant, Iraq, Central Asia and India.
2 credits

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 33 | Islamic Art and Architecture
See HTA 323
2 credits

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 will introduce students to major issues surrounding site-specific art, including Earth art, out-door sited art and installation art within an architectural space. The range of artistic interpretation of site-specificity will be examined, from works that are conceived for and inseparable from a particular site, to works created in response to one site, but subsequently reconceived in response to another. We will place special emphasis on the relationship, both physical and conceptual, that site-specific artworks have with their site. While the primary focus of the course will be on temporarily sited artworks, some relevant examples of permanent public art will also be investigated. Through readings, discussion and looking at images, the course will provide an opportunity to approach and understand an important development in post war and contemporary art. Field trips will be integral to the course.
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? What kind of body made this work? What kind of body does this work address as spectator.
2 credits

HTA 99 | Independent Study (History and Theory of Art)
2 credits

POLICIES

CODE OF CONDUCT

Effective as of July 1, 2012

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
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

4.1 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.

4.2 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.

4.3 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.

4.4 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 advisor to the committee members.

4.5 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 Affairs, 3rd floor, 29 3rd Avenue, NY 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.

7.1 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.

7.2 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.

7.3 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.
7.4 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.
7.5 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.
7.6 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.
7.7 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
8.1 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.
8.2 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.

8.3 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?

8.4 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.

COPYRIGHT POLICY

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 Cooper Union's Code of Conduct, 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 Cooper Union's policy:

www.uspto.gov/web/offices/dcom/olia/copyright/copyrightrefresher.htm www.copyright.umich.edu/file-sharing-faq.html deanofstudents.utexas.edu/lss/spot_illegalfile-sharing.php www.copyright.gov/title17

Fair Use

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

The routine use of file sharing programs to obtain music, movies and software does not constitute fair use. For more information on fair use see:
www.copyright.gov/fls/fl102.html

In addition to the sanctions for copyright infringement provided by federal law, 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 each computer on its networks. A student who is using excessive bandwidth may have his or her internet access reduced or terminated.

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

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

FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT

The Family Educational Rights and Privacy Act (FERPA) affords students certain rights with respect to their education records. These rights include:

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 Enrollment Services written requests that identify the record(s) they wish to inspect. The Office of Enrollment Services 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 Enrollment Services, the office shall advise the student of the correct official to whom the request should be addressed.

The right to request the amendment of any aspect of the student's education records that the student believes is inaccurate, misleading, or otherwise in violation of the student's privacy rights.

A student may write to the Office of Enrollment Services (admissions@cooper.edu) to request amendment of a record that he or she believes is inaccurate, misleading, or in violation of privacy rights. Any such request should clearly identify the part of the record the student wants changed, and explain the basis for the student's request.

If the Office of Enrollment Services decides not to amend the record as requested by the student, the Office 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.

The right to consent to disclosures 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 or to carry out an essential educational or administrative function of The Cooper Union.

The Cooper Union has defined directory information to include the following: name, local address, local telephone listing, e-mail address, major field of study and college attended, dates of attendance, enrollment status, participation in officially recognized activities and sports and any degrees earned and awards received. Directory information may be released unless the student informs the Vice President of Enrollment Services otherwise in writing. Students who wish to suppress their directory information from the printed student directory must inform the Vice President of Enrollment Services in writing or by designating such on the Directory Information Form within 10 days of the start of fall classes. Students may rescind their no-release request at any time by writing to the Vice President of Enrollment Services or by amending the Directory Information Form. The Directory Information Form is available through the Office of Enrollment Services.

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

OFFICE OF PUBLIC SAFETY AND SECURITY

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

POLICY ON ALCOHOL & ILLEGAL DRUGS

The Cooper Union strictly adheres to all local, state, and federal laws relating to the use or illegal manufacture of drugs and alcohol on its premises or at any college-sponsored event. Students who violate Cooper Union's policies will be subject to disciplinary actions under the Code of Conduct.

As a professional school, The Cooper Union has historically attracted students who are serious about academic and artistic achievement and who have understood how substance addictions undermine academic performance. It is a goal of this institution to maintain an environment of academic seriousness.

The most immediate consequence of substance abuse at The Cooper Union is often a dismal academic performance, leading to academic dismissal. Long-term consequences of substance abuse can include major health problems, lowered employment prospects, and even an early demise.

Loss of a student to substance abuse not only blights the prospects of that individual to have a fulfilling career, but also deprives the community at The Cooper Union of that individual's unique talents and contributions. To avoid such a loss, the institution is committed to providing assistance to students with substance abuse problems through appropriate education and referral.

New York State Law Regarding Alcohol

New York State has very strict laws about alcohol. Section 65 of the Alcohol Beverage Control Law states:

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

1. Any person, actually or apparently, under the age of twenty-one years;
2. Any visibly intoxicated person;
3. Any habitual drunkard known to be such to the person authorized to dispense any alcoholic beverages.

In addition, legislation enacted in November of 1991 specifies that a U.S. or Canadian drivers' license or non-driver 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 makes it a crime to produce fraudulent proof of age. Students in possession of a phony identification card should know that the antiterrorism measures put in place by the New York City police department have improved the ability to detect fake ids and have resulted in several arrests.

New York State imposes liability on any person who serves alcohol illegally to a minor. This means if someone serves a minor alcohol, the person serving the alcohol can be sued for damages by anyone harmed by that minor, including the parents or family of the minor if the minor himself or herself suffers harm.

Serving of Alcoholic Beverages at Student Events Sponsored by Joint Activities Committee Student Organizations

1. The serving of alcohol is not permitted at any JAC student organization event that is held on Cooper Union property.
2. The Cooper Union does not support any student organization events involving the serving of alcohol.
3. Student Organizations must use their own funds for all aspects of any event involving alcohol. No Cooper Union provided JAC funds can be used to support any aspect of any event where alcohol is served.
4. Student groups must hold any events that involve alcohol at a licensed facility off-campus. The licensed facility must be responsible for the serving of alcohol at student events.
5. Students sponsoring events involving alcohol assume full responsibility for the event.

POLICY ON RELIGIOUS OBSERVANCES

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

POLICY ON STUDENT HEALTH RECORDS

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

POLICY ON TUITION/HOUSING PAYMENT PLAN

It is the responsibility of students to make housing and tuition payments on a timely basis. Failure to pay by the scheduled dates will result in a $100 finance charge. The Cooper Union allows students to make housing payments using one of three methods: full payment, the Four Month Payment Plan or the Applied Financial Aid Payment Plan. Note: students with full tuition scholarship must pay their student/lab studio fees in full. These fees cannot be paid in installments.

Four Month Payment Plan The Fall Tuition and Housing Fees must be paid in 4 monthly installments beginning on August 1, 2016 and must be paid in full by November 1, 2016. The Spring Tuition and Housing Fees will begin January 1, 2017 and must be paid in full by April 1, 2017.

Applied Financial Aid Payment Plan The student may elect to apply expected sources of financial aid and/or loans against the Tuition and Housing fees. The student is responsible for completing and submitting the required paperwork to the Financial Aid Office. Please contact the Financial Aid Office for more information. Students expecting outside scholarships may apply these amounts to the installment plan when the scholarship is received.

Deadlines

International Students Fee: August 15, 2016
Proof of Insurance to Waive Cooper Union Insurance: August 18, 2016
Student Accident and Sickness/Enrollment Waiver form: September 9, 2016

TRUSTEES

Representatives to the Board

OFFICERS & DEANS

William E. Mea, Acting President
William Mea, Vice President Finance and Administration
Christopher Chamberlin, Dean of Students
Mike Essl, Acting Dean, School of Art
William Germano, Dean, Faculty of Humanities and Social Sciences
Mitchell Lipton, Vice President of Enrollment Services and Dean of Admissions
Richard Stock, Acting Dean, Albert Nerken School of Engineering
Nader Tehrani, Dean, The Irwin S. Chanin School of Architecture

ALUMNI ASSOCIATION EXECUTIVE BOARD

Term July 1, 2016—June 30, 2017
Nils Folke Anderson A'94, President
Karina Tipton CE'99, Secretary/Treasurer
Kelly Occhiuzzo Zack A'90, Vice President/Alumni Activities
Margaret Matz AR'83, Vice President/Faculty and Student Liaison
Sean Cusack BSE'98, Nominating Committee Chair
Carol Wolf A'84, (Ex-officio Executive Committee)
Annual Fund Committee Chair
Ciera Lowe ChE'14, (Ex-officio non-voting Executive Committee)
Communications Committee Chair